Appendix 6E Errata

Please add the following pages after page 6E-396 of the Appendix 6E file.

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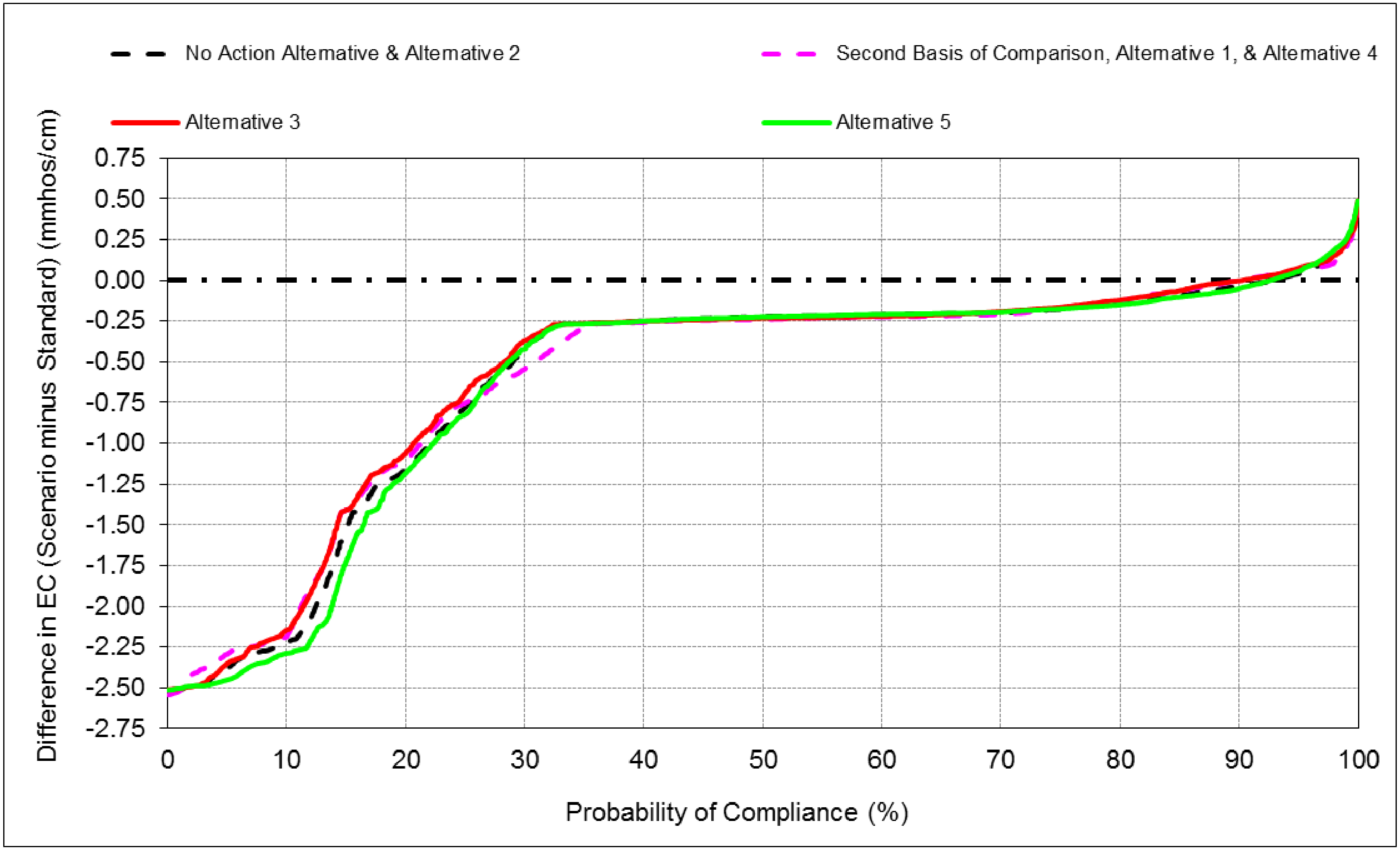
B.28. Sacramento River at Emmaton Compliance with D-1641 Agricultural Salinity Standard

Figure 6E.B.28. Sacramento River at Emmaton Compliance with D-1641 Agricultural Salinity Standard



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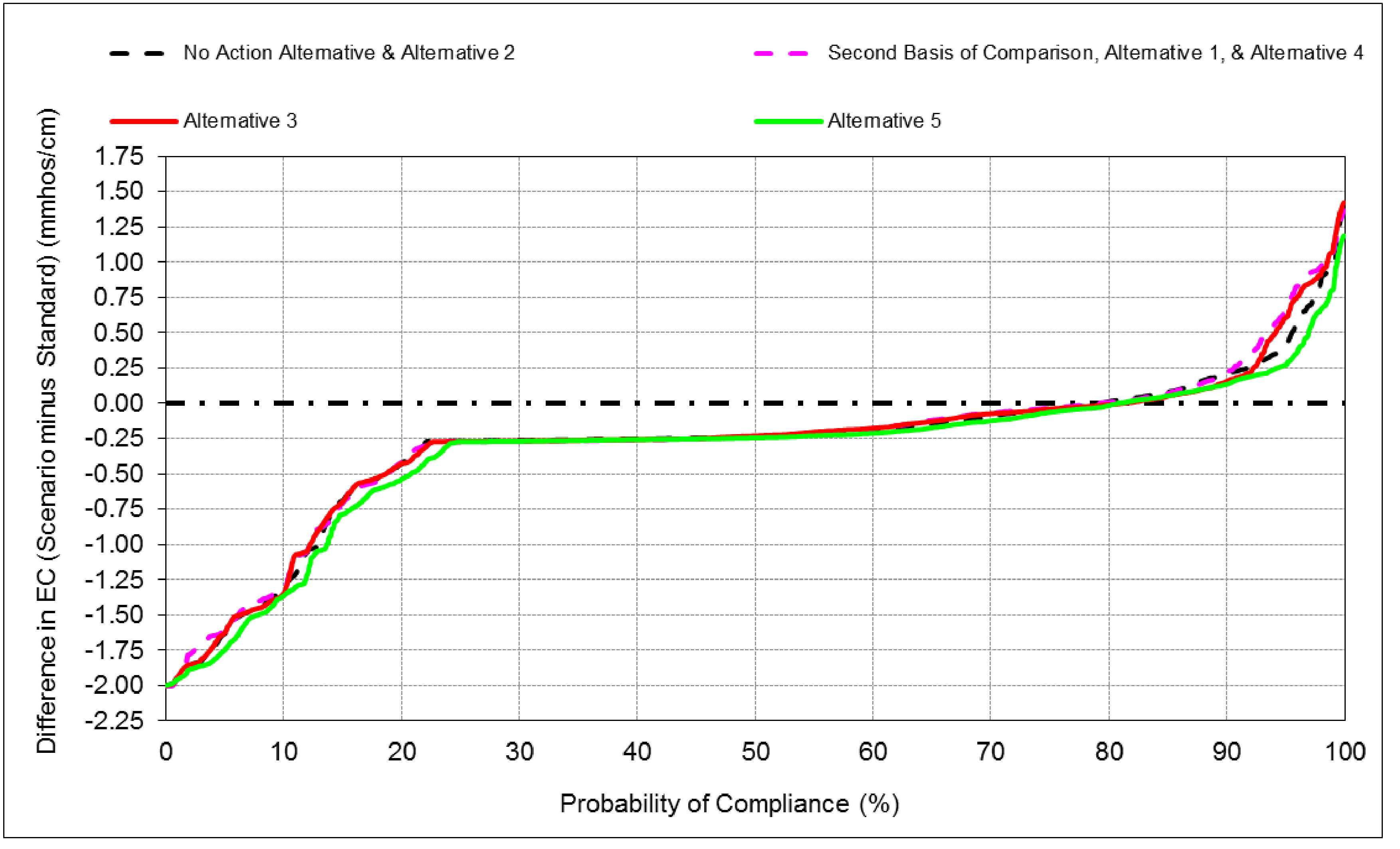
B.29. San Joaquin River at Jersey Point Compliance with D-1641 Agricultural Salinity Standard

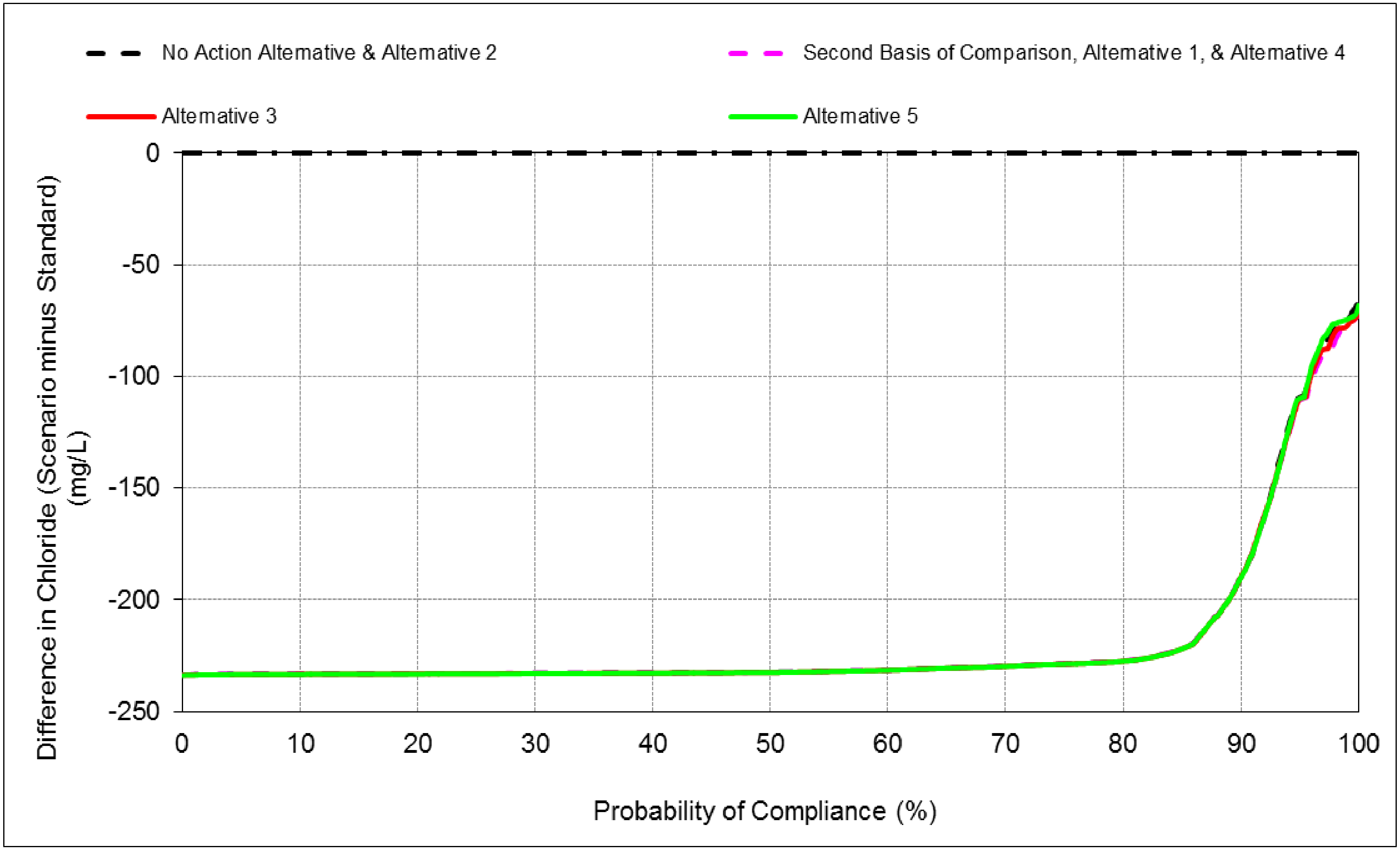
Figure 6E.B.29. San Joaquin River at Jersey Point Compliance with D-1641 Agricultural Water Quality Standard



Notes: 1) Probability of compliance is defined as the probability the standard threshold will not be exceeded. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text. 5) Values are the 14-day average from April through August.

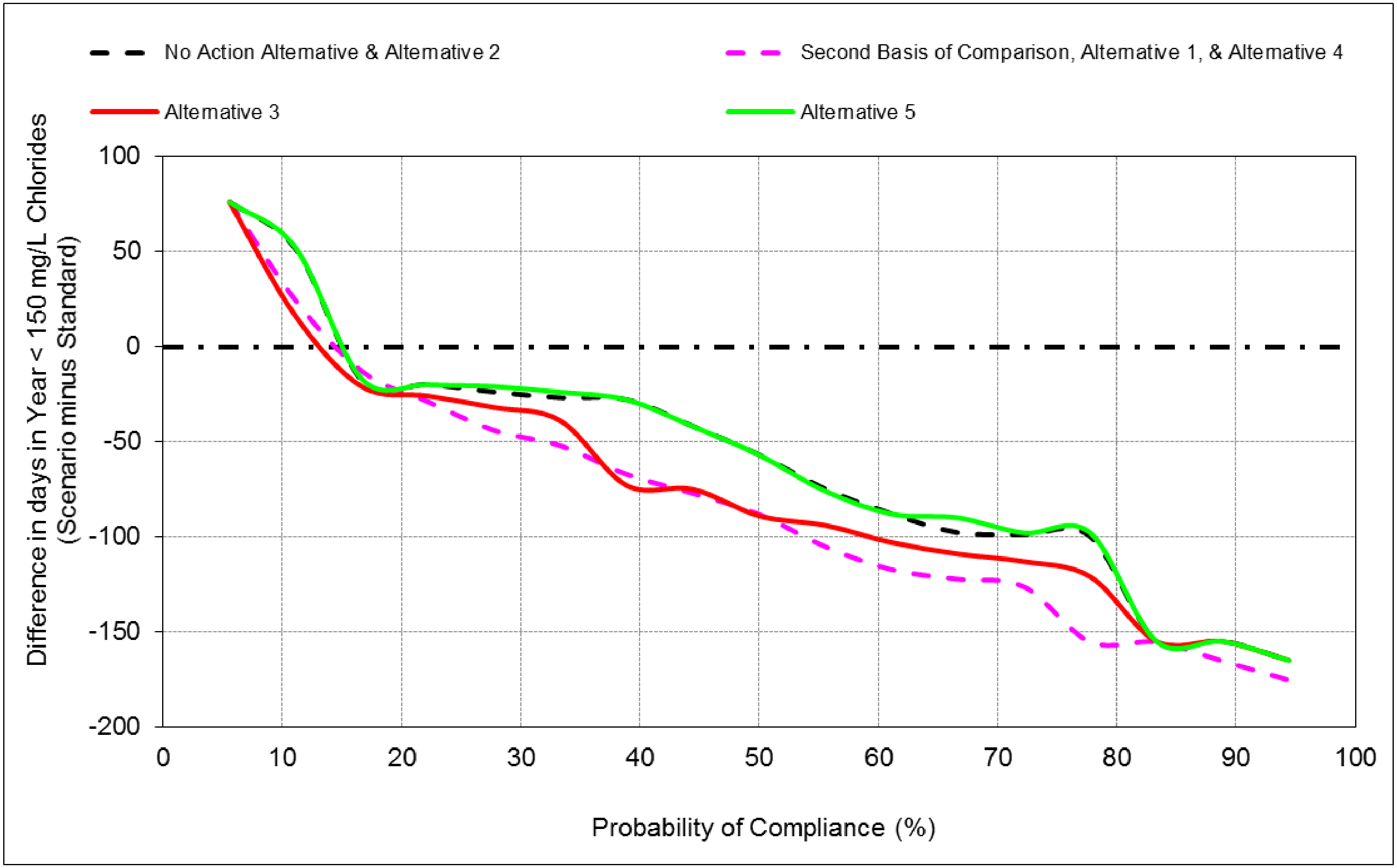
B.30. Contra Costa Canal at Pumping Plant #1 Compliance with D-1641 M&I Chloride Standard

Figure 6E.B.30.1. Contra Costa Canal at Pumping Plant #1 Compliance with D-1641 M&I Chloride Standard



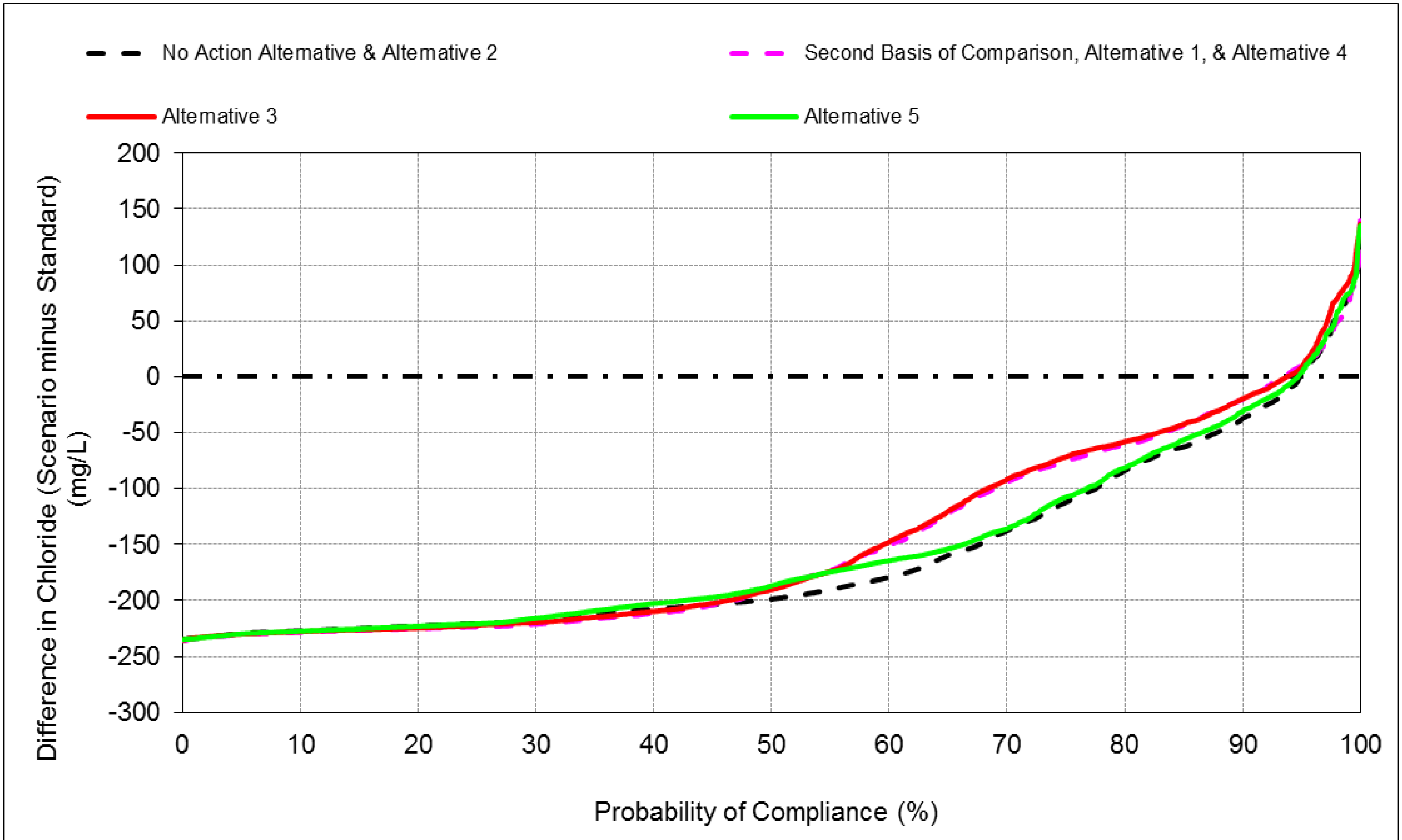
Notes: 1) Probability of compliance is defined as the probability the standard threshold will not be exceeded. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text. 5) Values are daily average.

Figure 6E.B.30.2. Contra Costa Canal at Pumping Plant #1 Compliance with D-1641 M&I Water Quality Standard



B.31. San Joaquin River at Antioch Water Works Compliance with D-1641 M&I Chloride Standard

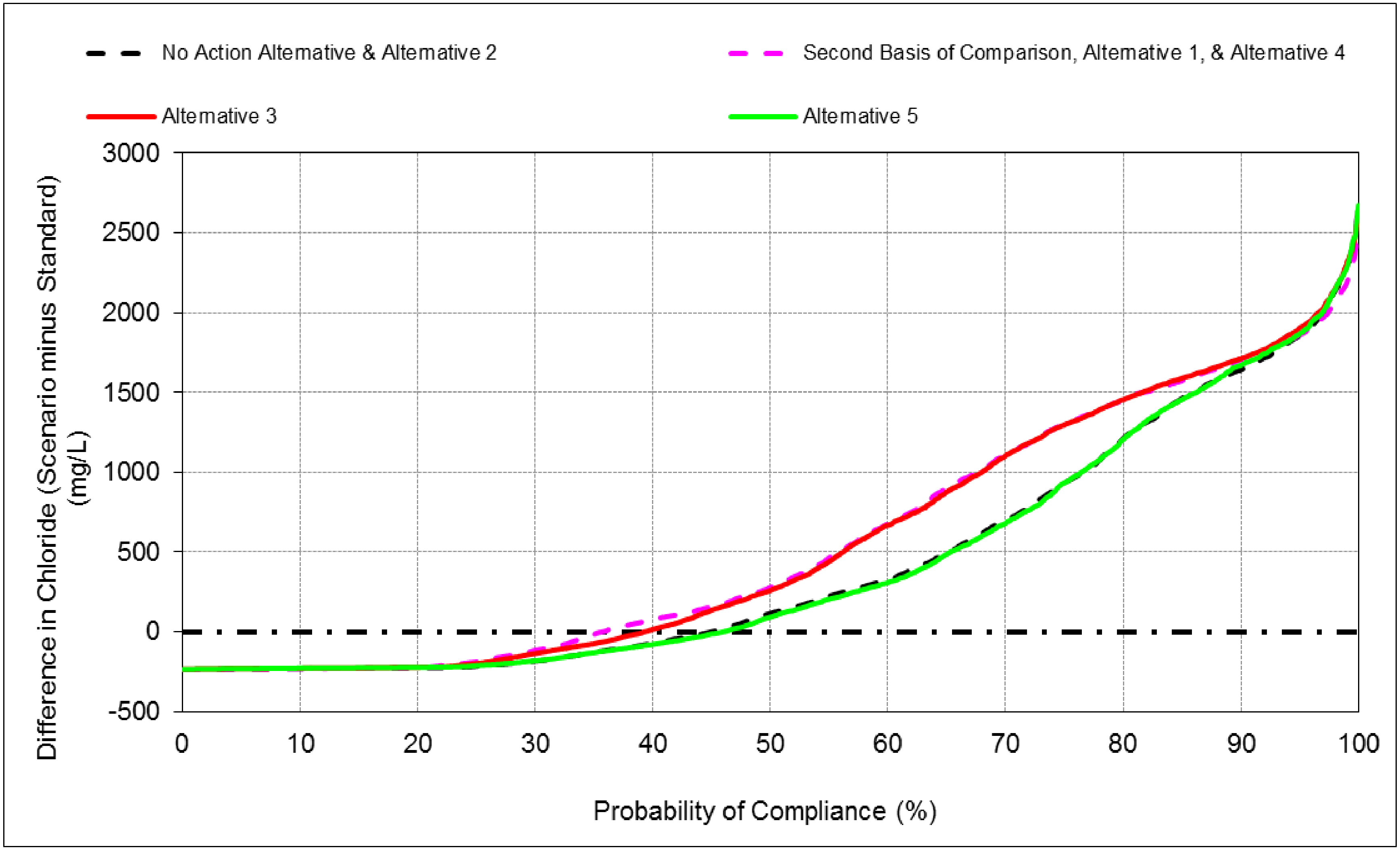
Figure 6E.B.31. San Joaquin River at Antioch Water Works Compliance with D-1641 M&I Water Quality Standard



Notes: 1) Probability of compliance is defined as the probability the standard threshold will not be exceeded. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text. 5) Values are daily average.

B.32. West Canal at Mouth of Clifton Court Forebay Compliance with D-1641 M&I Chloride Standard

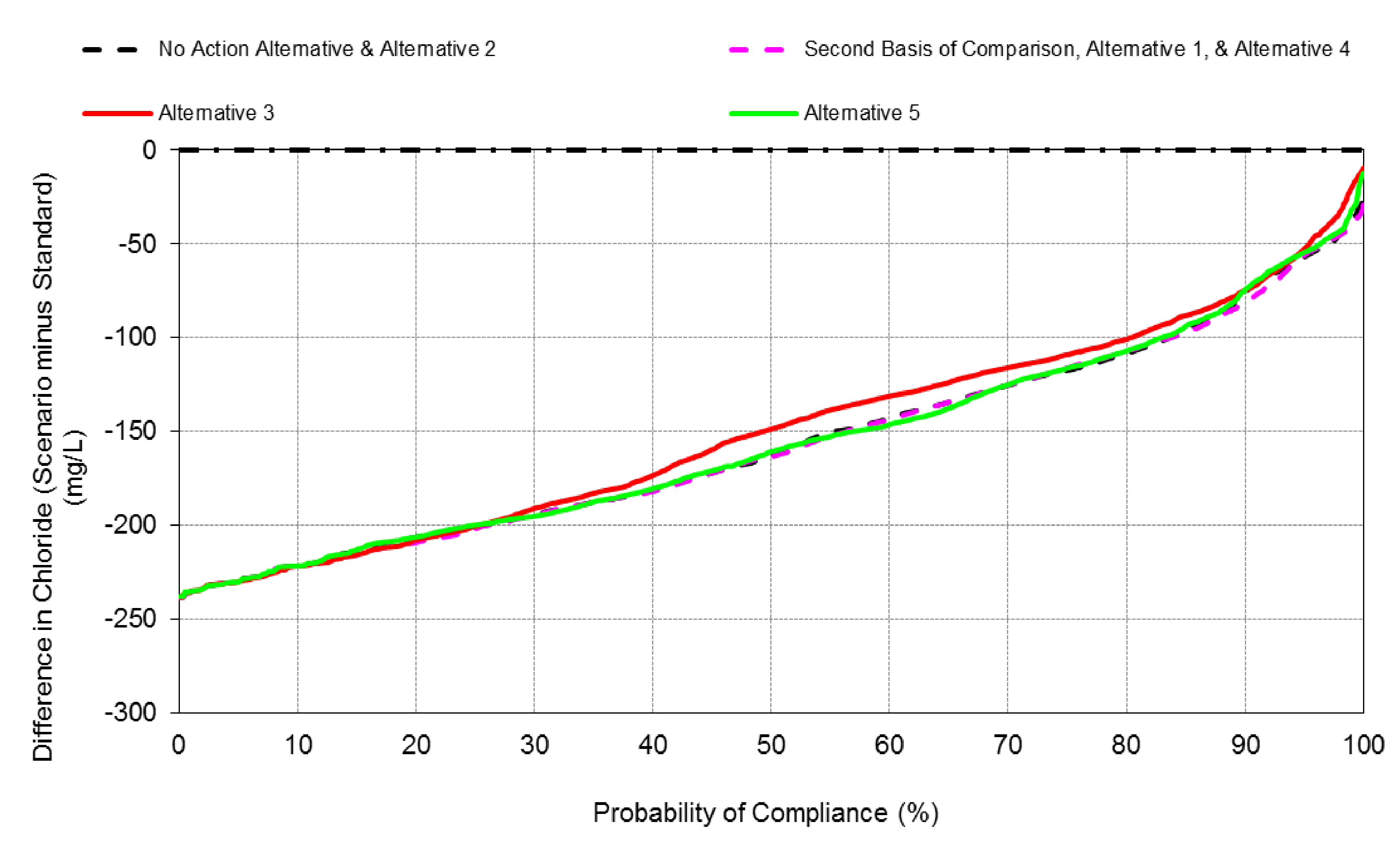
Figure 6E.B.32. West Canal at mouth of Clifton Court Forebay Compliance with D-1641 M&I Water Quality Standard



Notes: 1) Probability of compliance is defined as the probability the standard threshold will not be exceeded. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text. 5) Values are daily average.

B.33. Delta-Mendota Canal at Tracy Pumping Plant Compliance Compliance with D-1641 M&I Chloride Standard

Figure 6E.B.33. Delta-Mendota Canal at Tracy Pumping Plant Compliance with D-1641 M&I Water Quality Standard

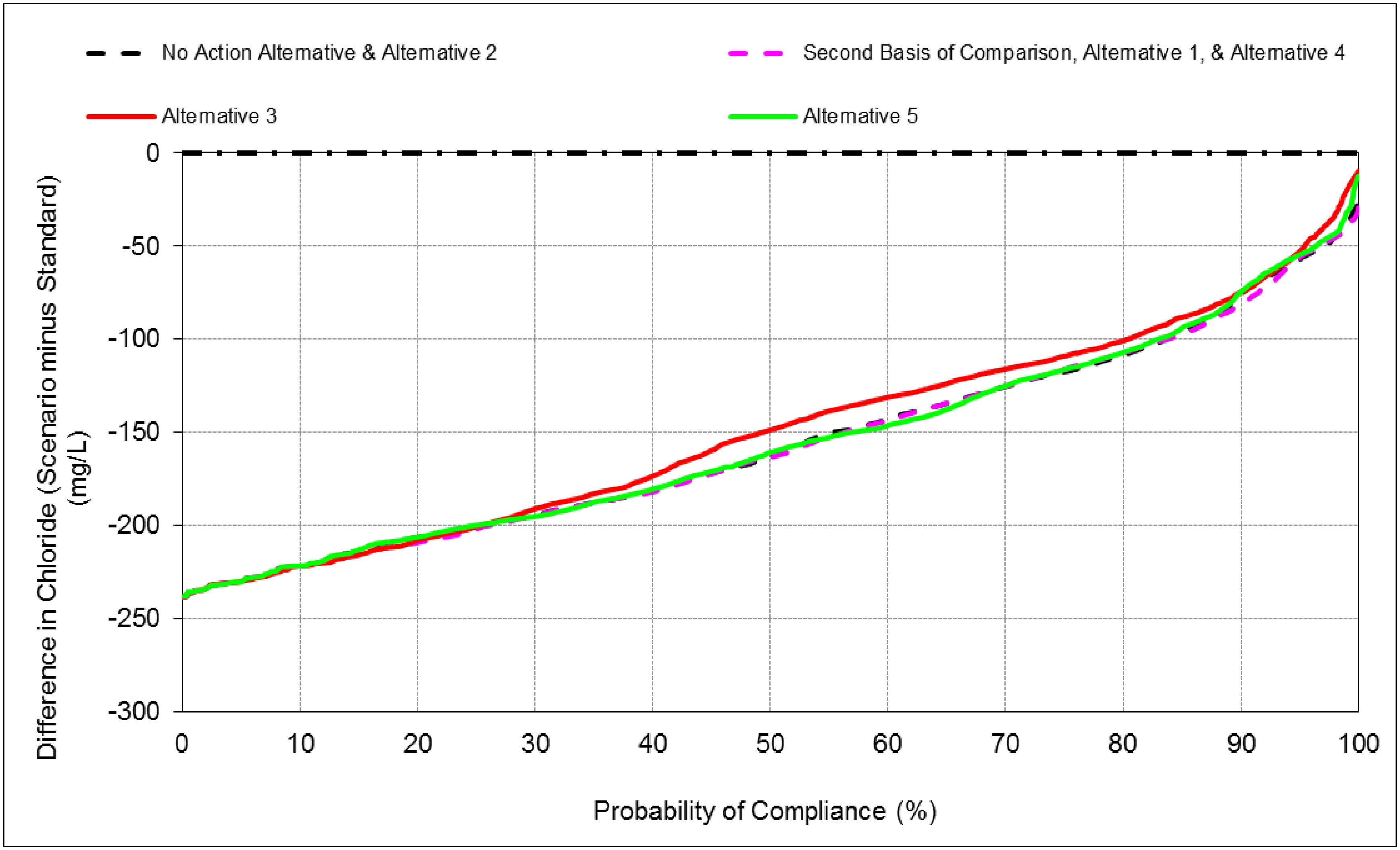


Notes: 1) Probability of compliance is defined as the probability the standard threshold will not be exceeded. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text. 5) Values are daily average.

B.34. Barker Slough at North Bay Aqueduct Compliance

Compliance with D-1641 M&I Chloride Standard

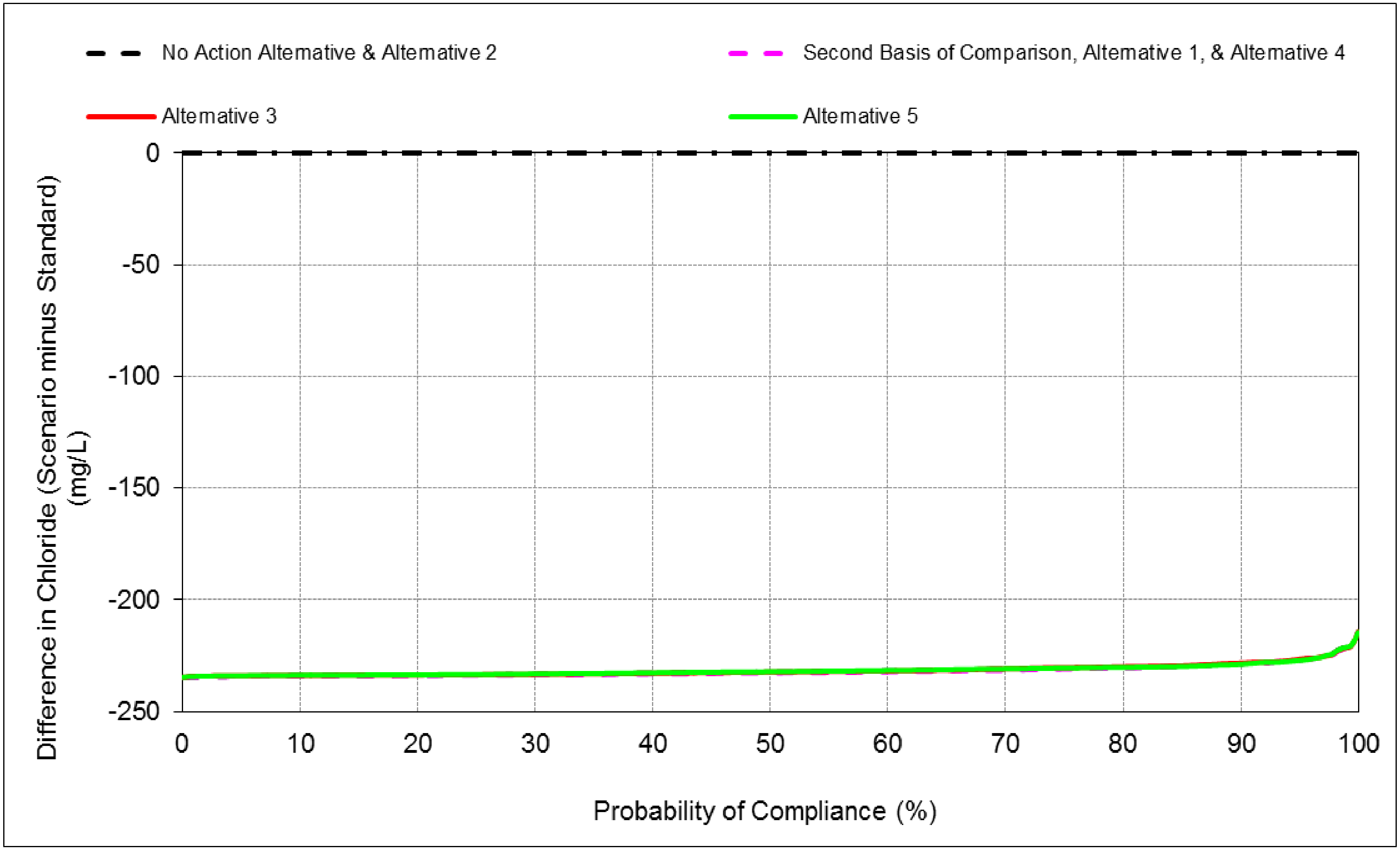
Figure 6E.B.34. Barker Slough at North Bay Aqueduct Compliance with D-1641 M&I Water Quality Standard



Notes: 1) Probability of compliance is defined as the probability the standard threshold will not be exceeded. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text. 5) Values are daily average.

B.35. Cache Slough at City of Vallejo Intake Compliance with D-1641 M&I Chloride Standard

Figure 6E.B.35. Cache Slough at City of Vallejo Intake Compliance with D-1641 M&I Water Quality Standard



Notes: 1) Probability of compliance is defined as the probability the standard threshold will not be exceeded. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text. 5) Values are daily average.

Appendix 7A

Groundwater Model Documentation

This appendix provides information about the assumptions, modeling tools, and the methods used for the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) impact analysis including information for the No Action Alternative simulation. The appendix also describes model output processing and interpretation methods used for the impacts analysis and descriptions. Additional information pertaining to the development of the analytical tools, incorporating climate change, and using input data from other models is also provided.

This appendix is organized into three main sections that are briefly described below:

- Section 7A.1: Groundwater Modeling Methodology
  - The groundwater impacts analysis uses the Central Valley Hydrologic Model (CVHM) to forecast effects of the alternatives on the long-term operations and the environment. This section provides information about the overall analytical framework and how some of the model input information obtained from other models was processed using analytical tools.
- Section 7A.2: CVHM Modeling Simulations and Assumptions
  - This section provides a brief description of the assumptions for CVHM simulations of the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.
- Section 7A.3: CVHM Modeling Results
  - This section describes the model simulation outputs used in the analysis and interpretation of modeling results for the alternatives impacts assessment. A description of post-processing tools is provided along with the different types of output display to facilitate data interpretation.

7A.1 Groundwater Modeling Methodology

This section summarizes the groundwater modeling methodology used for the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5. It describes the overall analytical framework and contains descriptions of the key analytical and numerical tools and approaches used in evaluating the alternatives. The project alternatives include several major components that will influence CVP and SWP operations and the hydrologic and hydrogeologic responses of the system.

In evaluating the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5, climate change assumptions centered on year 2025 (for assumed conditions at 2030) were used to develop modified climate input files. The modeling assumptions are provided in more detail in Section 7A.2.

The impacts on groundwater in the Central Valley and the CVP and SWP export service areas because of the project were analyzed using CVHM (USGS 2009). CVHM is a three-dimensional saturated groundwater flow model based on the widely used MODFLOW code (USGS 2000) and incorporates a number of modeling packages to simulate streamflow, crop demand, groundwater pumping, and subsidence.

7A.1.1 Overview of the Modeling Approach

To support the groundwater impact analysis of the alternatives, modeling of the physical groundwater system in the Central Valley has been undertaken to forecast changes to conditions affecting groundwater resources in areas that use CVP and SWP surface water deliveries.

CVHM is a calibrated historical model that includes a 42-year simulation period from water years 1962 through 2003. The model domain encompasses the entire Central Valley, including Sacramento Valley, San Joaquin Valley (including Tulare Basin), and the Sacramento-San Joaquin Delta. CVHM simulates primarily subsurface and limited surface hydrologic processes using a uniform grid-cell spacing of 1 mile.

CVHM was run over the 42-year hydrologic period, and boundary conditions were modified to reflect anticipated changes in surface water availability, including some potential effects of climate change. Surface water flows from operations models (descriptions of CalSim II methodology is included in Appendix 5A) were used to define selected surface water boundary conditions in CVHM. The linkage between CalSim II surface flows and CVHM inputs is further described below.

Future climate parameters centered on year 2025 were developed using the Variable Infiltration Capacity (VIC) model. Changes to the historical hydrology related to the future climate were applied in the CalSim II model and combined with the assumed operations for each alternative (Appendix 5A). The CalSim II model simulates the operation of the major CVP and SWP facilities in the Central Valley and generates river flows, exports, reservoir storage, deliveries, and other parameters for use with each alternative. River flows based on operational assumptions and reflected in the reservoir releases simulated in CalSim II are included in selected boundary conditions in the CVHM input files, along with the Delta exports to San Joaquin and Tulare service areas, and the surface water deliveries to CVP and SWP users in the Sacramento Valley. CVHM was used to forecast the changes in groundwater levels and groundwater pumping with implementation of the alternatives, and results are processed for input into the Statewide Agricultural Production (SWAP) model. The SWAP model then forecasts impacts on agricultural production based on pumping lifts and cost of groundwater pumping, as described in Chapter 12, Agricultural Resources. Figure 7A.1 shows the modeling tools applied in the groundwater impacts assessment and the relationship between these tools. Each model included in

Figure 7A.1 provides information to the subsequent "downstream" model in order to support the impacts analysis.

The results from this suite of computer models were used to assess potential groundwater effects from implementing each alternative considered in the EIS.

Modeling objectives included evaluating the following potential changes related to groundwater resources because of the various alternatives:

- Changes in groundwater elevations, which result from changes in groundwater use and could affect nearby municipal, agricultural, and domestic well yields
- Changes to groundwater quality based on a potential inducement of migration of poor-quality groundwater because of groundwater flow changes

7A.1.2 Key Components of the Groundwater Modeling Framework

7A.1.2.1 Model Function

CVHM was used to forecast groundwater level changes and other impacts to groundwater resulting from changes in assumed surface water deliveries from the CVP and SWP into the service areas located north and south of the Delta. More specifically, surface water operational changes from project implementation along with the effects of climate change were incorporated into CVHM as modified boundary inflows into the model domain and as semi-routed and nonrouted surface water deliveries to each CVHM water balance subregion (WBS). In addition, forecast climate variations were incorporated as modified precipitation and reference evapotranspiration (ET) rates in the model input files.

The overall construction and calibration of CVHM was left unchanged during this analysis. The only modifications to CVHM involved the prescribed surface water inflows and deliveries, which were modified based on simulations performed using CalSim II, as well as modified reference ET and precipitation input files to reflect potential climate change conditions centered on year 2025. CalSim II flows reflect operations in the Delta based on assumptions related to future operations of the project (see Chapter 5, Surface Water Resources and Water Supplies).

The active CVHM domain was subdivided into 21 WBSs, as originally defined by the California Department of Water Resources (DWR) (Figure 7A.2). During model simulations, applied water requirements for each WBS were computed based on crop type and available water from precipitation, shallow groundwater, and surface water (limited by surface water rights).

Selected major streams flowing through the Central Valley were explicitly represented in CVHM. Observed USGS gage flows were used as inflows into the model domain for natural, unregulated rivers and streams. Reservoir releases on regulated rivers were also used as boundary inflows into the model domain. The reservoir releases were modified for each alternative according to operational changes and are represented by modified time-series flow data obtained from the CalSim II simulations. Surface water deliveries to meet a portion of the applied water demands were diverted directly from the rivers, according to water rights constraints. Additional surface water was delivered through “nonrouted” methods in the model. Nonrouted surface water deliveries represent water transfers or surface water deliveries to a WBS not connected to a stream or major canal. This conveyance typically occurs through small canals or diversion ditches (USGS 2009). Some irrigation canals and aqueducts were not included in CVHM, such as the California Aqueduct and the Delta-Mendota Canal. Water delivered through these conveyances was simulated in CVHM as nonrouted deliveries, directly added to the destination WBS. The deliveries to WBSs south of the Delta from the CVP and SWP and associated conveyance losses were estimated from CalSim II simulations and included in CVHM. The surface water diversion flows for the CVP and SWP contractors and settlement contractors in the Sacramento Valley were also obtained from CalSim II simulations for each alternative.

7A.1.2.2 Computer Code Description

CVHM is a regional groundwater modeling application based on the MODFLOW-2000 (MF2K) computer code (USGS 2000) and incorporates a variety of additional modules that were specifically developed to interact with MF2K and increase the capabilities of the overall modeling package. The additional modules incorporated into the CVHM application are summarized in Table C1 of USGS Professional Paper 1766 (USGS 2009). The package that is responsible for simulating the majority of the agricultural water balance is the Farm Process (FMP) (USGS 2006). Within the FMP documentation, the WBSs are referred to as “farms”; WBS and farms are used interchangeably in this text. FMP computes the applied water demand for each farm based on crop types specified in each model cell and computes the availability of water from “natural” sources such as precipitation and shallow groundwater. After the available natural water is allocated, FMP computes the amount of water that needs to be delivered from other sources, such as surface water deliveries (routed and nonrouted) and groundwater pumping to meet the remaining applied water demand.

Another important module integrated into CVHM is the Stream Flow Routing (SFR1) package. This package simulates the routing of surface water through virtual channels within the model domain, accounts for surface water diversions and deliveries to individual WBSs, tracks the flow and associated stage in surface water reaches, and computes stream-aquifer exchange.

CVHM was chosen to simulate the impacts of the alternatives for three main reasons:

1. Readily available and peer-reviewed. CVHM was developed, calibrated, and tested by USGS and is based on a widely recognized computer code. It is publicly available, and extensive documentation has been published describing CVHM as well as all the modules and packages that make up the model.

2. Geographic extent. A large potentially impacted area to be evaluated as part of this project includes the Sacramento Valley and the San Joaquin Valley (including the Tulare Lake area). Surface water operational changes resulting

from project operations are defined at the margins of the Central Valley. The CVHM domain covers the entire Central Valley and allows for the efficient imposition of boundary conditions throughout the basin.

3. Model subareas and discretization. CVHM is divided into 21 WBSs that correspond to the historical water balance regions identified by DWR. Water balances are computed for each WBS by the model. This distribution of areas in the Central Valley is consistent with models used by other resource teams, provides for consistent model reporting to the other teams, and allows for efficient sharing of data with other models.

7A.1.2.3 General Numerical Model Description

CVHM simulates surface water flows, groundwater flows, and land subsidence in response to stresses from water use and climate variability throughout the entire Central Valley. It uses the MF2K (USGS 2000) groundwater flow model code combined with the FMP modular package to simulate groundwater and surface water flow, irrigated agriculture, and other key processes in the Central Valley on a monthly basis from April 1961 through September 2003. CVHM is discretized laterally over a 20,000-square-mile area and vertically into 10 layers ranging in thickness from 50 feet near the land surface to 400 feet at depth. Layers 4 and 5 represent the Corcoran Clay member where it exists in portions of the San Joaquin Valley. In the Sacramento Valley, the Corcoran Clay member is not present; therefore, the model layering effectively consists of eight layers.

The FMP allocates water deliveries, simulates crop-applied water demand processes, and computes mass balances for the 21 WBSs (or farms) in CVHM. The FMP was developed for MF2K to estimate applied irrigation water allocations from conjunctively used surface water and groundwater. It is designed to simulate the demand components representing crop irrigation requirements and on-farm inefficiency losses, and the supply components representing surface water deliveries and supplemental groundwater pumping. The FMP also simulates additional head-dependent inflows and outflows such as canal losses and gains, surface runoff, surface water return flows, evaporation, transpiration, and deep percolation of excess water. Unmetered pumping and surface water deliveries for the 21 WBSs are also included within the FMP (USGS 2006).

The original calibration of CVHM by USGS was accomplished using a combination of trial-and-error and automated methods. An autocalibration code called UCODE-2005 (USGS 2005) was used to help assess the ability of CVHM to estimate the effects of changing stresses on the hydrologic system. Simulated changes in water levels, streamflows, streamflow losses, and subsidence through time were compared by USGS to those measured in wells, at streamflow gages, and at extensometer sites. For model calibration, USGS screened groundwater levels and surface water stages to obtain a calibration target data set that is distributed spatially (geographically and vertically) throughout the Central Valley; distributed temporally throughout the simulation period (1961–2003); and available during both wet and dry climatic regimes. From the available wells records, a subset of 170 comparison wells was selected based on perforation depths, completeness of record, and locations throughout the Central Valley (USGS 2009). No changes were made to physical parameter values in CVHM for this project. A more detailed description of CVHM is in USGS Professional Paper 1766 (USGS 2009).

7A.2 CVHM Modeling Simulations and Assumptions

As described in Section 7A.1, groundwater modeling was performed for evaluating the alternatives considered in the EIS. This section describes the assumptions for the CVHM simulations of the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.

The following model simulations were performed as the basis of evaluating the impacts of the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1 – for CVHM simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for CVHM simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for CVHM simulation purposes, considered the same as Second Basis of Comparison.
- Alternative 5

Assumptions for each of these alternatives were developed with the surface water modeling tools and are described in Appendix 5.

The general CVHM modeling assumptions described below pertain to all the baseline and alternative runs.

7A.2.1 Climate Change Assumptions

Climate variables of interest from a climate-change perspective within CVHM include precipitation and reference ET, which are among the required inputs for the FMP module to compute the applied water demand. These two variables are formatted as two-dimensional model array input files with one value assigned to each surficial model grid cell.

The original historical climate input data for CVHM were developed for the simulation period 1961-2003 from Parameter-Elevation Regressions on Independent Slopes Model (PRISM) data (Climate Source 2006). For precipitation, PRISM data were interpolated onto the model domain, and reference ET data were computed from PRISM temperature data. Reference ET data were computed using the Penman-Monteith estimate of potential ET and are used to evaluate the crop potential ET in combination with crop coefficients, and minimum and maximum temperatures for each stress period (USGS 2009).

For the alternative simulations, climate conditions centered on year 2025 were assumed. Therefore, to be consistent with the other water supply and economics models, the climate input data for CVHM were modified to represent potential climate conditions centered on year 2025. A more detailed description of how climate change was incorporated into the CVHM forecast simulations follows.

The CVHM historical monthly precipitation and reference ET values were modified to incorporate potential climate change based on the median climate change scenario for the early long-term period (centered on 2025) (DWR, Reclamation, USFWS, and NMFS 2013). The analysis uses five statistically representative climate change scenarios to characterize the central tendency and the range of the ensemble uncertainty, including projections representing drier, less warming; drier, more warming; wetter, more warming; and wetter, less warming conditions as compared with the median projection. Climate change scenarios were developed from an ensemble of 112 bias-corrected, spatially downscaled global climate model (GCM) simulations. These GCM simulations were from 16 climate models for Special Report on Emissions Scenarios (SRES) A2, A1B, and B1 (Maurer et al. 2007) from the Coupled Model Intercomparison Project Phase 3 that are part of the Intergovernmental Panel on Climate Change Fourth Assessment Report. The forecast changes over the 30-year climatological period centered on 2025 (i.e., 2011-2040 to represent 2030 timeline) were combined with a set of historically observed temperature and precipitation (Hamlet and Lettenmaier 2005) to generate climate sequences that maintain important multiyear variability. The approach uses a technique called "quantile mapping", which maps the statistical properties of climate variables from one data subset with the time series of events from a different data subset.

Historical temperature and precipitation data gridded to a 1/8 degree (°) spatial resolution across California (Hamlet and Lettenmaier 2005) were obtained from the Surface Water Modeling Group at the University of Washington (http://www.hydro.washington.edu). These data are based on the National Weather Service cooperative network of weather observations stations, augmented by information from the higher quality Global Historical Climatology Network stations. The Hamlet and Lettenmaier (2005) dataset includes the period from January 1915 through December 2003.

The historical and modified temperature (maximum and minimum values) based on the median early long-term climate-change scenario (centered on 2025) were used in the VIC hydrological model (Liang et al. 1994; Reclamation 2011) to simulate reference ET using the Penman–Monteith method (Allen et al. 1998).

Based on the above assumptions and methods, two sets of monthly fractional changes (i.e., perturbation factors) were computed to adjust the CVHM historical precipitation and reference ET input model array files. The first set of monthly fractional changes was computed from the historical and modified precipitation at each 1/8° VIC grid cell (future precipitation divided by historical precipitation). Similarly, the second set of monthly fractional changes was computed from reference ET simulated using historical and modified climate inputs that were computed using the Penman–Monteith method (Allen et al. 1998) embedded in the VIC hydrological model (simulated future reference ET divided by simulated reference ET). The fractional changes were computed for the historical period April 1961 through September 2003 for consistency with the CVHM simulation period.

The monthly fractional changes at 1/8° VIC grid cell were then applied to each CVHM monthly precipitation and reference ET data set at the corresponding CVHM grid cells by spatially mapping the two sets of grids. A utility tool was developed for intersecting the CVHM grid cells with the 1/8° VIC grids to assign fractional changes from the 1/8° VIC grid cell to historical precipitation and reference ET at each surficial CVHM cell to produce modified precipitation and reference ET values for planning level CVHM simulations that incorporate potential future climate change centered on year 2025. Figure 7A.3 illustrates the relationship between the VIC model grid and the CVHM grid.

7A.2.2 Land Use Assumptions

In CVHM, "the land use attributes are defined in the model on a cell-by-cell basis and include urban and agricultural areas, water bodies, and natural vegetation. The land use that covered the largest fraction of each 1-mi² model cell was the representative land use specified for that cell" (USGS 2009). Further, the agricultural land use is divided into 12 DWR Class 1 crop categories, also referred to as "virtual crops". As described in USGS 2009, the process of identifying a representative land use type and crop category for each model cell is very complex over the 42-year hydrologic period with different climate variations. This type of data is not readily available publicly, and other land use coverages require extensive processing to convert it into a format suitable for CVHM simulations. Thus, generating future land use changes for each cell of the CVHM grid was not undertaken in the impacts analysis in this EIS. In addition, other related FMP input files (such as crop coefficients and irrigation efficiencies) change over time and need to be updated accordingly with the land use.

For the groundwater modeling, the land use distribution for water year 2003 was used for the entire forecast simulation period. This was the most recent land use data available in a format appropriate for the model simulations. The limitation of using the 2003 land use distribution is that some of the most recent changes to crop production in the Central Valley over the past decade are not included in the simulations. In addition, projections of land use changes because of economic effects and climate change are not considered in CVHM, nor are the potential crop changes in response to water supply availability from CVP and SWP operational changes from the alternatives (see Chapter 12, Agricultural

Resources, for a discussion of changes in crops because of water supply availability and costs). However, these assumptions are the same for the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5; and are therefore adequate for the comparative analysis required in the EIS. There have been changes in crop patterns since 2003; however, those changes would be consistent in the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.

7A.2.3 Stream Boundary Inflows Assumptions

CVHM includes 43 stream boundary inflows, which represent smaller natural streams as well as managed reservoir outflows. Of these, 13 inflows were linked to CalSim II reservoir releases. Natural stream inflows were kept unchanged from the original CVHM and therefore are linked to the historical climate data. It should be noted that CalSim II does not include the Tulare Lake area, and all stream inflows in that area were kept the same as those from the original CVHM.

For each alternative simulation, the surface water inflows at specific locations are updated in the SFR input file based on time series computed by CalSim II. Table 7A.1 lists the CVHM inflow locations at which updated CalSim II flows were applied based on simulation results from the corresponding CalSim II nodes. Figure 7A.4 provides a map with the stream boundary inflow locations in CVHM.

Table 7A.1 CVHM Modified Inflow Locations

CVHM Node ID	Description	CalSim II Equivalent Nodes
AMER_374	American River Downstream of Lake Natoma + South Folsom Canal	C9 + D9
MOKE_173	Mokelumne River below Comanche Reservoir	I504 + Original CVHM Diversions on Mokelumne River
CALV_161	Calaveras River (release from New Hogan Reservoir)	C92
STAN_146	Stanislaus River (below Goodwin + Oakdale Canal + SSJ Canal)	C520 + D520B + D520C
TUOL_135	Tuolumne River (Don Pedro Reservoir Release)	C81
SACR_205	Sacramento River (Keswick Reservoir Release)	C5
STON_263	Stony Creek (Black Butte Reservoir Release)	C42
FEAT_341	Feather River below Oroville + Palermo Canal	C6 + D6
YUBA_349	Yuba River below Englebright + Deer Creek inflow + French Dry Creek inflow	C230 + D230
MERC_116	Merced River (Lake McClure outflow)	C20
CHOW_080	Chowchilla River (Eastman Lake outflow)	C53
FRES_069	Fresno River (Hensley Lake outflow)	C52
SANJ_054	SJR at Friant Dam (Millerton Lake outflow)	C18

7A.2.4 Project Deliveries Assumptions

CVHM includes two different methods to deliver surface water diversions to a WBS: semi-routed deliveries and nonrouted deliveries. These deliveries occur through the interaction of the SFR and FMP modules and the WBS.

Semi-routed deliveries occur through the SFR package to account for water that is routed through stream networks. With the SFR package, CVHM conveys water from streams and canals as semi-routed deliveries to WBSs through the FMP based on model-computed applied water demand (USGS 2009).

The nonrouted delivery process allows the model to obtain surface water from a source that is not simulated with the stream network. For instance, not all canals are physically simulated within CVHM, but the water conveyed through those canals can still be delivered to the appropriate WBSs without actually simulating the conveyance features explicitly.

In the CVHM simulations, the nonrouted surface water supply components have first delivery and use priority, and semi-routed surface water deliveries have second priority. If the WBSs water delivery requirements computed by the crop consumptive use through FMP are not met using surface water, the FMP computes the amount of supplemental groundwater necessary to be pumped from "farm" (agricultural production) wells to satisfy the total WBS water demand (USGS 2009). The nonrouted and semi-routed surface water deliveries are simulated as monthly transient time series that set the upper bound of available surface water for the WBSs. The actual diversions and deliveries for each WBS are driven by agricultural water demand.

Within the CVHM configuration, nonrouted deliveries tend to be associated with the south-of-Delta exports to the San Joaquin Valley service areas, because the California Aqueduct and the Delta-Mendota Canal are not simulated in the model. Semi-routed deliveries occur in areas where diversions from streams and canals are simulated for both settlement contractors and riparian diverters. Because of the difference in water rights allocations and the different CVHM characteristics in the Sacramento Valley versus the San Joaquin Valley, the surface water allocations are simulated differently, as described below. Figure 7A.5 shows the surface water delivery types for each WBS as simulated in CVHM.

For the groundwater impacts simulations, the calibrated historical CVHM was set up to run in a "predictive mode" (for future planning simulations) with the diversion time series fixed at water year 2003 for all semi-routed diversions that represent riparian or other water rights users. This method provides the latest available (2003) diversion flows to agricultural water users for an average hydrology year with seasonal patterns. Project water deliveries were developed from CalSim II time series, as described below.

7A.2.4.1 Sacramento Valley

The Sacramento Valley is defined in CVHM as WBSs 1 through 8 (Figure 7A.2). In the Sacramento Valley, the diversion time series for the CVP and SWP settlement contractors and CVP contract agricultural diverters were linked to

CalSim II time series for consistent project delivery estimates for each alternative. Table 7A.2 shows the detailed linkage between CalSim II nodes and CVHM diversions nodes for the Sacramento Valley (also shown in Figure 7A.6).

Table 7A.2 CVHM Diversions linked to CalSim II Flows in the Sacramento Valley

CVHM WBS	CVHM Node ID	Type of Flow	Description – CVHM (CalSim II)	CalSim II Equivalent Node
1	BELL_0206	–	Bella Vista Conduit (ag only)	0.57*D104_PAG
1	SACR_A223	CVP Settlement Ag + CVP Ag Delivery	Diversions – Sacramento River between Keswick and Red Bluff (ag only)	D104_PAG - (BELL_0206) + (0.86*D104_PSC)
0*	SACR_B223	CVP M&I + CVP Settlement M&I Delivery	Diversions – Sacramento River between Keswick and Red Bluff (M&I only)	D104_PMI + 0.14*D104_PSC
2	CORN_0232	CVP Ag Delivery	Corning Canal	D171
2	TE10_0232	CVP Ag Delivery	Tehama Colusa Canal	D172
3	TE12_0323	CVP Ag Delivery	Tehama Colusa Canal	D174 + D178
3	GLEN_0261	CVP Settlement Ag Delivery	Glenn Colusa Canal	D143A + D145A
3	COL_0328	CVP Settlement	Colusa Basin Drain for Irrigation Supply (Colusa Drain MWC)	D180 + D182A + D18302
3	DS12_0282	CVP Settlement	Sacramento River Right Banks Exports (Princeton-Cordova-Glenn ID, Provident ID, Maxwell ID)	D122A
4	DS15_0331	CVP Settlement	HD from Sacramento River between Red Bluff and Knights Landing (Maxwell ID, Sycamore Family Trust, Roberts Ditch IC, RD 108, River Garden Farms, Meridian Farms WC, Pelger Mutual WC, RD 1004, Carter MWC, Sutter MWC, Tisdale Irrigation and Drainage Co)	D122B + D129A + D128

CVHM WBS	CVHM Node ID	Type of Flow	Description – CVHM (CalSim II)	CalSim II Equivalent Node
6	DS65_0381	CVP Settlement	Sacramento River Right Banks Diversions between Knights Landing and Sacramento	D163_PSC
5	DS69_0366	SWP Settlement Contractors in FRSA	DSA 69 HD from Feather River; aggregated deliveries for DSA 69 including from Thermalito Complex and Feather River diversions	D7A + D7B + D202 + D206A + D206B
5	YUBA_0351	–	HD from Yuba River - Diversions for "Big 3" diverters, primarily YCWA	D230
7	DS70-0381	CVP Settlement Ag Delivery	HD from Sac River between Knights Landing and Sacramento - all but City water	D162

[*] WBS 0 means that water is diverted from the stream but not delivered to any to any of the WBSs. This occurs for M&I diversions not used for crop irrigation.

The linkage was based on the definition and assumptions of CalSim II and CVHM deliveries, and on the spatial approximation of the stream diversion location in CVHM. Each time series is updated in the SFR input file for each alternative simulation.

In addition to the semi-routed deliveries, WBSs 5 and 7 receive water from nonrouted deliveries. However, most of these deliveries are either linked to riparian (nonproject) water rights or deliveries from outside the model domain. Therefore, WBS 5 and 7 nonrouted deliveries remained unchanged from the calibrated CVHM model.

7A.2.4.2 San Joaquin Valley

In CVHM, the San Joaquin Valley is defined as WBSs 10 through 21 and includes the Tulare Lake portion of the San Joaquin Valley (Figure 7A.2). In the San Joaquin Valley, the majority of agricultural surface water deliveries are provided through south-of Delta exports from the CVP and SWP contract allocations. CalSim II time series representing project water deliveries for the San Joaquin Valley WBSs were aggregated into one time series for each WBS using a spreadsheet-based preprocessing tool. These time-series data were then used for the FMP nonrouted deliveries input file. The semi-routed deliveries in the San Joaquin Valley are either of riparian nature or for other non-project use, and therefore were not changed from the historical CVHM. The only exception occurred in WBS 11, in the East San Joaquin area, where two CVP agricultural deliveries were linked to CalSim II time series (Figure 7A.6):

- Deliveries for Oakdale Irrigation District North and South San Joaquin Irrigation District, simulated in CVHM as the diversions at the South San Joaquin Canal near Knights Ferry (SSJK_0147 in Figure 7A.6), were linked to CalSim II node D520B
- Deliveries for Oakdale Irrigation District South, simulated in CVHM as the diversions at the Oakdale Canal near Knights Ferry (OAKK_0147 in Figure 7A.6), were linked to CalSim II node D520C

These two semi-routed diversions and deliveries were incorporated into the SFR input file along with all the other surface water diversion and boundary inflow modifications for each alternative.

7A.2.5 Model Application Methodology

For each simulation scenario (No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5), boundary inflows in CVHM, WBS surface water estimates, and farm delivery estimates were updated with the appropriate CalSim II model outputs, which account for assumed operational changes for each alternative. The original 42-year hydrology for water years 1962 through 2003 was updated with climate conditions centered on year 2025 for each predictive simulation. Thus, impact evaluations assume the dry to wet hydrology patterns as indicated from climate model simulations centered on year 2025. The simulated groundwater levels for each alternative were compared to the No Action Alternative and Second Basis of Comparison simulations. Model outputs were processed such that impacts to groundwater were shown on an average monthly basis by water year type, and the analysis was centered on potential impacts occurring during the month with the largest agricultural deliveries, which generally is July. The simulation period did not intend to provide groundwater levels at exact future dates, but rather provide a range of groundwater level changes that could occur from implementing each alternative, given assumed future fluctuations in hydrology.

7A.2.5.1 No Action Alternative and Second Basis of Comparison Models

The overall purpose of the No Action Alternative and Second Basis of Comparison models is to provide a set of baseline conditions for comparison with the forecasts of the alternative models to assess whether implementing the proposed alternatives are likely to result in substantial changes to groundwater resources.

Preparing the CVHM No Action Alternative model and the Second Basis of Comparison model was based on the modified CalSim II flow time series for the reservoir outflows and the deliveries to the WBSs in the export service areas. The following are additional assumptions inherent in the predictive version of CVHM:

- The urban groundwater pumping locations for 2003, the most recent available in CVHM, were assumed to remain for the duration of the 42-year predictive simulation period.
- The original CVHM 2003 surface water diversions were assumed for the duration of the predictive simulation for nonproject diversions.
- The land use distribution and associated cropping patterns available in the calibrated CVHM at approximately year 2000-2003 were kept constant throughout the predictive simulation.
- The climatic data were updated to represent a wet to dry precipitation pattern centered on year 2025.

7A.2.5.2 Other Alternatives Models

For each alternative model simulation, the same procedure as described for the No Action Alternative and Second Basis of Comparison models was used, with similar assumptions, to update flows from the CalSim II simulations. Detailed modeling processes and impacts analysis procedures are described in the next section.

7A.3 CVHM Modeling Results

A complex and detailed model such as CVHM requires developing and applying preprocessing and post-processing tools to create input files, run the model, and view and interpret results. The processing tools range from geographic information system (GIS) and spreadsheet-based tools to custom-coded programming utilities that use viewing programs such as Golden Software Surfer. The general preprocessing and input files development are described in Section 7A.2. The following subsections describe data analyses and results.

7A.3.1 Post-Processing and Results Analysis

Output data resulting from CVHM simulations for each alternative were processed to provide a graphical depiction of applicable information that support the analysis and description of potential impacts to groundwater resources. As discussed previously, the primary outputs from CVHM used in this analysis were simulated heads and agricultural groundwater pumping to meet applied water demands.

CVHM outputs simulated hydraulic heads (heads) and groundwater fluxes for each model grid cell in each model layer. Based on analysis of common screen elevations of agricultural pumping wells, Model Layer 6 of the original CVHM includes the majority of the groundwater extraction. Actual locations of agricultural wells are not represented in the model; they are represented as “virtual wells” in model cells representing areas with known groundwater pumping and having a corresponding agricultural land use. The simulated heads in each cell for Model Layer 6 only are interpolated using triangulation with linear interpolation to facilitate viewing results for the entire Central Valley for each alternative. Because July generally has the highest agricultural groundwater pumping during the CVHM timeframe, the results analysis focuses on this month for each alternative. A post-processing utility was developed to create monthly average heads for July for each water-year type. The difference in monthly average heads between each alternative and No Action Alternative and each alternative and Second Basis of Comparison was then computed, interpolated, and displayed on a Central Valley map for change visualization. The differences were computed by subtracting the simulated heads for No Action Alternative and Second Basis of Comparison from the simulated heads for the alternatives, respectively.

A resulting positive head difference indicates that heads in the alternative simulation are higher than those from the No Action Alternative or Second Basis of Comparison simulation to which the alternative simulation is being compared. Conversely, a resulting negative head difference indicates that heads in the alternative simulation are lower than those from the No Action Alternative or Second Basis of Comparison simulation to which the alternative simulation is being compared. Results are provided in Figures 7.15 through 7.60 and a narrative of the forecast head differences (i.e., project effect to groundwater levels) is provided in Chapter 7, Groundwater Resources and Groundwater Quality.

The results give an indication of the horizontal distribution of the potential impacts to groundwater levels in Model Layer 6 for an average month of July for each water year type. To assess the temporal variations in groundwater level fluctuations, head difference hydrographs at eight model cells were developed to show a range of typical groundwater level variations and changes between alternatives and No Action Alternative and Second Basis of Comparison at different locations in the Central Valley. The location of the simulated groundwater level time series were chosen based on general areas of USGS wells that were used for calibrating CVHM. The hydrograph plots are shown on a CVHM WBS map for the Sacramento Valley and San Joaquin Valley (Figures 7.20, 7.21, 7.29, 7.30, 7.38, 7.39, 7.45, 7.46, 7.52, 7.53, 7.59, and 7.60).

In addition to spatial and temporal representations of groundwater level changes associated with the alternatives, agricultural groundwater pumping differences are also depicted on a map of the WBSs. This graphical representation shows which areas of the Central Valley are impacted the most by changes in surface water deliveries for each alternative. The data for these results were processed from the FMP output files, which include the amount of water used from each available source by the farm, based on the computed applied water demand for each WBS (Figures 7.22, 7.23, 7.31, and 7.32).

7A.3.2 Output Data for Other Models

Simulated heads from CVHM were post-processed for use in evaluating agricultural economic impacts related to each alternative. An agricultural economic impact evaluation of each alternative was performed using the SWAP model. For more information on using this model and the results, refer to

Chapter 12, Agricultural Resources and Appendix 12A. The simulated heads output file was processed to average the July head data for Model Layer 6 for each SWAP region. In addition, processing of CVHM heads for the SWAP model further separates the average simulated head between irrigated portions and non-irrigated portions of each SWAP region.

As a result, each SWAP region includes one estimated average head change representing the agricultural pumping impacts. This average value was used to compute a pumping lift for SWAP input, to compute average electrical cost to pump groundwater for irrigation.

7A.3.3 Model Limitations and Applicability

Although it is impossible to predict future hydrology, land use, and water use with certainty, CVHM was used to forecast impacts to groundwater resources that could result from implementing the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 to aid in developing the EIS. CVHM was used in a comparative manner to estimate potential changes by implementing Alternatives 1 through 5 as compared to the No Action Alternative, and the No Action Alternative and Alternatives 1 through 5 as compared to the Second Basis of Comparison. Mathematical models like CVHM can only approximate processes of physical systems. Models are inherently inexact because the mathematical description of the physical system is imperfect, and the understanding of interrelated physical processes is incomplete. However, CVHM is a powerful tool that, when used carefully, can provide useful insight into processes of the physical system. The following are some known limitations that should be considered when evaluating the forecast impacts.

- CVHM simulates groundwater conditions in the Central Valley with cells on 1-mile centers. Therefore, surface water and groundwater features that occur at a scale smaller than 1 mile cannot be simulated explicitly in CVHM. Likewise, CVHM simulates groundwater conditions using monthly stress periods. Thus, groundwater variations cannot be simulated explicitly in CVHM over timeframes shorter than 1 month.
- The “predictive” (future planning) version of CVHM used for the impacts analysis does not include land use changes after year 2003. Thus, land use changes that have occurred since 2003 and those that might occur in the future are not considered in the impacts analysis.
- The future planning version of CVHM incorporates potential climate-change effects centered on year 2025 (assumed conditions at year 2030). It is not possible to know whether these potential climate-change effects will actually occur in the future, as modeled.
- Operation of groundwater banks and groundwater transfer programs and how implementing the alternatives could affect them is not included in the future planning level CVHM simulations.
- The future planning version of CVHM does not include potential affects from planned or unplanned changes in groundwater regulations in California

(i.e., implementation of California Sustainable Groundwater Management Act).

- The subsidence package, as implemented in the version of CVHM used for the impacts analysis, does not consider the potential reduction in the rate of subsidence that would occur as the magnitude of compaction approaches the physical thickness of the affected fine-grained interbeds. Thus, subsidence forecasts from the predictive versions of CVHM were judged to be overly conservative. Therefore, a qualitative approach was used for estimating the potential for increased land subsidence in areas of the Central Valley that have historically experienced inelastic subsidence because of the compaction of fine-grained interbeds.

7A.4 References

Allen, R.G., L.S. Pereira, D. Raes, and M. Smith. 1998. Crop evapotranspiration – Guidelines for computing crop water requirements. FAO Irrigation and Drainage paper, page 56. Food and Agriculture Organization of the United Nations, Rome.

Climate Source. 2006. Precipitation data from PRISM data. Site accessed by the USGS and included in USGS 2009 (data set not revised by authors).

DWR, Reclamation, USFWS, and NMFS (California Department of Water Resources, Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service). 2013. *Draft Environmental Impact Report/Environmental Impact Statement for the Bay Delta Conservation Plan*. November.

Hamlet, A. F., and D. P. Lettenmaier. 2005. Production of temporally consistent gridded precipitation and temperature fields for the continental U.S. J. of Hydrometeorology 6:330–336.

Liang, X., D.P. Lettenmaier, E.F. Wood, and S.J. Burges. 1994. A Simple Hydrologically Based Model of Land Surface Water and Energy Fluxes for General Circulation Models. Journal of Geophysical Research, Vol. 99, pp. 14415-14428.

Maurer, E. P., L. Brekke, T. Pruitt, and P. B. Duffy. 2007. Fine-Resolution Climate Projections Enhance Regional Climate Change Impact Studies. Eos Trans. AGU. 88(47):504.

Reclamation (Bureau of Reclamation). 2011. West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections', Technical Memorandum No. 86-68210-2011-01. 138pp.

USGS (U.S. Geological Survey). 2000. MODFLOW-2000: The U.S. Geological Survey Modular Ground-Water Model–User Guide to Modularization Concepts and the Ground-Water Flow Process. U.S. Geological Survey Open-File Report 00 92.

USGS (U.S. Geological Survey). 2005. UCODE_2005 and Six Other Computer Codes for Universal Sensitivity Analysis, Calibration, and Uncertainty Evaluation. Techniques and Methods 6-A11.

USGS (U.S. Geological Survey). 2006. User Guide for the Farm Process (FMP1) for the U.S. Geological Survey's Modular Three-Dimensional Finite-Difference Ground-Water Flow Model, MODFLOW-2000. Techniques and Methods 6–A17.

USGS (U.S. Geological Survey). 2009. Groundwater Availability of the Central Valley Aquifer, California. U.S. Geological Survey Professional Paper 1766. Groundwater Resources Program.

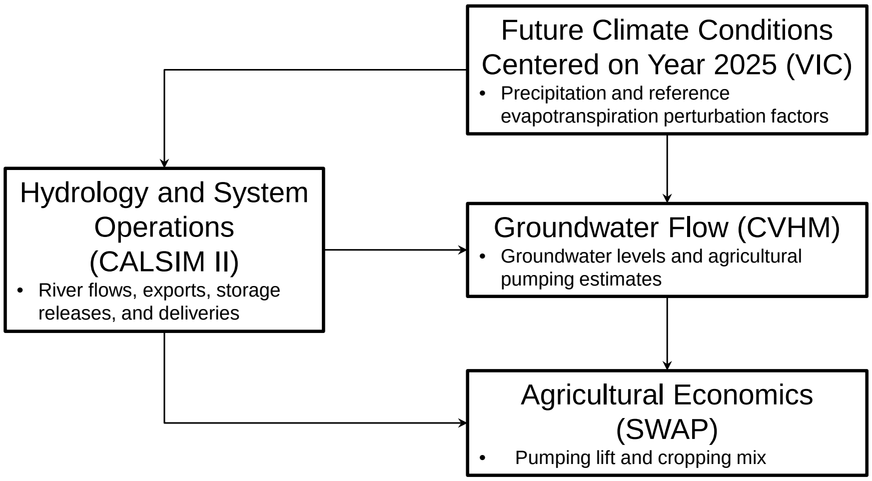


Figure 7A.1 Relationships among the Different Modeling Tools Used in the Groundwater Impacts Analysis Framework

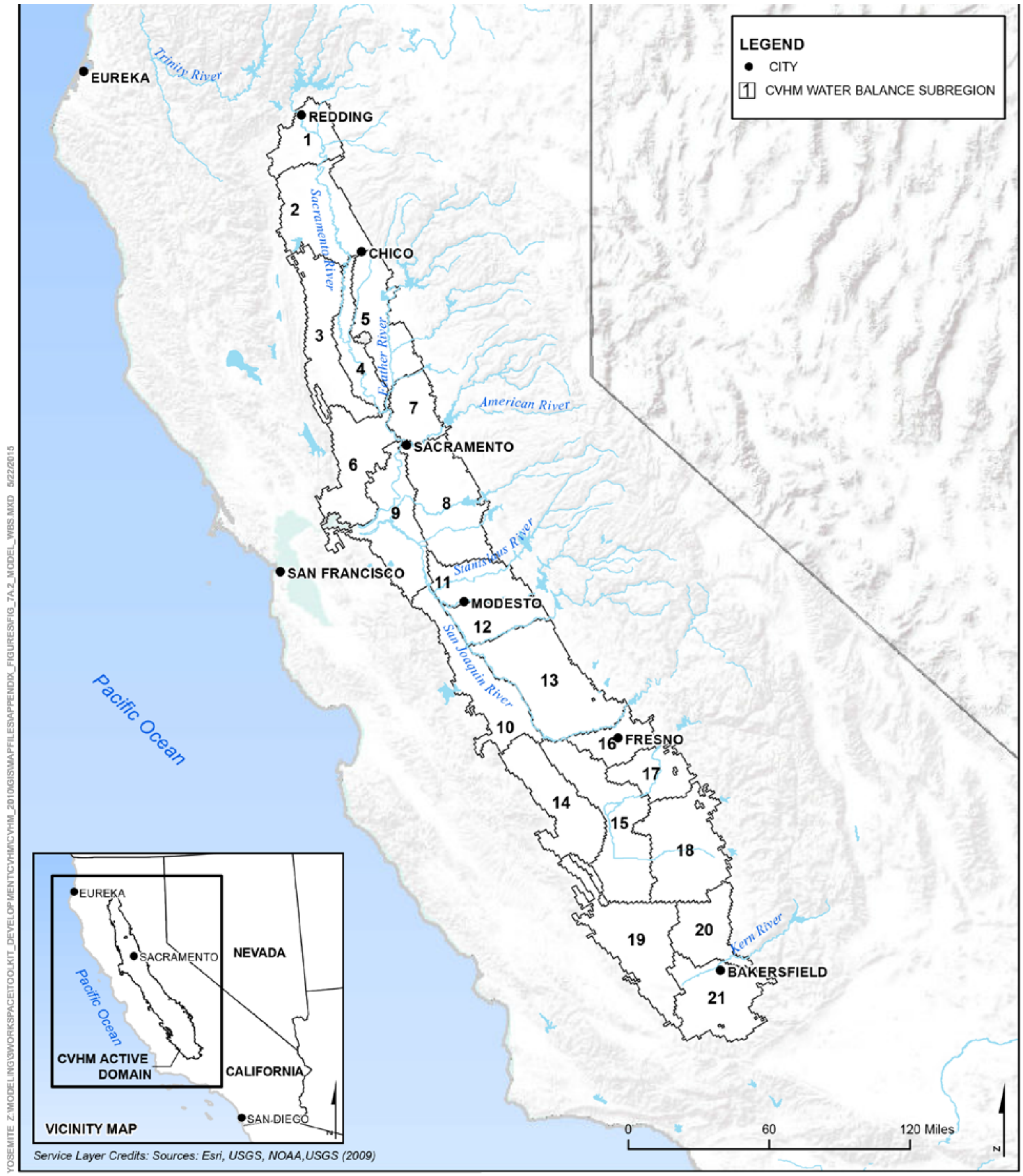


Figure 7A.2 Groundwater Model Domain and Water Balance Subregions in the Central Valley

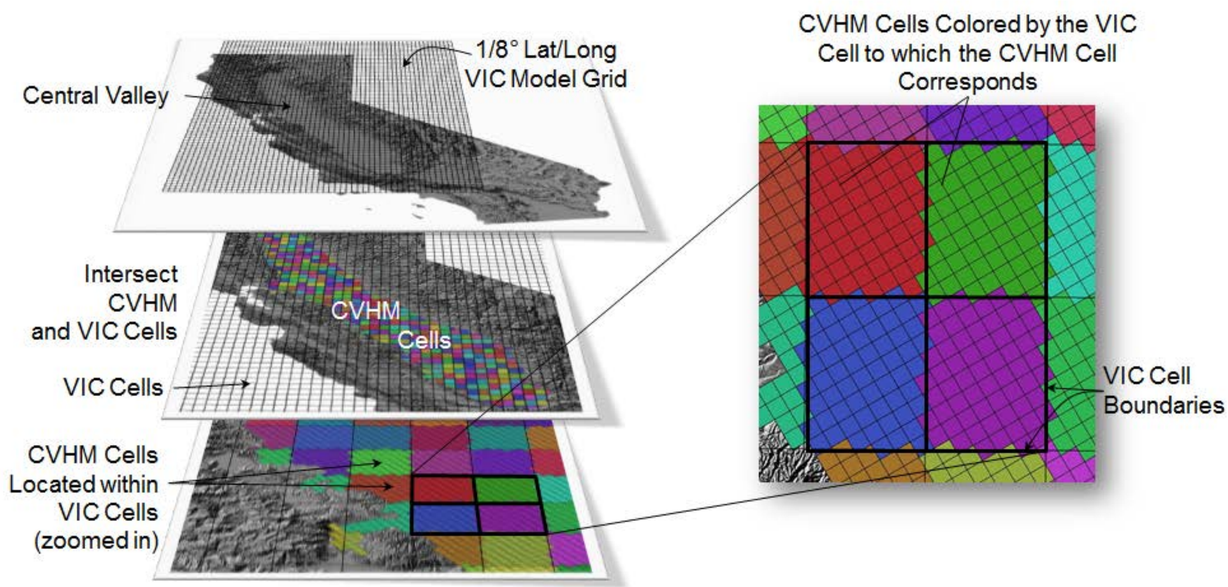


Figure 7A.3 Relationship between VIC and CVHM Grid Cells

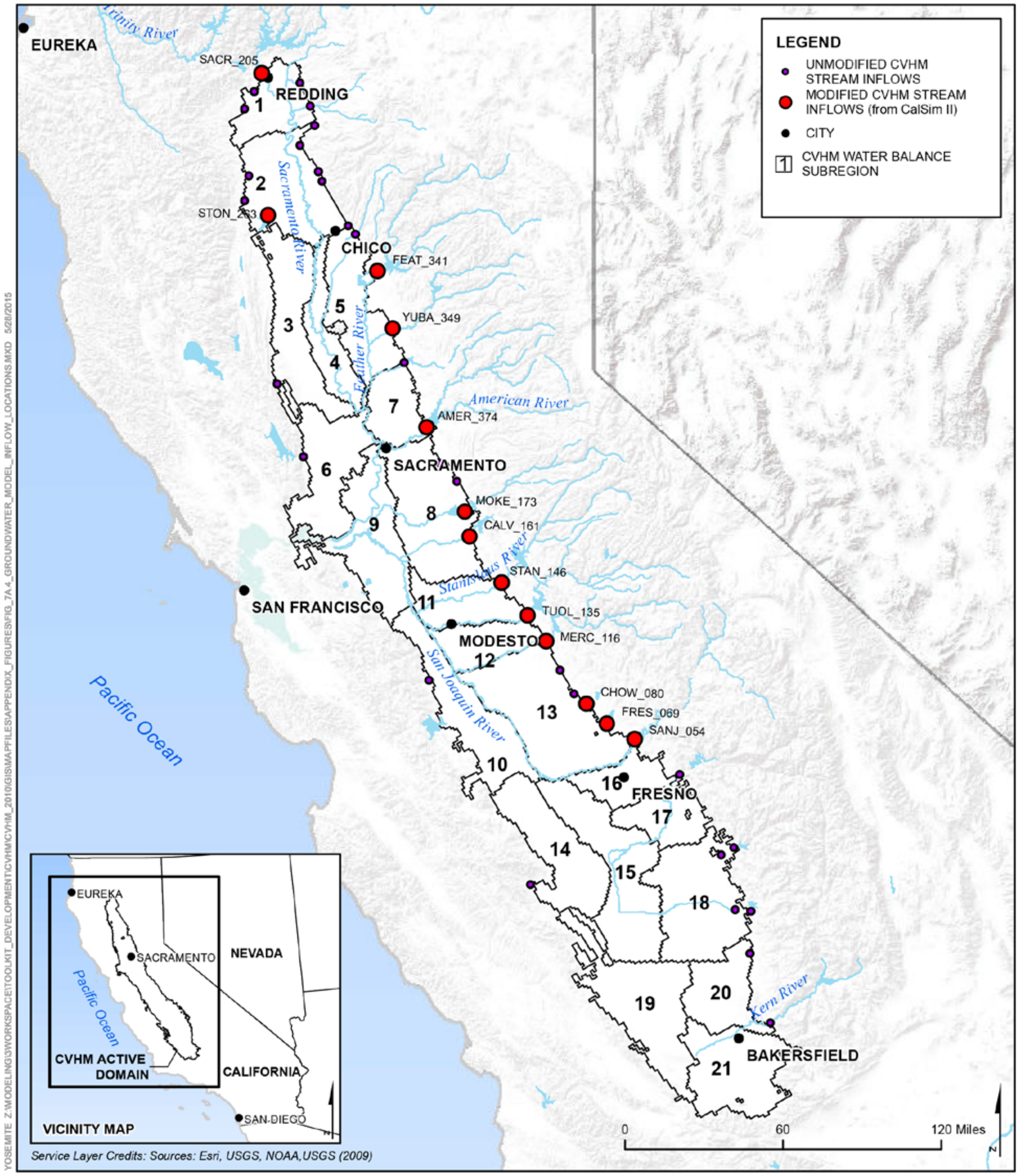


Figure 7A.4 Groundwater Model Stream Inflow Locations

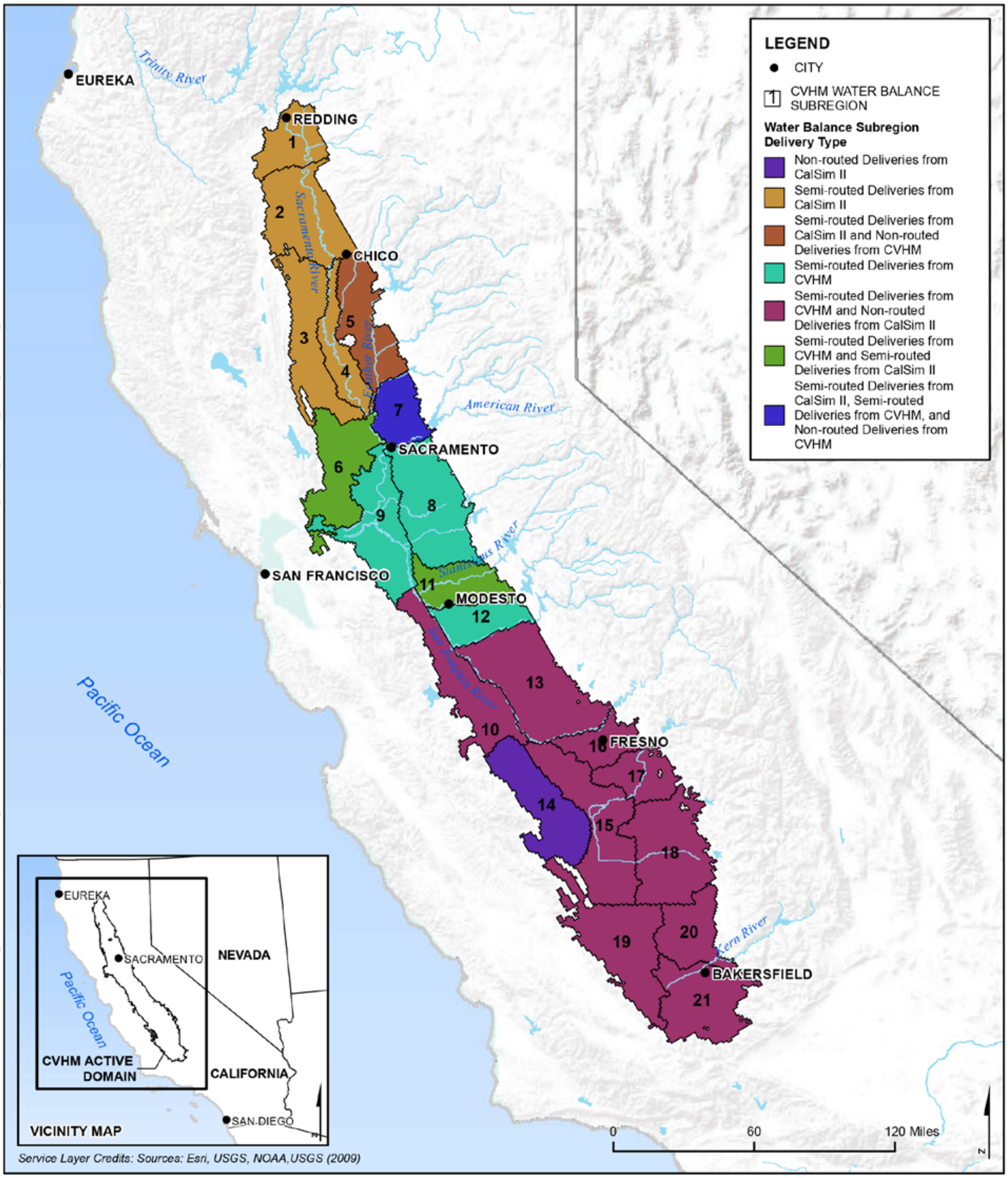


Figure 7A.5 Groundwater Model Surface Water Delivery Types by Water Balance Subregion

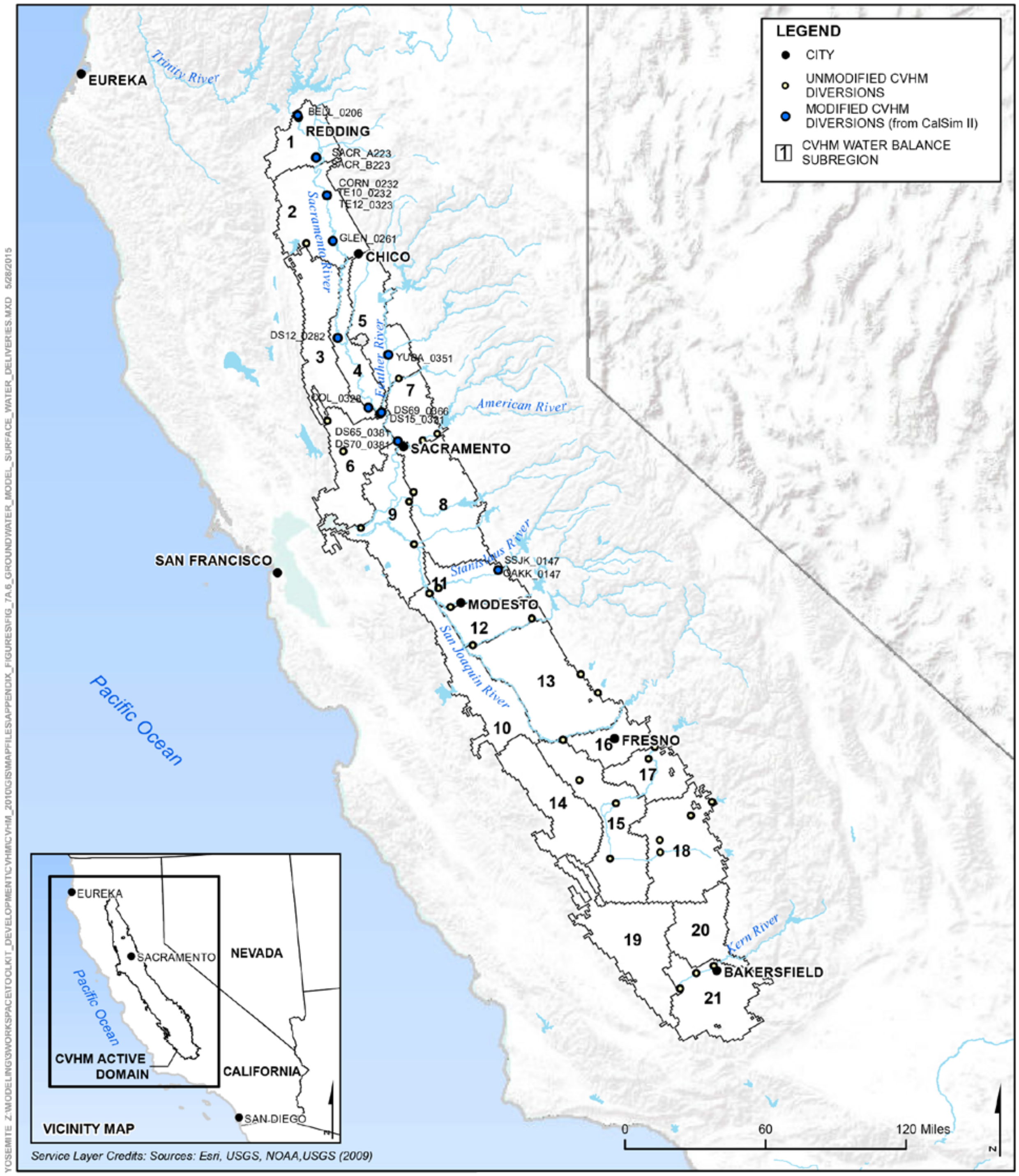


Figure 7A.6 Groundwater Model Surface Water Semi-routed Deliveries Locations

Appendix 8A

Power Model Documentation

Appendix 8A provides information about the assumptions, modeling tools, and methods used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) Environmental Consequences. The appendix also provides model result processing and interpretation methods used for the impacts analysis and descriptions. Additional information pertaining to the development of the analytical tools and the use of input data from other models, is also provided.

Appendix 8A is organized into two main sections that are briefly described below:

- Section 8A.1: Power Modeling Methodology and Assumptions
  - The power impacts analysis uses the LTGen and SWP Power spreadsheet models to assess and quantify effects of the alternatives on the long-term operations and the environment. This section provides information about the modeling approach, equations, and assumptions used by the two power models.
- Section 8A.2: Power Modeling Results
  - This section provides a detailed description of the model simulation output formats used in the analysis and interpretation of modeling results for the alternatives impacts assessment.

8A.1 Power Model Methodology and Assumptions

This section summarizes the power modeling methodology used for the EIS No Action Alternative, Second Basis of Comparison, and other alternatives. There are two spreadsheet tools that are used to estimate average annual peaking power capacity, energy generation, and energy use at CVP and SWP facilities:

- LTGen (LTGen_BenchmarkBO_04-01-2015): analyzes CVP facilities
- SWP_Power (SWP_Gen_J604_02-23-2015): analyzes SWP facilities

The sections below describe the equations that are used to estimate energy use, generation, peaking power capacity, and transmission losses.

8A.1.1 Energy Use at Pumping Facilities

Energy use at CVP and SWP pumping facilities are determined using empirical energy factors provided by the Western Area Power Authority (Western) for CVP facilities and by the Department of Water Resources (DWR) Operations Control Office (OCO) for SWP facilities. For these facilities, energy use is estimated using the following equation:

Energy Use (in Megawatt-hour [MWh]) =

*Energy_Factor * (Q in cubic feet/second)*

The tools also estimate whether user-defined off-peak energy use targets can be met. For example, if it is desired that 90 percent of required pumping energy use during a particular month occur during off-peak hours, the tools determine whether this is feasible given power and flow capacity limits.

8A.1.2 Energy Generation

Energy generation at CVP and SWP power facilities are determined using empirical energy factors provided by Western for CVP facilities and by the OCO for SWP facilities. For these facilities, energy generation is estimated using the following equation:

Energy Generation (MWh) =

*Energy_Factor * (Q in cubic feet/second)*

8A.1.3 Energy Generation

Energy generation is limited on a monthly basis by an average power capacity at each facility. At any one time, power capacity can be higher or lower, depending upon reservoir levels and scheduled water releases. Power production in general will be high during summer months when reservoir levels are higher and water is being released to meet delivery requirements, and power operations are optimized to provide the greatest benefit to taxpayers.

Average monthly power capacity for CVP facilities is estimated using empirical equations provided by Western. The approach used to estimate average monthly power capacity for SWP facilities assumes that peak capacity is a function of total head and average power plant flow. The average monthly power capacity is estimated using the following equation:

Power Capacity (in megawatt [MW]) =

(0.7457 kilowatt/horsepower)(62.4 pounds/cubic foot)*(1MW/1000 kilowatt)* (1 horsepower/(550 pounds per foot/second))*(1/η)*(Head in feet)*(Average Power Plant Flow Rate in cubic feet/second)*

8A.1.4 Transmission Losses

Transmission losses are estimated to estimate energy use and generation at load center, as a percentage of energy use or generation.

8A.1.5 Assumptions Tables

Tables 8A.1 and 8A.2 show assumptions that are used to estimate energy use and transmission losses at CVP and SWP pumping facilities. Tables 8A.3 and 8A.4 show assumptions that are used to estimate energy generation, power capacity, and transmission losses at CVP and SWP generation facilities.

8A.1.6 Flow and Storage Inputs

CalSim II results are used as flow and storage inputs for the power models for each alternative, using the entire October 1921 to September 2003 simulation period. Climate change and sea-level rise are inherently represented through CalSim II outputs. As mentioned in Appendix 5A, the CalSim II simulations do not consider future climate change adaptation that may manage the CVP and SWP system in a different manner than today to reduce climate impacts.

8A.2 Power Model Results

Power Model results were processed individually for each alternative simulation. Tables for total monthly generation capacity, energy generation, energy use, and net energy use for both the CVP and SWP are presented in this section in the following order:

- B.1. CVP Total Generating Capacity
- B.2. CVP Total Energy Generation
- B.3. CVP Total Energy Use
- B.4. CVP Net Energy Generation
- B.5. SWP Total Generating Capacity
- B.6. SWP Total Energy Generation
- B.7. SWP Total Energy Use
- B.8. SWP Net Energy Generation

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Table 8A.1. Central Valley Project Pumping Plant Characteristics

Jones Pumping Plant

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	237.5	237.5	237.5	237.5	237.5	237.5	237.5	237.5	237.5	237.5	237.5	237.5
# Units	6	6	6	6	6	6	6	6	6	6	6	6
Capacity/Unit (MW)	16	16	16	16	16	16	16	16	16	16	16	16
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%
On Peak Cap Adj Factor	1.05	1.05	1.05	1.50	1.20	2.20	1.60	2.30	1.50	1.05	1.05	1.05
Off Peak Cap Adj Factor	1.05	1.05	1.05	0.00	1.20	2.20	1.60	2.30	1.50	1.05	1.05	1.05

CVP Banks Pumping Plant

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	297	297	297	297	297	297	297	297	297	297	297	297
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	53.7%	53.7%	53.7%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	53.7%	53.7%	53.7%
On Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Off Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Contra Costa Pumping Plant

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	164.8	164.8	164.8	164.8	164.8	164.8	164.8	164.8	164.8	164.8	164.8	164.8
# Units	6	6	6	6	6	6	6	6	6	6	6	6
Capacity/Unit (MW)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Transmission Loss (%)	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	1.20	1.20	1.20	1.20	2.00	2.00
Off Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	1.20	1.20	1.20	1.20	2.00	2.00

O'Neill Pumping Plant

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2
# Units	6	6	6	6	6	6	6	6	6	6	6	6
Capacity/Unit (MW)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	48.5%	48.5%	48.5%	48.5%	48.5%	48.5%	48.5%	48.5%	48.5%	48.5%	48.5%	48.5%
On Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Off Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

CVP San Luis Pumping Plant

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	function	function	function	function	function	function	function	function	function	function	function	function
# Units	8	8	8	8	8	8	8	8	8	8	8	8
Capacity/Unit (MW)	function	function	function	function	function	function	function	function	function	function	function	function
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%
On Peak Cap Adj Factor	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Off Peak Cap Adj Factor	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50

San Felipe Pumping Plant (Pacheco)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	function	function	function	function	function	function	function	function	function	function	function	function
# Units	12	12	12	12	12	12	12	12	12	12	12	12
Capacity/Unit (MW)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.20	1.20	1.20	1.20	1.20
Off Peak Cap Adj Factor	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.20	1.20	1.20	1.20	1.20

CVP Dos Amigos Pumping Plant

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9
# Units	6	6	6	6	6	6	6	6	6	6	6	6
Capacity/Unit (MW)	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	56.6%	56.6%	56.6%	76.6%
On Peak Cap Adj Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Off Peak Cap Adj Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Folsom Pumping Plant

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	function	function	function	function	function	function	function	function	function	function	function	function
# Units	6	6	6	6	6	6	6	6	6	6	6	6
Capacity/Unit (MW)	5	5	5	5	5	5	5	5	5	5	5	5
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Off Peak Cap Adj Factor	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50

Table 8A.1. Central Valley Project Pumping Plant Characteristics

Corning Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	190	190	190	190	190	190	190	190	190	190	190	190
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Loss (%)	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	3.00	4.00	4.00	4.00	4.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00
Off Peak Cap Adj Factor	3.00	4.00	4.00	4.00	4.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00

Red Bluff Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	12	12	12	12	12	12	0	0	0	0	0	12
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Adj Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Off Peak Adj Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

San Luis Other												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Loss (%)	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.50	2.00
Off Peak Cap Adj Factor	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.50	2.00

DMC Other												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Loss (%)	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	3.00	3.00	3.00	3.00	2.50	2.00	2.00	1.50	1.50	1.50	1.50	1.50
Off Peak Cap Adj Factor	3.00	3.00	3.00	3.00	2.50	2.00	2.00	1.50	1.50	1.50	1.50	1.50

Tehama Other												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	2.00	3.00	3.00	3.00	3.00	3.00	1.50	1.50	1.50	1.50	1.50	1.50
Off Peak Cap Adj Factor	2.00	3.00	3.00	3.00	3.00	3.00	1.50	1.50	1.50	1.50	1.50	1.50

Miscellaneous Project Use												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
MW	7	5	6	6	9	11	4	5	15	23	33	9
Transmission Loss (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Percentage of Main Pumps	15.8%	9.2%	5.9%	8.0%	12.5%	13.1%	39.9%	81.1%	35.5%	43.2%	38.6%	17.9%
Percent Eng Off Peak (%)	59.1%	61.6%	67.3%	64.3%	62.0%	59.0%	52.2%	52.9%	49.1%	50.3%	49.8%	61.3%

DMC Intertie												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3
# Units	8	8	8	8	8	8	8	8	8	8	8	8
Capacity/Unit (MW)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
On Peak Cap Adj Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Off Peak Cap Adj Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 8A.2. State Water Project Pumping Plant Characteristics

Banks Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	297	297	297	297	297	297	297	297	297	297	297	297
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	53.7%	53.7%	53.7%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	53.7%	53.7%	53.7%

SWP San Luis Pumping Plant (Gianelli Pumping Plant)												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	function	function	function	function	function	function	function	function	function	function	function	function
# Units	8	8	8	8	8	8	8	8	8	8	8	8
Capacity/Unit (MW)	function	function	function	function	function	function	function	function	function	function	function	function
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%	89.7%

Dos Amigos Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9	137.9
# Units	6	6	6	6	6	6	6	6	6	6	6	6
Capacity/Unit (MW)	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Percent Eng Off Peak (%)	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	56.6%	56.6%	56.6%	76.6%

Buena Vista Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	242	242	242	242	242	242	242	242	242	242	242	242
Plant Power Rating (MW)	107.797	107.797	107.797	107.797	107.797	107.797	107.797	107.797	107.797	107.797	107.797	107.797
Transmission Loss (%)	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Teerink (Wheeler Ridge) Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	295	295	295	295	295	295	295	295	295	295	295	295
Plant Power Rating (MW)	111.9	111.9	111.9	111.9	111.9	111.9	111.9	111.9	111.9	111.9	111.9	111.9
Transmission Loss (%)	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Chrisman (Wind Gap) Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	639	639	639	639	639	639	639	639	639	639	639	639
Plant Power Rating (MW)	246.18	246.18	246.18	246.18	246.18	246.18	246.18	246.18	246.18	246.18	246.18	246.18
Transmission Loss (%)	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%	1.51%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Edmonson Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	2,236	2,236	2,236	2,236	2,236	2,236	2,236	2,236	2,236	2,236	2,236	2,236
Plant Power Rating (MW)	775.84	775.84	775.84	775.84	775.84	775.84	775.84	775.84	775.84	775.84	775.84	775.84
Transmission Loss (%)	1.64%	1.64%	1.64%	1.64%	1.64%	1.64%	1.64%	1.64%	1.64%	1.64%	1.64%	1.64%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Pearblossom Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	703	703	703	703	703	703	703	703	703	703	703	703
Plant Power Rating (MW)	151.588	151.588	151.588	151.588	151.588	151.588	151.588	151.588	151.588	151.588	151.588	151.588
Transmission Loss (%)	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Oso Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	280	280	280	280	280	280	280	280	280	280	280	280
Plant Power Rating (MW)	69.975	69.975	69.975	69.975	69.975	69.975	69.975	69.975	69.975	69.975	69.975	69.975
Transmission Loss (%)	2.34%	2.34%	2.34%	2.34%	2.34%	2.34%	2.34%	2.34%	2.34%	2.34%	2.34%	2.34%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

South Bay Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	797	797	797	797	797	797	797	797	797	797	797	797
Plant Power Rating (MW)	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69	20.69
Transmission Loss (%)	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Del Valle Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	72	72	72	72	72	72	72	72	72	72	72	72
Plant Power Rating (MW)	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.746
Transmission Loss (%)	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8A.2. State Water Project Pumping Plant Characteristics

Las Perillas Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	77	77	77	77	77	77	77	77	77	77	77	77
Plant Power Rating (MW)	3.021	3.021	3.021	3.021	3.021	3.021	3.021	3.021	3.021	3.021	3.021	3.021
Transmission Loss (%)	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Badger Hill Pumping Plant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	200	200	200	200	200	200	200	200	200	200	200	200
Plant Power Rating (MW)	8.766	8.766	8.766	8.766	8.766	8.766	8.766	8.766	8.766	8.766	8.766	8.766
Transmission Loss (%)	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%	1.32%
Percent Eng Off Peak (%)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 8A.3. Central Valley Project Powerplant Characteristics

Trinity Powerplant - Peaking Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
`	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	2	2	2	2	2	2	2	2	2	2	2	2
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Lewiston Powerplant - Baseload Operation												
	Oct	Nov	Dec	Jan	0	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	0	0	0	0	0	0	0	0	0	0	0	0
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Carr Powerplant - Peaking Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	2	2	2	2	2	2	2	2	2	2	2	2
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Spring Creek Powerplant - Peaking Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	2	2	2	2	2	2	2	2	2	2	2	2
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Shasta Powerplant - Peaking Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	5	5	5	5	5	5	5	5	5	5	5	5
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Keswick Powerplant - Baseload Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	3	3	3	3	3	3	3	3	3	3	3	3
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Folsom Powerplant - Peaking Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	3	3	3	3	3	3	3	3	3	3	3	3
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Nimbus Powerplant - Baseload Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	2	2	2	2	2	2	2	2	2	2	2	2
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

New Melones Powerplant - Peaking Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	2	2	2	2	2	2	2	2	2	2	2	2
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

CVP San Luis Powerplant - Peaking Operation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	8	8	8	8	8	8	8	8	8	8	8	8
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Share of Total Cap (%)	47.1%	47.1%	47.1%	47.1%	47.1%	47.1%	47.1%	47.1%	47.1%	47.1%	47.1%	47.1%

O'Neill Powerplant - Baseload Operation, flow computation												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	6	6	6	6	6	6	6	6	6	6	6	6
Capacity/Unit (MW)	3	3	3	3	3	3	3	3	3	3	3	3
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

Table 8A.4. State Water Project Powerplant Characteristics

Hyatt (Lake Oroville) Powerplant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Maximum Flow Capacity (cfs)	16,950	16,950	16,950	16,950	16,950	16,950	16,950	16,950	16,950	16,950	16,950	16,950
Plant Power Rating (MW)	812	812	812	812	812	812	812	812	812	812	812	812
Plant Efficiency	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

Thermalito Powerplant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Maximum Flow Capacity (cfs)	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400
Plant Power Rating (MW)	120	120	120	120	120	120	120	120	120	120	120	120
Plant Efficiency	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%	87.3%
Transmission Loss (%)	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

SWP San Luis (Gianelli Powerplant)												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Capacity/Unit (MW)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
# Units	8	8	8	8	8	8	8	8	8	8	8	8
Share of Total Cap (%)	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%	52.9%
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

AlamoPowerplant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	105	105	105	105	105	105	105	105	105	105	105	105
Maximum Flow Capacity (cfs)	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740	1,740
Plant Power Rating (MW)	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
Plant Efficiency	80.1%	80.1%	80.1%	80.1%	80.1%	80.1%	80.1%	80.1%	80.1%	80.1%	80.1%	80.1%
Transmission Loss (%)	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%

Mojave Powerplant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	95	95	95	95	95	95	95	95	95	95	95	95
Maximum Flow Capacity (cfs)	2,880	2,880	2,880	2,880	2,880	2,880	2,880	2,880	2,880	2,880	2,880	2,880
Plant Power Rating (MW)	32.90	32.90	32.90	32.90	32.90	32.90	32.90	32.90	32.90	32.90	32.90	32.90
Plant Efficiency	84.00%	84.00%	84.00%	84.00%	84.00%	84.00%	84.00%	84.00%	84.00%	84.00%	84.00%	84.00%
Transmission Loss (%)	5.93%	5.93%	5.93%	5.93%	5.93%	5.93%	5.93%	5.93%	5.93%	5.93%	5.93%	5.93%

Devil's Canyon Powerplant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113	1,113
Maximum Flow Capacity (cfs)	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940
Plant Power Rating (MW)	357.90	357.90	357.90	357.90	357.90	357.90	357.90	357.90	357.90	357.90	357.90	357.90
Plant Efficiency	82.03%	82.03%	82.03%	82.03%	82.03%	82.03%	82.03%	82.03%	82.03%	82.03%	82.03%	82.03%
Transmission Loss (%)	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%

W. E. Warner Powerplant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	573	573	573	573	573	573	573	573	573	573	573	573
Maximum Flow Capacity (cfs)	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564
Plant Power Rating (MW)	78.2	78.2	78.2	78.2	78.2	78.2	78.2	78.2	78.2	78.2	78.2	78.2
Plant Efficiency	81.4%	81.4%	81.4%	81.4%	81.4%	81.4%	81.4%	81.4%	81.4%	81.4%	81.4%	81.4%
Transmission Loss (%)	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%

Castaic Powerplant												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Energy Factor (kWh/af)	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function	Function
Maximum Flow Capacity (cfs)	17,840	17,840	17,840	17,840	17,840	17,840	17,840	17,840	17,840	17,840	17,840	17,840
Plant Power Rating (MW)	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260
Plant Efficiency	88.4%	88.4%	88.4%	88.4%	88.4%	88.4%	88.4%	88.4%	88.4%	88.4%	88.4%	88.4%
Transmission Loss (%)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

B.1. CVP Total Generating Capacity

Table B-1-1. CVP Total Capacity, Monthly Capacity

No Action Alternative

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,688	1,743	1,810	1,854	1,883	1,895	1,877	1,848	1,785	1,749	1,670	1,647
20%	1,638	1,724	1,772	1,829	1,858	1,872	1,842	1,806	1,719	1,695	1,623	1,615
30%	1,600	1,694	1,744	1,802	1,837	1,842	1,825	1,782	1,671	1,623	1,585	1,599
40%	1,579	1,635	1,710	1,776	1,811	1,812	1,793	1,736	1,634	1,583	1,545	1,553
50%	1,550	1,611	1,681	1,732	1,778	1,782	1,757	1,711	1,607	1,543	1,510	1,516
60%	1,529	1,556	1,622	1,700	1,749	1,752	1,725	1,652	1,564	1,504	1,481	1,473
70%	1,465	1,519	1,588	1,661	1,712	1,714	1,685	1,618	1,524	1,457	1,433	1,432
80%	1,354	1,428	1,521	1,584	1,666	1,675	1,637	1,578	1,440	1,353	1,332	1,342
90%	1,137	1,293	1,403	1,455	1,476	1,502	1,454	1,384	1,203	1,120	1,085	1,103
Long Term												
Full Simulation Period[b]	1,476	1,542	1,612	1,685	1,727	1,734	1,705	1,648	1,542	1,468	1,429	1,430
Water Year Types[c]												
Wet (32%)	1,621	1,696	1,761	1,824	1,860	1,877	1,859	1,831	1,753	1,717	1,645	1,628
Above Normal (16%)	1,465	1,580	1,676	1,762	1,814	1,814	1,793	1,741	1,633	1,590	1,545	1,541
Below Normal (13%)	1,530	1,580	1,669	1,719	1,764	1,757	1,728	1,665	1,559	1,491	1,478	1,483
Dry (24%)	1,441	1,491	1,556	1,637	1,690	1,709	1,680	1,607	1,508	1,434	1,418	1,433
Critical (15%)	1,180	1,221	1,264	1,348	1,374	1,355	1,299	1,205	1,025	832	808	825

Alternative 1

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,767	1,807	1,854	1,883	1,910	1,941	1,942	1,899	1,825	1,767	1,751	1,733
20%	1,731	1,790	1,829	1,862	1,891	1,923	1,907	1,856	1,739	1,676	1,669	1,677
30%	1,687	1,768	1,809	1,849	1,876	1,899	1,890	1,808	1,695	1,620	1,608	1,647
40%	1,645	1,727	1,787	1,832	1,865	1,879	1,857	1,770	1,654	1,590	1,571	1,574
50%	1,583	1,686	1,750	1,811	1,846	1,855	1,832	1,745	1,612	1,550	1,541	1,544
60%	1,561	1,629	1,710	1,768	1,811	1,831	1,788	1,701	1,584	1,509	1,487	1,488
70%	1,482	1,568	1,650	1,714	1,771	1,786	1,760	1,669	1,550	1,471	1,439	1,448
80%	1,379	1,450	1,576	1,644	1,719	1,747	1,713	1,616	1,490	1,391	1,387	1,375
90%	1,197	1,360	1,427	1,535	1,569	1,552	1,523	1,429	1,335	1,222	1,183	1,134
Long Term												
Full Simulation Period[b]	1,532	1,606	1,675	1,735	1,780	1,795	1,772	1,693	1,574	1,492	1,469	1,474
Water Year Types[c]												
Wet (32%)	1,679	1,756	1,811	1,857	1,892	1,926	1,920	1,871	1,773	1,717	1,694	1,701
Above Normal (16%)	1,522	1,652	1,747	1,810	1,856	1,877	1,860	1,778	1,653	1,584	1,567	1,564
Below Normal (13%)	1,606	1,671	1,754	1,792	1,830	1,838	1,807	1,718	1,593	1,496	1,481	1,487
Dry (24%)	1,476	1,536	1,607	1,689	1,746	1,771	1,746	1,652	1,533	1,463	1,445	1,456
Critical (15%)	1,250	1,290	1,342	1,416	1,466	1,419	1,366	1,262	1,106	948	902	904

Alternative 1 minus No Action Alternative

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	78	64	44	29	27	46	65	50	39	18	81	86
20%	92	66	57	33	33	52	64	50	20	-19	46	62
30%	87	74	66	47	39	57	65	26	24	-3	23	48
40%	66	92	76	56	54	67	64	34	20	6	27	21
50%	32	76	69	78	68	73	74	35	5	7	30	28
60%	32	73	88	68	61	79	62	49	20	6	6	16
70%	17	49	62	53	59	72	75	50	27	14	7	16
80%	25	23	55	60	53	72	75	37	51	38	55	33
90%	60	67	25	80	93	50	68	46	132	102	97	31
Long Term												
Full Simulation Period[b]	56	64	62	50	53	61	66	45	32	24	40	45
Water Year Types[c]												
Wet (32%)	58	60	50	33	32	50	60	40	20	0	48	73
Above Normal (16%)	56	72	70	48	42	63	67	36	20	-6	22	23
Below Normal (13%)	75	92	86	72	66	81	79	53	34	5	3	4
Dry (24%)	35	45	52	52	56	63	66	45	25	29	28	23
Critical (15%)	70	69	79	69	91	64	68	57	80	116	94	79

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-2. CVP Total Capacity, Monthly Capacity

No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,688	1,743	1,810	1,854	1,883	1,895	1,877	1,848	1,785	1,749	1,670	1,647
20%	1,638	1,724	1,772	1,829	1,858	1,872	1,842	1,806	1,719	1,695	1,623	1,615
30%	1,600	1,694	1,744	1,802	1,837	1,842	1,825	1,782	1,671	1,623	1,585	1,599
40%	1,579	1,635	1,710	1,776	1,811	1,812	1,793	1,736	1,634	1,583	1,545	1,553
50%	1,550	1,611	1,681	1,732	1,778	1,782	1,757	1,711	1,607	1,543	1,510	1,516
60%	1,529	1,556	1,622	1,700	1,749	1,752	1,725	1,652	1,564	1,504	1,481	1,473
70%	1,465	1,519	1,588	1,661	1,712	1,714	1,685	1,618	1,524	1,457	1,433	1,432
80%	1,354	1,428	1,521	1,584	1,666	1,675	1,637	1,578	1,440	1,353	1,332	1,342
90%	1,137	1,293	1,403	1,455	1,476	1,502	1,454	1,384	1,203	1,120	1,085	1,103
Long Term												
Full Simulation Period[b]	1,476	1,542	1,612	1,685	1,727	1,734	1,705	1,648	1,542	1,468	1,429	1,430
Water Year Types[c]												
Wet (32%)	1,621	1,696	1,761	1,824	1,860	1,877	1,859	1,831	1,753	1,717	1,645	1,628
Above Normal (16%)	1,465	1,580	1,676	1,762	1,814	1,814	1,793	1,741	1,633	1,590	1,545	1,541
Below Normal (13%)	1,530	1,580	1,669	1,719	1,764	1,757	1,728	1,665	1,559	1,491	1,478	1,483
Dry (24%)	1,441	1,491	1,556	1,637	1,690	1,709	1,680	1,607	1,508	1,434	1,418	1,433
Critical (15%)	1,180	1,221	1,264	1,348	1,374	1,355	1,299	1,205	1,025	832	808	825

Alternative 3

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,778	1,818	1,852	1,884	1,910	1,945	1,947	1,910	1,837	1,777	1,759	1,753
20%	1,749	1,789	1,828	1,860	1,894	1,930	1,930	1,883	1,766	1,692	1,687	1,696
30%	1,708	1,772	1,814	1,851	1,884	1,900	1,895	1,828	1,717	1,654	1,633	1,659
40%	1,663	1,741	1,781	1,838	1,866	1,882	1,849	1,777	1,670	1,601	1,604	1,600
50%	1,609	1,689	1,744	1,800	1,840	1,851	1,821	1,760	1,644	1,572	1,554	1,569
60%	1,579	1,639	1,695	1,748	1,797	1,814	1,781	1,711	1,603	1,542	1,511	1,510
70%	1,499	1,557	1,632	1,703	1,768	1,784	1,755	1,665	1,567	1,487	1,453	1,465
80%	1,394	1,457	1,570	1,624	1,708	1,738	1,707	1,620	1,506	1,408	1,378	1,372
90%	1,231	1,365	1,434	1,496	1,518	1,545	1,519	1,453	1,343	1,229	1,190	1,181
Long Term												
Full Simulation Period[b]	1,551	1,613	1,676	1,732	1,777	1,794	1,775	1,705	1,592	1,512	1,486	1,493
Water Year Types[c]												
Wet (32%)	1,690	1,756	1,806	1,856	1,894	1,929	1,928	1,885	1,791	1,730	1,713	1,716
Above Normal (16%)	1,527	1,640	1,746	1,802	1,852	1,875	1,862	1,786	1,679	1,615	1,591	1,589
Below Normal (13%)	1,629	1,676	1,751	1,790	1,829	1,832	1,788	1,718	1,607	1,529	1,504	1,501
Dry (24%)	1,504	1,551	1,612	1,686	1,748	1,768	1,745	1,660	1,555	1,479	1,459	1,475
Critical (15%)	1,283	1,319	1,355	1,411	1,444	1,422	1,386	1,288	1,113	967	909	930

Alternative 3 minus No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	90	76	43	30	27	50	70	62	51	28	89	106
20%	111	65	55	31	36	58	88	77	46	-3	64	81
30%	109	79	70	49	47	57	70	46	46	32	48	60
40%	84	106	70	62	54	70	56	41	36	18	60	47
50%	58	78	63	67	62	68	63	49	37	29	44	53
60%	49	83	73	48	47	62	56	59	39	38	30	37
70%	34	38	44	42	56	69	71	47	43	31	20	33
80%	39	29	49	40	42	63	69	42	66	55	46	30
90%	94	72	31	41	42	42	64	70	140	109	104	78
Long Term												
Full Simulation Period[b]	75	71	64	47	50	61	69	56	50	44	57	64
Water Year Types[c]												
Wet (32%)	69	60	45	32	34	52	68	54	37	13	68	88
Above Normal (16%)	61	60	70	40	38	62	69	45	45	25	45	48
Below Normal (13%)	99	97	82	70	65	75	60	54	49	39	26	18
Dry (24%)	63	61	57	49	58	59	66	53	46	45	42	42
Critical (15%)	103	98	92	64	70	67	87	83	88	136	101	104

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-3. CVP Total Capacity, Monthly Capacity

No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,688	1,743	1,810	1,854	1,883	1,895	1,877	1,848	1,785	1,749	1,670	1,647
20%	1,638	1,724	1,772	1,829	1,858	1,872	1,842	1,806	1,719	1,695	1,623	1,615
30%	1,600	1,694	1,744	1,802	1,837	1,842	1,825	1,782	1,671	1,623	1,585	1,599
40%	1,579	1,635	1,710	1,776	1,811	1,812	1,793	1,736	1,634	1,583	1,545	1,553
50%	1,550	1,611	1,681	1,732	1,778	1,782	1,757	1,711	1,607	1,543	1,510	1,516
60%	1,529	1,556	1,622	1,700	1,749	1,752	1,725	1,652	1,564	1,504	1,481	1,473
70%	1,465	1,519	1,588	1,661	1,712	1,714	1,685	1,618	1,524	1,457	1,433	1,432
80%	1,354	1,428	1,521	1,584	1,666	1,675	1,637	1,578	1,440	1,353	1,332	1,342
90%	1,137	1,293	1,403	1,455	1,476	1,502	1,454	1,384	1,203	1,120	1,085	1,103
Long Term												
Full Simulation Period[b]	1,476	1,542	1,612	1,685	1,727	1,734	1,705	1,648	1,542	1,468	1,429	1,430
Water Year Types[c]												
Wet (32%)	1,621	1,696	1,761	1,824	1,860	1,877	1,859	1,831	1,753	1,717	1,645	1,628
Above Normal (16%)	1,465	1,580	1,676	1,762	1,814	1,814	1,793	1,741	1,633	1,590	1,545	1,541
Below Normal (13%)	1,530	1,580	1,669	1,719	1,764	1,757	1,728	1,665	1,559	1,491	1,478	1,483
Dry (24%)	1,441	1,491	1,556	1,637	1,690	1,709	1,680	1,607	1,508	1,434	1,418	1,433
Critical (15%)	1,180	1,221	1,264	1,348	1,374	1,355	1,299	1,205	1,025	832	808	825

Alternative 5

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,693	1,746	1,805	1,849	1,882	1,891	1,879	1,849	1,777	1,748	1,671	1,650
20%	1,635	1,721	1,772	1,829	1,859	1,867	1,843	1,806	1,725	1,690	1,624	1,612
30%	1,599	1,680	1,744	1,797	1,836	1,839	1,816	1,766	1,655	1,616	1,576	1,579
40%	1,566	1,638	1,710	1,767	1,801	1,801	1,785	1,732	1,619	1,571	1,538	1,547
50%	1,538	1,596	1,668	1,726	1,775	1,774	1,737	1,700	1,598	1,555	1,504	1,510
60%	1,516	1,552	1,617	1,687	1,737	1,733	1,701	1,643	1,537	1,484	1,460	1,457
70%	1,458	1,512	1,571	1,650	1,694	1,699	1,673	1,596	1,506	1,415	1,413	1,413
80%	1,327	1,399	1,504	1,574	1,644	1,639	1,616	1,532	1,439	1,324	1,302	1,310
90%	1,044	1,242	1,372	1,427	1,440	1,483	1,450	1,351	1,173	1,061	1,046	1,029
Long Term												
Full Simulation Period[b]	1,460	1,532	1,603	1,672	1,716	1,717	1,692	1,633	1,525	1,450	1,410	1,410
Water Year Types[c]												
Wet (32%)	1,609	1,690	1,755	1,819	1,856	1,873	1,858	1,830	1,748	1,715	1,641	1,625
Above Normal (16%)	1,458	1,576	1,671	1,757	1,808	1,806	1,785	1,735	1,624	1,577	1,536	1,532
Below Normal (13%)	1,504	1,559	1,648	1,712	1,755	1,743	1,710	1,653	1,546	1,474	1,465	1,468
Dry (24%)	1,428	1,478	1,545	1,622	1,676	1,686	1,657	1,585	1,485	1,403	1,383	1,391
Critical (15%)	1,152	1,205	1,253	1,308	1,344	1,310	1,274	1,159	985	793	768	794

Alternative 5 minus No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	5	4	-5	-5	-1	-4	2	1	-8	0	0	3
20%	-4	-4	0	-1	1	-5	0	0	6	-5	1	-3
30%	-1	-14	1	-4	-1	-3	-9	-17	-16	-7	-9	-20
40%	-12	2	-1	-9	-10	-11	-8	-4	-15	-12	-6	-7
50%	-13	-15	-13	-6	-3	-8	-20	-11	-9	11	-7	-6
60%	-13	-4	-5	-13	-12	-19	-24	-9	-27	-20	-21	-15
70%	-7	-6	-17	-11	-19	-16	-11	-23	-17	-41	-20	-19
80%	-27	-29	-16	-10	-22	-36	-21	-46	-1	-29	-30	-31
90%	-93	-51	-31	-28	-36	-19	-5	-33	-29	-59	-39	-74
Long Term												
Full Simulation Period[b]	-16	-11	-10	-13	-11	-16	-13	-15	-17	-18	-19	-19
Water Year Types[c]												
Wet (32%)	-12	-5	-6	-6	-4	-4	-2	-1	-6	-2	-4	-3
Above Normal (16%)	-7	-4	-5	-5	-5	-7	-8	-6	-10	-13	-9	-9
Below Normal (13%)	-26	-21	-21	-8	-9	-14	-17	-12	-13	-16	-13	-15
Dry (24%)	-14	-12	-10	-14	-14	-23	-23	-22	-23	-30	-35	-42
Critical (15%)	-28	-17	-11	-40	-30	-46	-24	-46	-40	-39	-40	-31

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-4. CVP Total Capacity, Monthly Capacity

Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,767	1,807	1,854	1,883	1,910	1,941	1,942	1,899	1,825	1,767	1,751	1,733
20%	1,731	1,790	1,829	1,862	1,891	1,923	1,907	1,856	1,739	1,676	1,669	1,677
30%	1,687	1,768	1,809	1,849	1,876	1,899	1,890	1,808	1,695	1,620	1,608	1,647
40%	1,645	1,727	1,787	1,832	1,865	1,879	1,857	1,770	1,654	1,590	1,571	1,574
50%	1,583	1,686	1,750	1,811	1,846	1,855	1,832	1,745	1,612	1,550	1,541	1,544
60%	1,561	1,629	1,710	1,768	1,811	1,831	1,788	1,701	1,584	1,509	1,487	1,488
70%	1,482	1,568	1,650	1,714	1,771	1,786	1,760	1,669	1,550	1,471	1,439	1,448
80%	1,379	1,450	1,576	1,644	1,719	1,747	1,713	1,616	1,490	1,391	1,387	1,375
90%	1,197	1,360	1,427	1,535	1,569	1,552	1,523	1,429	1,335	1,222	1,183	1,134
Long Term												
Full Simulation Period[b]	1,532	1,606	1,675	1,735	1,780	1,795	1,772	1,693	1,574	1,492	1,469	1,474
Water Year Types[c]												
Wet (32%)	1,679	1,756	1,811	1,857	1,892	1,926	1,920	1,871	1,773	1,717	1,694	1,701
Above Normal (16%)	1,522	1,652	1,747	1,810	1,856	1,877	1,860	1,778	1,653	1,584	1,567	1,564
Below Normal (13%)	1,606	1,671	1,754	1,792	1,830	1,838	1,807	1,718	1,593	1,496	1,481	1,487
Dry (24%)	1,476	1,536	1,607	1,689	1,746	1,771	1,746	1,652	1,533	1,463	1,445	1,456
Critical (15%)	1,250	1,290	1,342	1,416	1,466	1,419	1,366	1,262	1,106	948	902	904

No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,688	1,743	1,810	1,854	1,883	1,895	1,877	1,848	1,785	1,749	1,670	1,647
20%	1,638	1,724	1,772	1,829	1,858	1,872	1,842	1,806	1,719	1,695	1,623	1,615
30%	1,600	1,694	1,744	1,802	1,837	1,842	1,825	1,782	1,671	1,623	1,585	1,599
40%	1,579	1,635	1,710	1,776	1,811	1,812	1,793	1,736	1,634	1,583	1,545	1,553
50%	1,550	1,611	1,681	1,732	1,778	1,782	1,757	1,711	1,607	1,543	1,510	1,516
60%	1,529	1,556	1,622	1,700	1,749	1,752	1,725	1,652	1,564	1,504	1,481	1,473
70%	1,465	1,519	1,588	1,661	1,712	1,714	1,685	1,618	1,524	1,457	1,433	1,432
80%	1,354	1,428	1,521	1,584	1,666	1,675	1,637	1,578	1,440	1,353	1,332	1,342
90%	1,137	1,293	1,403	1,455	1,476	1,502	1,454	1,384	1,203	1,120	1,085	1,103
Long Term												
Full Simulation Period[b]	1,476	1,542	1,612	1,685	1,727	1,734	1,705	1,648	1,542	1,468	1,429	1,430
Water Year Types[c]												
Wet (32%)	1,621	1,696	1,761	1,824	1,860	1,877	1,859	1,831	1,753	1,717	1,645	1,628
Above Normal (16%)	1,465	1,580	1,676	1,762	1,814	1,814	1,793	1,741	1,633	1,590	1,545	1,541
Below Normal (13%)	1,530	1,580	1,669	1,719	1,764	1,757	1,728	1,665	1,559	1,491	1,478	1,483
Dry (24%)	1,441	1,491	1,556	1,637	1,690	1,709	1,680	1,607	1,508	1,434	1,418	1,433
Critical (15%)	1,180	1,221	1,264	1,348	1,374	1,355	1,299	1,205	1,025	832	808	825

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-78	-64	-44	-29	-27	-46	-65	-50	-39	-18	-81	-86
20%	-92	-66	-57	-33	-33	-52	-64	-50	-20	19	-46	-62
30%	-87	-74	-66	-47	-39	-57	-65	-26	-24	3	-23	-48
40%	-66	-92	-76	-56	-54	-67	-64	-34	-20	-6	-27	-21
50%	-32	-76	-69	-78	-68	-73	-74	-35	-5	-7	-30	-28
60%	-32	-73	-88	-68	-61	-79	-62	-49	-20	-6	-6	-16
70%	-17	-49	-62	-53	-59	-72	-75	-50	-27	-14	-7	-16
80%	-25	-23	-55	-60	-53	-72	-75	-37	-51	-38	-55	-33
90%	-60	-67	-25	-80	-93	-50	-68	-46	-132	-102	-97	-31
Long Term												
Full Simulation Period[b]	-56	-64	-62	-50	-53	-61	-66	-45	-32	-24	-40	-45
Water Year Types[c]												
Wet (32%)	-58	-60	-50	-33	-32	-50	-60	-40	-20	0	-48	-73
Above Normal (16%)	-56	-72	-70	-48	-42	-63	-67	-36	-20	6	-22	-23
Below Normal (13%)	-75	-92	-86	-72	-66	-81	-79	-53	-34	-5	-3	-4
Dry (24%)	-35	-45	-52	-52	-56	-63	-66	-45	-25	-29	-28	-23
Critical (15%)	-70	-69	-79	-69	-91	-64	-68	-57	-80	-116	-94	-79

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-5. CVP Total Capacity, Monthly Capacity

Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,767	1,807	1,854	1,883	1,910	1,941	1,942	1,899	1,825	1,767	1,751	1,733
20%	1,731	1,790	1,829	1,862	1,891	1,923	1,907	1,856	1,739	1,676	1,669	1,677
30%	1,687	1,768	1,809	1,849	1,876	1,899	1,890	1,808	1,695	1,620	1,608	1,647
40%	1,645	1,727	1,787	1,832	1,865	1,879	1,857	1,770	1,654	1,590	1,571	1,574
50%	1,583	1,686	1,750	1,811	1,846	1,855	1,832	1,745	1,612	1,550	1,541	1,544
60%	1,561	1,629	1,710	1,768	1,811	1,831	1,788	1,701	1,584	1,509	1,487	1,488
70%	1,482	1,568	1,650	1,714	1,771	1,786	1,760	1,669	1,550	1,471	1,439	1,448
80%	1,379	1,450	1,576	1,644	1,719	1,747	1,713	1,616	1,490	1,391	1,387	1,375
90%	1,197	1,360	1,427	1,535	1,569	1,552	1,523	1,429	1,335	1,222	1,183	1,134
Long Term												
Full Simulation Period[b]	1,532	1,606	1,675	1,735	1,780	1,795	1,772	1,693	1,574	1,492	1,469	1,474
Water Year Types[c]												
Wet (32%)	1,679	1,756	1,811	1,857	1,892	1,926	1,920	1,871	1,773	1,717	1,694	1,701
Above Normal (16%)	1,522	1,652	1,747	1,810	1,856	1,877	1,860	1,778	1,653	1,584	1,567	1,564
Below Normal (13%)	1,606	1,671	1,754	1,792	1,830	1,838	1,807	1,718	1,593	1,496	1,481	1,487
Dry (24%)	1,476	1,536	1,607	1,689	1,746	1,771	1,746	1,652	1,533	1,463	1,445	1,456
Critical (15%)	1,250	1,290	1,342	1,416	1,466	1,419	1,366	1,262	1,106	948	902	904

Alternative 3

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,778	1,818	1,852	1,884	1,910	1,945	1,947	1,910	1,837	1,777	1,759	1,753
20%	1,749	1,789	1,828	1,860	1,894	1,930	1,930	1,883	1,766	1,692	1,687	1,696
30%	1,708	1,772	1,814	1,851	1,884	1,900	1,895	1,828	1,717	1,654	1,633	1,659
40%	1,663	1,741	1,781	1,838	1,866	1,882	1,849	1,777	1,670	1,601	1,604	1,600
50%	1,609	1,689	1,744	1,800	1,840	1,851	1,821	1,760	1,644	1,572	1,554	1,569
60%	1,579	1,639	1,695	1,748	1,797	1,814	1,781	1,711	1,603	1,542	1,511	1,510
70%	1,499	1,557	1,632	1,703	1,768	1,784	1,755	1,665	1,567	1,487	1,453	1,465
80%	1,394	1,457	1,570	1,624	1,708	1,738	1,707	1,620	1,506	1,408	1,378	1,372
90%	1,231	1,365	1,434	1,496	1,518	1,545	1,519	1,453	1,343	1,229	1,190	1,181
Long Term												
Full Simulation Period[b]	1,551	1,613	1,676	1,732	1,777	1,794	1,775	1,705	1,592	1,512	1,486	1,493
Water Year Types[c]												
Wet (32%)	1,690	1,756	1,806	1,856	1,894	1,929	1,928	1,885	1,791	1,730	1,713	1,716
Above Normal (16%)	1,527	1,640	1,746	1,802	1,852	1,875	1,862	1,786	1,679	1,615	1,591	1,589
Below Normal (13%)	1,629	1,676	1,751	1,790	1,829	1,832	1,788	1,718	1,607	1,529	1,504	1,501
Dry (24%)	1,504	1,551	1,612	1,686	1,748	1,768	1,745	1,660	1,555	1,479	1,459	1,475
Critical (15%)	1,283	1,319	1,355	1,411	1,444	1,422	1,386	1,288	1,113	967	909	930

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	12	12	-2	1	-1	5	5	11	12	10	8	20
20%	18	-2	-2	-2	3	7	24	27	27	16	18	19
30%	22	5	5	3	8	0	5	20	23	35	25	12
40%	18	14	-6	5	0	3	-7	7	16	11	33	26
50%	26	3	-6	-11	-6	-4	-11	14	31	22	14	25
60%	17	9	-15	-20	-14	-17	-7	10	19	32	24	21
70%	17	-11	-18	-10	-3	-3	-4	-4	17	17	13	17
80%	14	7	-6	-20	-11	-9	-6	5	15	17	-9	-3
90%	34	5	7	-40	-51	-8	-4	24	8	7	7	47
Long Term												
Full Simulation Period[b]	19	7	1	-3	-2	-1	3	12	18	20	17	19
Water Year Types[c]												
Wet (32%)	11	0	-5	-1	3	3	8	14	17	13	19	15
Above Normal (16%)	5	-11	-1	-7	-4	-2	1	8	25	31	23	24
Below Normal (13%)	23	5	-3	-2	-2	-6	-19	1	14	34	23	14
Dry (24%)	28	15	5	-3	3	-3	0	9	22	16	14	19
Critical (15%)	33	29	13	-5	-22	3	20	26	7	19	7	26

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-6. CVP Total Capacity, Monthly Capacity

Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,767	1,807	1,854	1,883	1,910	1,941	1,942	1,899	1,825	1,767	1,751	1,733
20%	1,731	1,790	1,829	1,862	1,891	1,923	1,907	1,856	1,739	1,676	1,669	1,677
30%	1,687	1,768	1,809	1,849	1,876	1,899	1,890	1,808	1,695	1,620	1,608	1,647
40%	1,645	1,727	1,787	1,832	1,865	1,879	1,857	1,770	1,654	1,590	1,571	1,574
50%	1,583	1,686	1,750	1,811	1,846	1,855	1,832	1,745	1,612	1,550	1,541	1,544
60%	1,561	1,629	1,710	1,768	1,811	1,831	1,788	1,701	1,584	1,509	1,487	1,488
70%	1,482	1,568	1,650	1,714	1,771	1,786	1,760	1,669	1,550	1,471	1,439	1,448
80%	1,379	1,450	1,576	1,644	1,719	1,747	1,713	1,616	1,490	1,391	1,387	1,375
90%	1,197	1,360	1,427	1,535	1,569	1,552	1,523	1,429	1,335	1,222	1,183	1,134
Long Term												
Full Simulation Period[b]	1,532	1,606	1,675	1,735	1,780	1,795	1,772	1,693	1,574	1,492	1,469	1,474
Water Year Types[c]												
Wet (32%)	1,679	1,756	1,811	1,857	1,892	1,926	1,920	1,871	1,773	1,717	1,694	1,701
Above Normal (16%)	1,522	1,652	1,747	1,810	1,856	1,877	1,860	1,778	1,653	1,584	1,567	1,564
Below Normal (13%)	1,606	1,671	1,754	1,792	1,830	1,838	1,807	1,718	1,593	1,496	1,481	1,487
Dry (24%)	1,476	1,536	1,607	1,689	1,746	1,771	1,746	1,652	1,533	1,463	1,445	1,456
Critical (15%)	1,250	1,290	1,342	1,416	1,466	1,419	1,366	1,262	1,106	948	902	904

Alternative 5

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,693	1,746	1,805	1,849	1,882	1,891	1,879	1,849	1,777	1,748	1,671	1,650
20%	1,635	1,721	1,772	1,829	1,859	1,867	1,843	1,806	1,725	1,690	1,624	1,612
30%	1,599	1,680	1,744	1,797	1,836	1,839	1,816	1,766	1,655	1,616	1,576	1,579
40%	1,566	1,638	1,710	1,767	1,801	1,801	1,785	1,732	1,619	1,571	1,538	1,547
50%	1,538	1,596	1,668	1,726	1,775	1,774	1,737	1,700	1,598	1,555	1,504	1,510
60%	1,516	1,552	1,617	1,687	1,737	1,733	1,701	1,643	1,537	1,484	1,460	1,457
70%	1,458	1,512	1,571	1,650	1,694	1,699	1,673	1,596	1,506	1,415	1,413	1,413
80%	1,327	1,399	1,504	1,574	1,644	1,639	1,616	1,532	1,439	1,324	1,302	1,310
90%	1,044	1,242	1,372	1,427	1,440	1,483	1,450	1,351	1,173	1,061	1,046	1,029
Long Term												
Full Simulation Period[b]	1,460	1,532	1,603	1,672	1,716	1,717	1,692	1,633	1,525	1,450	1,410	1,410
Water Year Types[c]												
Wet (32%)	1,609	1,690	1,755	1,819	1,856	1,873	1,858	1,830	1,748	1,715	1,641	1,625
Above Normal (16%)	1,458	1,576	1,671	1,757	1,808	1,806	1,785	1,735	1,624	1,577	1,536	1,532
Below Normal (13%)	1,504	1,559	1,648	1,712	1,755	1,743	1,710	1,653	1,546	1,474	1,465	1,468
Dry (24%)	1,428	1,478	1,545	1,622	1,676	1,686	1,657	1,585	1,485	1,403	1,383	1,391
Critical (15%)	1,152	1,205	1,253	1,308	1,344	1,310	1,274	1,159	985	793	768	794

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-74	-61	-49	-34	-28	-50	-63	-49	-48	-18	-81	-84
20%	-96	-70	-57	-33	-32	-56	-64	-50	-14	14	-44	-65
30%	-88	-88	-65	-51	-40	-60	-75	-43	-40	-4	-32	-68
40%	-79	-89	-77	-65	-64	-78	-72	-39	-35	-19	-33	-27
50%	-45	-90	-82	-84	-72	-81	-95	-46	-15	5	-37	-34
60%	-45	-77	-93	-81	-73	-98	-87	-58	-47	-26	-27	-31
70%	-24	-55	-79	-64	-78	-88	-86	-73	-44	-55	-27	-35
80%	-52	-51	-72	-70	-75	-108	-97	-84	-51	-67	-85	-64
90%	-153	-118	-56	-108	-129	-69	-73	-79	-161	-161	-136	-106
Long Term												
Full Simulation Period[b]	-72	-74	-72	-63	-64	-78	-80	-60	-48	-42	-59	-64
Water Year Types[c]												
Wet (32%)	-70	-65	-56	-38	-36	-53	-62	-41	-26	-2	-53	-76
Above Normal (16%)	-64	-75	-76	-53	-47	-70	-75	-43	-30	-8	-31	-32
Below Normal (13%)	-101	-113	-107	-80	-75	-95	-96	-65	-47	-22	-16	-19
Dry (24%)	-48	-58	-62	-67	-70	-86	-89	-66	-48	-60	-62	-66
Critical (15%)	-97	-85	-89	-109	-121	-110	-92	-103	-121	-155	-133	-110

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

B.2. CVP Total Energy Generation

Table B-2-1. CVP Total Generation, Monthly Generation

No Action Alternative

	Monthly Generation (GWh)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	409	413	641	689	671	696	492	616	619	756	585	630
20%	372	380	338	490	622	569	397	549	577	729	549	597
30%	329	310	240	381	471	363	358	514	561	705	536	469
40%	292	274	190	235	245	267	334	478	544	662	511	414
50%	270	231	175	201	205	229	318	464	527	644	496	342
60%	239	183	167	179	173	194	302	442	495	630	476	285
70%	210	162	146	152	141	171	282	415	479	598	451	250
80%	186	140	131	137	130	151	249	350	435	551	421	215
90%	159	118	105	120	110	141	217	291	350	474	359	184
Long Term												
Full Simulation Period[b]	273	255	260	317	322	329	343	461	514	631	487	376
Water Year Types[c]												
Wet (32%)	317	318	441	558	513	557	447	580	568	683	542	598
Above Normal (16%)	268	263	259	320	454	367	370	484	544	708	527	421
Below Normal (13%)	310	258	175	186	266	220	318	455	540	679	529	289
Dry (24%)	254	232	154	183	145	183	263	406	511	607	457	246
Critical (15%)	184	149	123	134	111	135	242	271	345	431	333	145

Alternative 1

	Monthly Generation (GWh)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	415	295	659	692	684	702	486	626	696	779	637	441
20%	339	256	436	584	637	584	393	572	655	757	588	370
30%	303	233	242	439	446	357	350	535	623	732	569	334
40%	268	220	194	266	287	256	325	507	602	711	549	315
50%	236	204	182	211	220	232	313	493	577	683	525	297
60%	212	180	169	177	175	194	289	470	553	654	501	278
70%	201	168	148	156	141	177	276	445	530	627	477	258
80%	172	138	134	143	133	154	248	372	481	571	436	225
90%	152	125	112	121	115	141	217	318	390	470	389	186
Long Term												
Full Simulation Period[b]	256	215	278	336	331	334	334	481	569	655	514	305
Water Year Types[c]												
Wet (32%)	297	269	491	582	521	549	428	586	636	697	573	399
Above Normal (16%)	245	215	245	362	479	396	341	513	618	740	571	341
Below Normal (13%)	282	221	188	231	280	246	323	496	612	724	575	306
Dry (24%)	243	183	158	179	150	181	262	433	542	637	463	251
Critical (15%)	180	145	134	134	107	140	253	286	376	442	357	154

Alternative 1 minus No Action Alternative

	Monthly Generation (GWh)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	6	-118	18	2	14	6	-6	9	77	23	52	-189
20%	-33	-124	98	94	16	14	-5	22	78	28	38	-227
30%	-25	-77	2	58	-25	-6	-8	21	62	27	33	-135
40%	-24	-55	4	30	41	-11	-9	29	58	49	38	-99
50%	-34	-27	7	11	15	3	-5	29	49	39	29	-45
60%	-28	-3	2	-2	2	0	-13	28	58	24	25	-7
70%	-9	6	2	4	0	7	-7	30	51	29	26	8
80%	-14	-3	3	5	3	3	-1	22	46	20	15	9
90%	-7	7	7	1	5	0	1	27	40	-5	30	2
Long Term												
Full Simulation Period[b]	-17	-40	18	19	9	6	-9	21	55	24	28	-71
Water Year Types[c]												
Wet (32%)	-20	-49	50	24	8	-8	-19	5	67	14	31	-199
Above Normal (16%)	-23	-47	-15	43	26	28	-29	30	74	33	43	-80
Below Normal (13%)	-28	-37	12	45	14	26	5	41	73	45	47	16
Dry (24%)	-11	-49	4	-4	5	-2	-1	27	31	29	6	5
Critical (15%)	-4	-4	11	1	-4	5	11	15	31	11	24	9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-2. CVP Total Generation, Monthly Generation

No Action Alternative

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	409	413	641	689	671	696	492	616	619	756	585	630
20%	372	380	338	490	622	569	397	549	577	729	549	597
30%	329	310	240	381	471	363	358	514	561	705	536	469
40%	292	274	190	235	245	267	334	478	544	662	511	414
50%	270	231	175	201	205	229	318	464	527	644	496	342
60%	239	183	167	179	173	194	302	442	495	630	476	285
70%	210	162	146	152	141	171	282	415	479	598	451	250
80%	186	140	131	137	130	151	249	350	435	551	421	215
90%	159	118	105	120	110	141	217	291	350	474	359	184
Long Term												
Full Simulation Period[b]	273	255	260	317	322	329	343	461	514	631	487	376
Water Year Types[c]												
Wet (32%)	317	318	441	558	513	557	447	580	568	683	542	598
Above Normal (16%)	268	263	259	320	454	367	370	484	544	708	527	421
Below Normal (13%)	310	258	175	186	266	220	318	455	540	679	529	289
Dry (24%)	254	232	154	183	145	183	263	406	511	607	457	246
Critical (15%)	184	149	123	134	111	135	242	271	345	431	333	145

Alternative 3

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	415	306	662	691	701	710	489	598	648	775	610	459
20%	342	256	426	590	650	583	393	551	635	759	578	387
30%	314	227	242	427	458	367	360	507	590	741	557	358
40%	275	216	199	254	283	258	330	493	564	720	538	328
50%	245	204	181	203	220	223	314	469	548	678	525	302
60%	222	180	170	173	179	192	291	442	518	657	513	279
70%	202	164	149	156	142	171	271	421	511	624	482	257
80%	176	145	133	134	128	153	250	363	453	561	445	227
90%	158	124	113	122	109	136	222	300	381	474	387	191
Long Term												
Full Simulation Period[b]	262	215	279	333	336	335	338	462	542	658	512	314
Water Year Types[c]												
Wet (32%)	298	268	493	584	537	551	430	562	593	712	576	407
Above Normal (16%)	249	222	245	350	477	401	346	482	580	736	550	341
Below Normal (13%)	284	211	187	228	283	245	332	476	580	711	557	347
Dry (24%)	256	184	162	175	146	180	265	416	532	635	471	251
Critical (15%)	189	150	132	130	113	139	253	285	373	445	360	160

Alternative 3 minus No Action Alternative

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	6	-107	21	2	31	14	-3	-19	30	19	25	-171
20%	-29	-124	88	100	29	14	-4	1	58	30	29	-210
30%	-14	-83	3	46	-13	4	3	-7	29	36	21	-111
40%	-18	-58	9	18	37	-8	-4	15	20	58	27	-85
50%	-25	-27	6	3	15	-7	-5	5	21	34	29	-40
60%	-17	-3	3	-6	6	-1	-10	-1	23	27	36	-6
70%	-8	2	3	4	0	0	-11	6	32	25	32	7
80%	-11	4	2	-3	-2	2	0	12	18	11	24	11
90%	-1	6	9	2	-1	-5	5	9	31	-1	27	7
Long Term												
Full Simulation Period[b]	-11	-40	19	17	14	7	-5	1	28	27	26	-62
Water Year Types[c]												
Wet (32%)	-19	-50	53	27	23	-6	-17	-18	24	29	34	-191
Above Normal (16%)	-18	-41	-14	30	24	33	-24	-1	36	29	23	-80
Below Normal (13%)	-25	-47	12	42	18	25	14	21	40	32	28	58
Dry (24%)	2	-47	8	-7	1	-2	2	10	21	28	14	5
Critical (15%)	6	1	9	-4	1	4	11	14	28	14	28	14

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-3. CVP Total Generation, Monthly Generation

No Action Alternative

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	409	413	641	689	671	696	492	616	619	756	585	630
20%	372	380	338	490	622	569	397	549	577	729	549	597
30%	329	310	240	381	471	363	358	514	561	705	536	469
40%	292	274	190	235	245	267	334	478	544	662	511	414
50%	270	231	175	201	205	229	318	464	527	644	496	342
60%	239	183	167	179	173	194	302	442	495	630	476	285
70%	210	162	146	152	141	171	282	415	479	598	451	250
80%	186	140	131	137	130	151	249	350	435	551	421	215
90%	159	118	105	120	110	141	217	291	350	474	359	184
Long Term												
Full Simulation Period[b]	273	255	260	317	322	329	343	461	514	631	487	376
Water Year Types[c]												
Wet (32%)	317	318	441	558	513	557	447	580	568	683	542	598
Above Normal (16%)	268	263	259	320	454	367	370	484	544	708	527	421
Below Normal (13%)	310	258	175	186	266	220	318	455	540	679	529	289
Dry (24%)	254	232	154	183	145	183	263	406	511	607	457	246
Critical (15%)	184	149	123	134	111	135	242	271	345	431	333	145

Alternative 5

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	404	410	647	689	671	694	491	627	618	752	574	628
20%	365	380	341	486	622	563	404	562	578	722	553	598
30%	328	316	236	381	459	362	368	513	557	705	534	468
40%	284	281	188	233	245	266	334	482	541	660	514	418
50%	269	226	173	201	205	229	327	460	525	648	498	351
60%	244	182	163	178	173	199	304	439	493	634	471	277
70%	220	161	145	153	139	170	281	412	472	601	451	248
80%	183	140	131	137	127	151	258	343	432	548	416	217
90%	155	113	102	120	108	136	233	308	350	463	365	184
Long Term												
Full Simulation Period[b]	273	254	258	317	321	328	348	463	509	628	485	378
Water Year Types[c]												
Wet (32%)	313	320	438	558	512	554	446	585	567	685	538	598
Above Normal (16%)	266	254	259	321	454	368	370	489	542	708	523	419
Below Normal (13%)	307	257	173	186	265	221	334	458	533	675	520	294
Dry (24%)	254	231	153	183	145	183	273	404	505	604	459	247
Critical (15%)	192	149	120	135	110	132	250	270	336	414	337	153

Alternative 5 minus No Action Alternative

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-5	-3	6	0	0	-2	-1	10	-1	-4	-11	-1
20%	-6	0	3	-4	0	-6	7	13	1	-6	4	1
30%	-1	6	-3	0	-13	-1	10	-1	-4	0	-2	-1
40%	-8	6	-2	-2	0	-1	0	5	-3	-2	3	4
50%	-1	-5	-2	0	0	0	9	-4	-2	3	2	9
60%	4	-1	-4	0	0	5	2	-3	-2	4	-5	-8
70%	11	-1	-1	1	-3	0	-2	-3	-7	2	1	-2
80%	-3	-1	0	0	-3	0	9	-7	-3	-3	-5	1
90%	-4	-5	-2	0	-2	-5	16	17	0	-12	6	0
Long Term												
Full Simulation Period[b]	-1	-1	-2	1	-1	-1	5	2	-5	-3	-2	2
Water Year Types[c]												
Wet (32%)	-4	2	-3	1	-1	-3	-1	5	-1	2	-4	1
Above Normal (16%)	-2	-8	-1	1	0	1	-1	5	-2	0	-5	-2
Below Normal (13%)	-3	-1	-2	-1	-1	1	15	3	-7	-4	-9	4
Dry (24%)	-1	-1	-1	0	0	0	9	-2	-6	-3	2	1
Critical (15%)	8	0	-3	1	-1	-3	8	-1	-9	-17	4	8

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-4. CVP Total Generation, Monthly Generation

Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	415	295	659	692	684	702	486	626	696	779	637	441
20%	339	256	436	584	637	584	393	572	655	757	588	370
30%	303	233	242	439	446	357	350	535	623	732	569	334
40%	268	220	194	266	287	256	325	507	602	711	549	315
50%	236	204	182	211	220	232	313	493	577	683	525	297
60%	212	180	169	177	175	194	289	470	553	654	501	278
70%	201	168	148	156	141	177	276	445	530	627	477	258
80%	172	138	134	143	133	154	248	372	481	571	436	225
90%	152	125	112	121	115	141	217	318	390	470	389	186
Long Term												
Full Simulation Period[b]	256	215	278	336	331	334	334	481	569	655	514	305
Water Year Types[c]												
Wet (32%)	297	269	491	582	521	549	428	586	636	697	573	399
Above Normal (16%)	245	215	245	362	479	396	341	513	618	740	571	341
Below Normal (13%)	282	221	188	231	280	246	323	496	612	724	575	306
Dry (24%)	243	183	158	179	150	181	262	433	542	637	463	251
Critical (15%)	180	145	134	134	107	140	253	286	376	442	357	154

No Action Alternative

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	409	413	641	689	671	696	492	616	619	756	585	630
20%	372	380	338	490	622	569	397	549	577	729	549	597
30%	329	310	240	381	471	363	358	514	561	705	536	469
40%	292	274	190	235	245	267	334	478	544	662	511	414
50%	270	231	175	201	205	229	318	464	527	644	496	342
60%	239	183	167	179	173	194	302	442	495	630	476	285
70%	210	162	146	152	141	171	282	415	479	598	451	250
80%	186	140	131	137	130	151	249	350	435	551	421	215
90%	159	118	105	120	110	141	217	291	350	474	359	184
Long Term												
Full Simulation Period[b]	273	255	260	317	322	329	343	461	514	631	487	376
Water Year Types[c]												
Wet (32%)	317	318	441	558	513	557	447	580	568	683	542	598
Above Normal (16%)	268	263	259	320	454	367	370	484	544	708	527	421
Below Normal (13%)	310	258	175	186	266	220	318	455	540	679	529	289
Dry (24%)	254	232	154	183	145	183	263	406	511	607	457	246
Critical (15%)	184	149	123	134	111	135	242	271	345	431	333	145

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-6	118	-18	-2	-14	-6	6	-9	-77	-23	-52	189
20%	33	124	-98	-94	-16	-14	5	-22	-78	-28	-38	227
30%	25	77	-2	-58	25	6	8	-21	-62	-27	-33	135
40%	24	55	-4	-30	-41	11	9	-29	-58	-49	-38	99
50%	34	27	-7	-11	-15	-3	5	-29	-49	-39	-29	45
60%	28	3	-2	2	-2	0	13	-28	-58	-24	-25	7
70%	9	-6	-2	-4	0	-7	7	-30	-51	-29	-26	-8
80%	14	3	-3	-5	-3	-3	1	-22	-46	-20	-15	-9
90%	7	-7	-7	-1	-5	0	-1	-27	-40	5	-30	-2
Long Term												
Full Simulation Period[b]	17	40	-18	-19	-9	-6	9	-21	-55	-24	-28	71
Water Year Types[c]												
Wet (32%)	20	49	-50	-24	-8	8	19	-5	-67	-14	-31	199
Above Normal (16%)	23	47	15	-43	-26	-28	29	-30	-74	-33	-43	80
Below Normal (13%)	28	37	-12	-45	-14	-26	-5	-41	-73	-45	-47	-16
Dry (24%)	11	49	-4	4	-5	2	1	-27	-31	-29	-6	-5
Critical (15%)	4	4	-11	-1	4	-5	-11	-15	-31	-11	-24	-9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-5. CVP Total Generation, Monthly Generation

Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	415	295	659	692	684	702	486	626	696	779	637	441
20%	339	256	436	584	637	584	393	572	655	757	588	370
30%	303	233	242	439	446	357	350	535	623	732	569	334
40%	268	220	194	266	287	256	325	507	602	711	549	315
50%	236	204	182	211	220	232	313	493	577	683	525	297
60%	212	180	169	177	175	194	289	470	553	654	501	278
70%	201	168	148	156	141	177	276	445	530	627	477	258
80%	172	138	134	143	133	154	248	372	481	571	436	225
90%	152	125	112	121	115	141	217	318	390	470	389	186
Long Term												
Full Simulation Period[b]	256	215	278	336	331	334	334	481	569	655	514	305
Water Year Types[c]												
Wet (32%)	297	269	491	582	521	549	428	586	636	697	573	399
Above Normal (16%)	245	215	245	362	479	396	341	513	618	740	571	341
Below Normal (13%)	282	221	188	231	280	246	323	496	612	724	575	306
Dry (24%)	243	183	158	179	150	181	262	433	542	637	463	251
Critical (15%)	180	145	134	134	107	140	253	286	376	442	357	154

Alternative 3

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	415	306	662	691	701	710	489	598	648	775	610	459
20%	342	256	426	590	650	583	393	551	635	759	578	387
30%	314	227	242	427	458	367	360	507	590	741	557	358
40%	275	216	199	254	283	258	330	493	564	720	538	328
50%	245	204	181	203	220	223	314	469	548	678	525	302
60%	222	180	170	173	179	192	291	442	518	657	513	279
70%	202	164	149	156	142	171	271	421	511	624	482	257
80%	176	145	133	134	128	153	250	363	453	561	445	227
90%	158	124	113	122	109	136	222	300	381	474	387	191
Long Term												
Full Simulation Period[b]	262	215	279	333	336	335	338	462	542	658	512	314
Water Year Types[c]												
Wet (32%)	298	268	493	584	537	551	430	562	593	712	576	407
Above Normal (16%)	249	222	245	350	477	401	346	482	580	736	550	341
Below Normal (13%)	284	211	187	228	283	245	332	476	580	711	557	347
Dry (24%)	256	184	162	175	146	180	265	416	532	635	471	251
Critical (15%)	189	150	132	130	113	139	253	285	373	445	360	160

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-1	11	3	-1	17	8	3	-28	-48	-4	-27	17
20%	4	0	-9	5	13	0	0	-21	-21	2	-10	17
30%	11	-6	0	-12	13	10	10	-28	-33	10	-12	24
40%	7	-3	6	-12	-4	3	6	-14	-38	9	-11	13
50%	9	-1	-2	-8	0	-9	0	-24	-28	-5	0	5
60%	10	1	1	-4	4	-1	3	-28	-35	3	12	1
70%	2	-3	1	0	1	-6	-4	-24	-19	-4	6	-1
80%	4	7	-1	-8	-5	-1	1	-9	-28	-9	9	2
90%	7	-1	1	0	-6	-5	4	-18	-8	4	-2	5
Long Term												
Full Simulation Period[b]	6	0	1	-3	5	1	3	-19	-27	2	-2	9
Water Year Types[c]												
Wet (32%)	1	-2	2	3	16	2	2	-24	-43	15	3	8
Above Normal (16%)	4	6	0	-12	-2	5	5	-31	-38	-4	-21	0
Below Normal (13%)	3	-10	-1	-3	3	-1	9	-20	-33	-12	-18	42
Dry (24%)	13	1	4	-3	-4	0	3	-17	-10	-2	8	0
Critical (15%)	9	5	-2	-4	6	-1	0	-1	-3	3	4	6

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-6. CVP Total Generation, Monthly Generation

Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	415	295	659	692	684	702	486	626	696	779	637	441
20%	339	256	436	584	637	584	393	572	655	757	588	370
30%	303	233	242	439	446	357	350	535	623	732	569	334
40%	268	220	194	266	287	256	325	507	602	711	549	315
50%	236	204	182	211	220	232	313	493	577	683	525	297
60%	212	180	169	177	175	194	289	470	553	654	501	278
70%	201	168	148	156	141	177	276	445	530	627	477	258
80%	172	138	134	143	133	154	248	372	481	571	436	225
90%	152	125	112	121	115	141	217	318	390	470	389	186
Long Term												
Full Simulation Period[b]	256	215	278	336	331	334	334	481	569	655	514	305
Water Year Types[c]												
Wet (32%)	297	269	491	582	521	549	428	586	636	697	573	399
Above Normal (16%)	245	215	245	362	479	396	341	513	618	740	571	341
Below Normal (13%)	282	221	188	231	280	246	323	496	612	724	575	306
Dry (24%)	243	183	158	179	150	181	262	433	542	637	463	251
Critical (15%)	180	145	134	134	107	140	253	286	376	442	357	154

Alternative 5

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	404	410	647	689	671	694	491	627	618	752	574	628
20%	365	380	341	486	622	563	404	562	578	722	553	598
30%	328	316	236	381	459	362	368	513	557	705	534	468
40%	284	281	188	233	245	266	334	482	541	660	514	418
50%	269	226	173	201	205	229	327	460	525	648	498	351
60%	244	182	163	178	173	199	304	439	493	634	471	277
70%	220	161	145	153	139	170	281	412	472	601	451	248
80%	183	140	131	137	127	151	258	343	432	548	416	217
90%	155	113	102	120	108	136	233	308	350	463	365	184
Long Term												
Full Simulation Period[b]	273	254	258	317	321	328	348	463	509	628	485	378
Water Year Types[c]												
Wet (32%)	313	320	438	558	512	554	446	585	567	685	538	598
Above Normal (16%)	266	254	259	321	454	368	370	489	542	708	523	419
Below Normal (13%)	307	257	173	186	265	221	334	458	533	675	520	294
Dry (24%)	254	231	153	183	145	183	273	404	505	604	459	247
Critical (15%)	192	149	120	135	110	132	250	270	336	414	337	153

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-11	115	-11	-2	-14	-9	4	1	-78	-27	-63	187
20%	27	124	-95	-99	-15	-21	11	-10	-77	-35	-35	228
30%	24	83	-5	-58	13	5	18	-23	-67	-27	-35	134
40%	16	61	-6	-33	-41	10	9	-25	-61	-51	-36	103
50%	33	22	-9	-11	-15	-3	14	-32	-51	-35	-27	55
60%	32	3	-6	2	-2	5	15	-31	-60	-20	-30	-1
70%	20	-6	-3	-3	-2	-7	5	-33	-58	-26	-25	-10
80%	11	2	-3	-5	-6	-3	10	-29	-49	-23	-20	-8
90%	3	-12	-10	-1	-7	-5	16	-10	-40	-7	-24	-2
Long Term												
Full Simulation Period[b]	16	39	-20	-19	-10	-7	14	-19	-59	-28	-30	73
Water Year Types[c]												
Wet (32%)	16	51	-53	-23	-9	5	18	-1	-69	-12	-35	199
Above Normal (16%)	21	39	14	-41	-25	-28	28	-24	-76	-33	-48	78
Below Normal (13%)	25	36	-14	-45	-15	-25	11	-38	-80	-49	-56	-12
Dry (24%)	10	48	-4	5	-5	2	10	-29	-37	-33	-4	-4
Critical (15%)	12	5	-14	1	3	-8	-3	-16	-40	-28	-20	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

B.3. CVP Total Energy Use

Table B-3-1. CVP Total Energy Use, Monthly Energy Use

No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Energy Use (GWh)											
Probability of Exceedance[a]												
10%	111	171	154	153	146	149	60	69	128	153	133	106
20%	95	150	149	131	133	138	43	46	103	139	122	105
30%	85	139	142	118	115	109	37	41	88	122	114	103
40%	76	129	134	113	99	98	35	39	78	114	109	96
50%	72	105	129	110	94	75	32	36	65	104	102	87
60%	67	93	123	105	85	65	31	33	58	93	94	76
70%	62	81	115	95	72	61	29	30	44	84	79	68
80%	57	65	96	83	47	46	25	26	34	69	59	58
90%	54	58	74	71	31	22	21	21	21	42	36	45
Long Term												
Full Simulation Period[b]	76	111	121	108	92	86	36	40	71	101	93	82
Water Year Types[c]												
Wet (32%)	81	125	130	124	125	122	50	58	113	132	119	94
Above Normal (16%)	74	120	123	97	91	104	36	40	85	99	108	87
Below Normal (13%)	79	122	132	107	84	76	30	33	61	106	106	92
Dry (24%)	76	103	120	108	77	64	30	30	42	90	65	72
Critical (15%)	65	73	89	85	52	31	21	22	22	51	56	57

Alternative 1

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Energy Use (GWh)											
Probability of Exceedance[a]												
10%	137	151	163	173	183	144	83	90	114	161	182	109
20%	121	141	160	167	149	127	81	65	105	156	154	108
30%	117	139	157	164	143	101	80	59	96	145	132	107
40%	96	134	156	162	139	80	75	54	91	140	128	106
50%	74	124	152	160	135	69	69	47	88	131	124	104
60%	67	109	144	158	116	67	59	45	78	119	109	90
70%	57	96	127	151	84	62	49	38	65	98	86	81
80%	46	80	111	124	55	52	36	29	43	85	63	68
90%	34	66	87	81	27	30	22	23	26	43	39	49
Long Term												
Full Simulation Period[b]	85	115	136	149	115	84	60	51	78	119	113	93
Water Year Types[c]												
Wet (32%)	100	132	154	168	139	94	77	69	102	145	150	110
Above Normal (16%)	76	116	136	151	128	94	78	58	100	129	135	117
Below Normal (13%)	92	134	148	158	104	85	61	52	85	146	137	94
Dry (24%)	86	103	124	143	104	83	44	36	55	107	68	75
Critical (15%)	53	78	106	105	79	50	30	26	30	46	63	56

Alternative 1 minus No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Energy Use (GWh)											
Probability of Exceedance[a]												
10%	26	-21	9	20	37	-5	23	21	-14	9	49	3
20%	26	-9	11	36	16	-11	38	19	2	17	32	3
30%	33	-1	16	47	28	-7	42	18	8	23	19	4
40%	20	6	21	49	40	-18	40	15	14	27	19	9
50%	3	19	23	50	41	-6	36	12	23	27	22	17
60%	0	16	21	52	30	2	28	12	20	26	15	13
70%	-5	15	12	55	12	1	20	8	20	14	7	13
80%	-12	15	15	42	8	6	11	3	9	16	3	10
90%	-21	8	13	10	-4	8	1	2	5	1	3	4
Long Term												
Full Simulation Period[b]	8	4	15	40	24	-2	24	11	7	18	20	11
Water Year Types[c]												
Wet (32%)	18	7	25	44	15	-28	27	10	-11	12	31	16
Above Normal (16%)	1	-3	13	54	38	-11	42	17	16	30	27	30
Below Normal (13%)	13	12	16	51	20	9	31	18	23	41	32	2
Dry (24%)	9	0	4	35	27	19	13	6	13	17	3	3
Critical (15%)	-12	5	17	19	27	20	10	3	8	-5	7	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-2. CVP Total Energy Use, Monthly Energy Use

No Action Alternative

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	111	171	154	153	146	149	60	69	128	153	133	106
20%	95	150	149	131	133	138	43	46	103	139	122	105
30%	85	139	142	118	115	109	37	41	88	122	114	103
40%	76	129	134	113	99	98	35	39	78	114	109	96
50%	72	105	129	110	94	75	32	36	65	104	102	87
60%	67	93	123	105	85	65	31	33	58	93	94	76
70%	62	81	115	95	72	61	29	30	44	84	79	68
80%	57	65	96	83	47	46	25	26	34	69	59	58
90%	54	58	74	71	31	22	21	21	21	42	36	45
Long Term												
Full Simulation Period[b]	76	111	121	108	92	86	36	40	71	101	93	82
Water Year Types[c]												
Wet (32%)	81	125	130	124	125	122	50	58	113	132	119	94
Above Normal (16%)	74	120	123	97	91	104	36	40	85	99	108	87
Below Normal (13%)	79	122	132	107	84	76	30	33	61	106	106	92
Dry (24%)	76	103	120	108	77	64	30	30	42	90	65	72
Critical (15%)	65	73	89	85	52	31	21	22	22	51	56	57

Alternative 3

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	143	149	161	165	151	147	87	99	142	154	156	139
20%	124	140	157	131	142	139	82	89	122	146	134	112
30%	119	138	154	120	126	100	81	79	106	139	132	107
40%	108	128	143	117	105	78	79	72	100	128	128	106
50%	86	118	140	110	91	72	72	66	91	118	113	105
60%	70	107	131	104	75	64	64	53	80	103	99	95
70%	63	95	122	93	65	62	46	40	59	87	83	85
80%	52	82	102	84	54	51	35	30	41	71	62	63
90%	46	66	73	76	31	24	23	23	24	46	41	45
Long Term												
Full Simulation Period[b]	91	113	129	109	95	85	62	62	85	109	106	97
Water Year Types[c]												
Wet (32%)	101	130	144	128	135	108	83	87	125	139	140	113
Above Normal (16%)	83	113	122	93	96	125	77	74	105	115	121	111
Below Normal (13%)	94	130	144	111	85	78	56	58	86	123	117	126
Dry (24%)	97	104	126	108	75	65	49	44	54	98	75	74
Critical (15%)	64	78	97	85	53	31	30	25	27	43	55	58

Alternative 3 minus No Action Alternative

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	31	-23	7	12	5	-2	27	31	14	1	23	33
20%	29	-10	8	0	9	0	39	43	20	7	12	7
30%	34	-1	13	2	11	-9	44	38	19	17	18	4
40%	32	-1	8	4	6	-20	45	33	22	14	19	10
50%	14	13	11	1	-3	-3	39	31	25	14	12	18
60%	3	14	8	-1	-10	-1	33	20	22	10	5	19
70%	1	14	8	-3	-7	1	17	10	14	3	4	17
80%	-5	18	6	2	7	5	10	4	8	2	3	5
90%	-9	8	-2	5	-1	1	2	2	3	4	5	1
Long Term												
Full Simulation Period[b]	14	2	9	1	4	-1	26	22	14	8	13	15
Water Year Types[c]												
Wet (32%)	20	5	14	4	10	-14	33	29	12	7	21	19
Above Normal (16%)	9	-7	-1	-4	6	20	41	34	20	16	13	24
Below Normal (13%)	15	9	12	4	1	2	26	25	25	17	11	34
Dry (24%)	21	0	6	0	-2	2	18	13	12	8	10	2
Critical (15%)	-1	4	8	0	1	0	9	3	4	-8	-1	2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-3. CVP Total Energy Use, Monthly Energy Use

No Action Alternative

	Monthly Energy Use (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	111	171	154	153	146	149	60	69	128	153	133	106
20%	95	150	149	131	133	138	43	46	103	139	122	105
30%	85	139	142	118	115	109	37	41	88	122	114	103
40%	76	129	134	113	99	98	35	39	78	114	109	96
50%	72	105	129	110	94	75	32	36	65	104	102	87
60%	67	93	123	105	85	65	31	33	58	93	94	76
70%	62	81	115	95	72	61	29	30	44	84	79	68
80%	57	65	96	83	47	46	25	26	34	69	59	58
90%	54	58	74	71	31	22	21	21	21	42	36	45
Long Term												
Full Simulation Period[b]	76	111	121	108	92	86	36	40	71	101	93	82
Water Year Types[c]												
Wet (32%)	81	125	130	124	125	122	50	58	113	132	119	94
Above Normal (16%)	74	120	123	97	91	104	36	40	85	99	108	87
Below Normal (13%)	79	122	132	107	84	76	30	33	61	106	106	92
Dry (24%)	76	103	120	108	77	64	30	30	42	90	65	72
Critical (15%)	65	73	89	85	52	31	21	22	22	51	56	57

Alternative 5

	Monthly Energy Use (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	106	174	154	153	146	153	59	68	128	155	132	106
20%	94	153	151	134	134	138	41	44	103	140	121	105
30%	85	140	142	120	116	109	35	40	86	122	113	102
40%	75	126	135	114	104	99	32	37	77	115	110	95
50%	72	106	128	110	94	75	30	33	65	105	102	90
60%	69	92	123	104	86	65	29	30	57	94	94	76
70%	63	74	115	95	71	61	24	22	46	88	80	70
80%	59	65	92	83	46	48	18	16	32	74	63	58
90%	54	56	68	71	32	22	13	12	24	50	49	47
Long Term												
Full Simulation Period[b]	76	110	121	109	92	86	33	36	71	103	95	82
Water Year Types[c]												
Wet (32%)	81	129	131	125	124	123	50	58	113	132	119	93
Above Normal (16%)	75	112	122	100	90	104	35	40	84	100	107	86
Below Normal (13%)	76	122	132	107	90	77	28	30	62	106	100	96
Dry (24%)	74	101	121	108	77	64	23	21	43	96	71	74
Critical (15%)	69	73	86	88	54	30	13	13	22	56	64	56

Alternative 5 minus No Action Alternative

	Monthly Energy Use (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	-5	3	0	0	1	4	-1	-1	0	2	-1	0
20%	-1	3	2	2	1	-1	-1	-2	1	1	-1	0
30%	0	0	0	2	1	0	-2	-1	-1	1	-1	-1
40%	-1	-3	1	1	5	0	-2	-2	-1	1	1	-1
50%	0	1	0	0	0	0	-2	-3	0	1	1	2
60%	3	-2	0	-2	1	0	-2	-3	-1	1	0	0
70%	1	-7	1	0	-1	0	-5	-8	2	4	1	2
80%	1	0	-4	0	-1	2	-6	-10	-2	5	4	0
90%	0	-2	-6	0	1	0	-8	-10	3	8	13	2
Long Term												
Full Simulation Period[b]	0	-1	0	1	1	0	-3	-4	0	2	2	0
Water Year Types[c]												
Wet (32%)	-1	4	1	1	-1	0	0	0	0	0	0	-1
Above Normal (16%)	1	-8	-1	3	0	0	-1	-1	-1	0	-1	-1
Below Normal (13%)	-3	0	0	0	6	1	-2	-4	0	0	-6	4
Dry (24%)	-2	-3	1	-1	0	0	-8	-9	1	6	6	2
Critical (15%)	4	0	-3	3	2	0	-8	-9	0	5	8	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-4. CVP Total Energy Use, Monthly Energy Use

Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	137	151	163	173	183	144	83	90	114	161	182	109
20%	121	141	160	167	149	127	81	65	105	156	154	108
30%	117	139	157	164	143	101	80	59	96	145	132	107
40%	96	134	156	162	139	80	75	54	91	140	128	106
50%	74	124	152	160	135	69	69	47	88	131	124	104
60%	67	109	144	158	116	67	59	45	78	119	109	90
70%	57	96	127	151	84	62	49	38	65	98	86	81
80%	46	80	111	124	55	52	36	29	43	85	63	68
90%	34	66	87	81	27	30	22	23	26	43	39	49
Long Term												
Full Simulation Period[b]	85	115	136	149	115	84	60	51	78	119	113	93
Water Year Types[c]												
Wet (32%)	100	132	154	168	139	94	77	69	102	145	150	110
Above Normal (16%)	76	116	136	151	128	94	78	58	100	129	135	117
Below Normal (13%)	92	134	148	158	104	85	61	52	85	146	137	94
Dry (24%)	86	103	124	143	104	83	44	36	55	107	68	75
Critical (15%)	53	78	106	105	79	50	30	26	30	46	63	56

No Action Alternative

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	111	171	154	153	146	149	60	69	128	153	133	106
20%	95	150	149	131	133	138	43	46	103	139	122	105
30%	85	139	142	118	115	109	37	41	88	122	114	103
40%	76	129	134	113	99	98	35	39	78	114	109	96
50%	72	105	129	110	94	75	32	36	65	104	102	87
60%	67	93	123	105	85	65	31	33	58	93	94	76
70%	62	81	115	95	72	61	29	30	44	84	79	68
80%	57	65	96	83	47	46	25	26	34	69	59	58
90%	54	58	74	71	31	22	21	21	21	42	36	45
Long Term												
Full Simulation Period[b]	76	111	121	108	92	86	36	40	71	101	93	82
Water Year Types[c]												
Wet (32%)	81	125	130	124	125	122	50	58	113	132	119	94
Above Normal (16%)	74	120	123	97	91	104	36	40	85	99	108	87
Below Normal (13%)	79	122	132	107	84	76	30	33	61	106	106	92
Dry (24%)	76	103	120	108	77	64	30	30	42	90	65	72
Critical (15%)	65	73	89	85	52	31	21	22	22	51	56	57

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-26	21	-9	-20	-37	5	-23	-21	14	-9	-49	-3
20%	-26	9	-11	-36	-16	11	-38	-19	-2	-17	-32	-3
30%	-33	1	-16	-47	-28	7	-42	-18	-8	-23	-19	-4
40%	-20	-6	-21	-49	-40	18	-40	-15	-14	-27	-19	-9
50%	-3	-19	-23	-50	-41	6	-36	-12	-23	-27	-22	-17
60%	0	-16	-21	-52	-30	-2	-28	-12	-20	-26	-15	-13
70%	5	-15	-12	-55	-12	-1	-20	-8	-20	-14	-7	-13
80%	12	-15	-15	-42	-8	-6	-11	-3	-9	-16	-3	-10
90%	21	-8	-13	-10	4	-8	-1	-2	-5	-1	-3	-4
Long Term												
Full Simulation Period[b]	-8	-4	-15	-40	-24	2	-24	-11	-7	-18	-20	-11
Water Year Types[c]												
Wet (32%)	-18	-7	-25	-44	-15	28	-27	-10	11	-12	-31	-16
Above Normal (16%)	-1	3	-13	-54	-38	11	-42	-17	-16	-30	-27	-30
Below Normal (13%)	-13	-12	-16	-51	-20	-9	-31	-18	-23	-41	-32	-2
Dry (24%)	-9	0	-4	-35	-27	-19	-13	-6	-13	-17	-3	-3
Critical (15%)	12	-5	-17	-19	-27	-20	-10	-3	-8	5	-7	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-5. CVP Total Energy Use, Monthly Energy Use

Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	137	151	163	173	183	144	83	90	114	161	182	109
20%	121	141	160	167	149	127	81	65	105	156	154	108
30%	117	139	157	164	143	101	80	59	96	145	132	107
40%	96	134	156	162	139	80	75	54	91	140	128	106
50%	74	124	152	160	135	69	69	47	88	131	124	104
60%	67	109	144	158	116	67	59	45	78	119	109	90
70%	57	96	127	151	84	62	49	38	65	98	86	81
80%	46	80	111	124	55	52	36	29	43	85	63	68
90%	34	66	87	81	27	30	22	23	26	43	39	49
Long Term												
Full Simulation Period[b]	85	115	136	149	115	84	60	51	78	119	113	93
Water Year Types[c]												
Wet (32%)	100	132	154	168	139	94	77	69	102	145	150	110
Above Normal (16%)	76	116	136	151	128	94	78	58	100	129	135	117
Below Normal (13%)	92	134	148	158	104	85	61	52	85	146	137	94
Dry (24%)	86	103	124	143	104	83	44	36	55	107	68	75
Critical (15%)	53	78	106	105	79	50	30	26	30	46	63	56

Alternative 3

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	143	149	161	165	151	147	87	99	142	154	156	139
20%	124	140	157	131	142	139	82	89	122	146	134	112
30%	119	138	154	120	126	100	81	79	106	139	132	107
40%	108	128	143	117	105	78	79	72	100	128	128	106
50%	86	118	140	110	91	72	72	66	91	118	113	105
60%	70	107	131	104	75	64	64	53	80	103	99	95
70%	63	95	122	93	65	62	46	40	59	87	83	85
80%	52	82	102	84	54	51	35	30	41	71	62	63
90%	46	66	73	76	31	24	23	23	24	46	41	45
Long Term												
Full Simulation Period[b]	91	113	129	109	95	85	62	62	85	109	106	97
Water Year Types[c]												
Wet (32%)	101	130	144	128	135	108	83	87	125	139	140	113
Above Normal (16%)	83	113	122	93	96	125	77	74	105	115	121	111
Below Normal (13%)	94	130	144	111	85	78	56	58	86	123	117	126
Dry (24%)	97	104	126	108	75	65	49	44	54	98	75	74
Critical (15%)	64	78	97	85	53	31	30	25	27	43	55	58

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	6	-2	-2	-8	-32	3	4	10	28	-7	-26	30
20%	3	-1	-2	-36	-7	11	1	24	18	-10	-21	4
30%	2	0	-3	-44	-17	-1	2	20	10	-6	-1	1
40%	12	-6	-13	-45	-34	-2	4	18	9	-13	0	0
50%	11	-5	-13	-49	-44	3	3	19	3	-13	-10	0
60%	3	-2	-13	-54	-40	-3	5	9	2	-17	-10	6
70%	6	-1	-4	-58	-19	0	-3	2	-6	-11	-4	4
80%	6	2	-9	-40	-1	-1	-1	2	-2	-14	0	-5
90%	12	0	-14	-6	3	-6	1	0	-2	3	3	-4
Long Term												
Full Simulation Period[b]	6	-1	-7	-40	-20	1	2	11	7	-10	-7	4
Water Year Types[c]												
Wet (32%)	1	-1	-10	-40	-5	14	6	18	23	-6	-10	3
Above Normal (16%)	7	-4	-14	-58	-32	31	-2	17	5	-14	-13	-6
Below Normal (13%)	2	-4	-3	-47	-19	-7	-6	7	1	-23	-20	32
Dry (24%)	11	1	2	-35	-29	-18	5	7	-1	-9	7	-1
Critical (15%)	11	0	-9	-19	-26	-20	0	0	-3	-3	-7	2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-6. CVP Total Energy Use, Monthly Energy Use

Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	137	151	163	173	183	144	83	90	114	161	182	109
20%	121	141	160	167	149	127	81	65	105	156	154	108
30%	117	139	157	164	143	101	80	59	96	145	132	107
40%	96	134	156	162	139	80	75	54	91	140	128	106
50%	74	124	152	160	135	69	69	47	88	131	124	104
60%	67	109	144	158	116	67	59	45	78	119	109	90
70%	57	96	127	151	84	62	49	38	65	98	86	81
80%	46	80	111	124	55	52	36	29	43	85	63	68
90%	34	66	87	81	27	30	22	23	26	43	39	49
Long Term												
Full Simulation Period[b]	85	115	136	149	115	84	60	51	78	119	113	93
Water Year Types[c]												
Wet (32%)	100	132	154	168	139	94	77	69	102	145	150	110
Above Normal (16%)	76	116	136	151	128	94	78	58	100	129	135	117
Below Normal (13%)	92	134	148	158	104	85	61	52	85	146	137	94
Dry (24%)	86	103	124	143	104	83	44	36	55	107	68	75
Critical (15%)	53	78	106	105	79	50	30	26	30	46	63	56

Alternative 5

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	106	174	154	153	146	153	59	68	128	155	132	106
20%	94	153	151	134	134	138	41	44	103	140	121	105
30%	85	140	142	120	116	109	35	40	86	122	113	102
40%	75	126	135	114	104	99	32	37	77	115	110	95
50%	72	106	128	110	94	75	30	33	65	105	102	90
60%	69	92	123	104	86	65	29	30	57	94	94	76
70%	63	74	115	95	71	61	24	22	46	88	80	70
80%	59	65	92	83	46	48	18	16	32	74	63	58
90%	54	56	68	71	32	22	13	12	24	50	49	47
Long Term												
Full Simulation Period[b]	76	110	121	109	92	86	33	36	71	103	95	82
Water Year Types[c]												
Wet (32%)	81	129	131	125	124	123	50	58	113	132	119	93
Above Normal (16%)	75	112	122	100	90	104	35	40	84	100	107	86
Below Normal (13%)	76	122	132	107	90	77	28	30	62	106	100	96
Dry (24%)	74	101	121	108	77	64	23	21	43	96	71	74
Critical (15%)	69	73	86	88	54	30	13	13	22	56	64	56

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-31	24	-8	-21	-36	9	-24	-22	13	-7	-50	-3
20%	-27	12	-8	-34	-15	10	-40	-20	-1	-16	-33	-3
30%	-32	1	-15	-45	-27	8	-44	-19	-10	-22	-20	-4
40%	-20	-9	-21	-48	-35	18	-42	-17	-15	-26	-18	-11
50%	-2	-18	-24	-50	-41	6	-39	-15	-22	-26	-22	-15
60%	3	-18	-21	-54	-30	-2	-30	-15	-20	-25	-15	-13
70%	6	-22	-11	-55	-13	-2	-26	-16	-19	-10	-6	-11
80%	13	-16	-19	-42	-9	-4	-17	-13	-11	-11	0	-11
90%	20	-10	-18	-10	5	-8	-9	-11	-2	7	11	-2
Long Term												
Full Simulation Period[b]	-9	-5	-15	-40	-23	2	-28	-15	-6	-15	-18	-10
Water Year Types[c]												
Wet (32%)	-19	-3	-24	-43	-16	29	-27	-11	11	-13	-30	-17
Above Normal (16%)	0	-4	-14	-51	-38	11	-43	-18	-17	-29	-28	-31
Below Normal (13%)	-16	-12	-16	-51	-14	-8	-33	-22	-23	-41	-38	2
Dry (24%)	-11	-2	-2	-35	-27	-19	-21	-15	-12	-11	3	-1
Critical (15%)	16	-5	-20	-16	-25	-20	-17	-12	-8	10	1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

B.4. CVP Net Energy Generation

Table B-4-1. CVP Net Generation, Monthly Net Generation

No Action Alternative

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	324	257	523	556	567	564	449	560	543	664	474	528
20%	283	220	218	372	491	444	355	513	500	624	446	491
30%	249	195	116	257	358	262	325	468	476	596	427	366
40%	216	162	72	147	163	169	304	441	452	558	418	344
50%	200	112	49	104	110	150	285	424	438	537	405	246
60%	154	96	42	71	94	133	270	404	426	508	381	198
70%	134	71	30	50	71	109	248	383	410	480	366	183
80%	119	56	18	37	54	95	225	327	377	450	347	150
90%	86	40	-1	24	36	72	198	262	332	400	302	104
Long Term												
Full Simulation Period[b]	197	145	139	209	230	243	307	420	443	530	393	295
Water Year Types[c]												
Wet (32%)	236	193	311	433	389	435	397	522	455	551	423	504
Above Normal (16%)	193	143	136	223	363	263	334	443	459	608	419	334
Below Normal (13%)	231	137	43	79	181	144	288	422	478	573	423	198
Dry (24%)	178	128	34	74	67	119	233	376	469	518	391	174
Critical (15%)	118	76	34	48	59	104	221	249	323	380	276	89

Alternative 1

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	285	162	524	558	567	562	404	561	600	638	480	291
20%	239	132	272	412	486	482	324	519	577	622	463	256
30%	195	103	114	288	296	288	297	481	531	602	438	227
40%	173	87	72	135	208	188	273	461	517	579	422	217
50%	162	81	43	78	114	155	255	444	488	547	405	205
60%	152	75	33	30	74	132	238	413	469	518	393	189
70%	138	58	24	18	53	108	214	384	454	493	369	179
80%	106	50	12	6	20	86	194	343	407	463	356	155
90%	92	32	-10	-8	-7	65	162	292	363	398	321	98
Long Term												
Full Simulation Period[b]	172	100	142	187	215	251	274	431	491	537	401	213
Water Year Types[c]												
Wet (32%)	197	138	336	414	382	455	351	517	533	552	423	289
Above Normal (16%)	169	99	109	211	351	302	263	456	517	611	436	224
Below Normal (13%)	189	87	40	73	176	161	262	444	527	577	438	212
Dry (24%)	158	80	34	35	46	98	219	397	487	530	395	176
Critical (15%)	126	67	28	30	28	90	223	261	346	395	294	98

Alternative 1 minus No Action Alternative

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-39	-95	2	1	0	-3	-45	2	58	-26	6	-237
20%	-44	-88	55	40	-5	38	-32	6	76	-2	17	-236
30%	-54	-92	-2	31	-61	26	-28	13	55	6	11	-139
40%	-43	-75	0	-11	45	19	-32	20	65	21	4	-126
50%	-38	-31	-6	-27	4	5	-30	20	50	11	0	-42
60%	-3	-22	-9	-40	-20	-1	-32	9	42	10	12	-9
70%	4	-12	-6	-32	-18	-1	-34	1	44	13	3	-4
80%	-13	-6	-6	-31	-34	-9	-32	15	30	13	8	5
90%	6	-8	-10	-32	-43	-7	-35	30	31	-2	19	-6
Long Term												
Full Simulation Period[b]	-25	-44	2	-21	-15	8	-33	10	48	7	8	-82
Water Year Types[c]												
Wet (32%)	-38	-55	25	-20	-7	20	-46	-5	78	1	0	-215
Above Normal (16%)	-24	-44	-28	-11	-12	39	-71	13	58	3	17	-110
Below Normal (13%)	-41	-49	-3	-6	-6	17	-27	22	49	4	15	14
Dry (24%)	-20	-48	0	-39	-21	-21	-14	21	18	12	3	2
Critical (15%)	8	-9	-6	-18	-31	-15	2	12	23	16	17	9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-2. CVP Net Generation, Monthly Net Generation

No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	324	257	523	556	567	564	449	560	543	664	474	528
20%	283	220	218	372	491	444	355	513	500	624	446	491
30%	249	195	116	257	358	262	325	468	476	596	427	366
40%	216	162	72	147	163	169	304	441	452	558	418	344
50%	200	112	49	104	110	150	285	424	438	537	405	246
60%	154	96	42	71	94	133	270	404	426	508	381	198
70%	134	71	30	50	71	109	248	383	410	480	366	183
80%	119	56	18	37	54	95	225	327	377	450	347	150
90%	86	40	-1	24	36	72	198	262	332	400	302	104
Long Term												
Full Simulation Period[b]	197	145	139	209	230	243	307	420	443	530	393	295
Water Year Types[c]												
Wet (32%)	236	193	311	433	389	435	397	522	455	551	423	504
Above Normal (16%)	193	143	136	223	363	263	334	443	459	608	419	334
Below Normal (13%)	231	137	43	79	181	144	288	422	478	573	423	198
Dry (24%)	178	128	34	74	67	119	233	376	469	518	391	174
Critical (15%)	118	76	34	48	59	104	221	249	323	380	276	89

Alternative 3

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	291	182	530	558	606	583	437	534	563	674	481	336
20%	235	125	266	480	511	511	316	479	531	638	465	266
30%	193	104	114	332	334	287	298	459	508	622	441	246
40%	173	91	74	160	183	189	268	439	473	596	424	216
50%	158	77	52	112	122	150	251	392	448	544	409	205
60%	147	66	39	72	84	122	229	374	433	528	387	195
70%	133	60	25	51	71	106	216	348	411	506	374	181
80%	113	52	12	36	56	92	200	316	387	469	362	155
90%	88	31	-6	18	41	71	174	260	340	397	326	104
Long Term												
Full Simulation Period[b]	172	102	150	224	241	250	275	400	457	549	406	217
Water Year Types[c]												
Wet (32%)	197	137	349	456	402	443	347	475	467	572	436	294
Above Normal (16%)	166	109	123	257	381	276	269	408	475	621	429	230
Below Normal (13%)	190	81	42	117	198	167	276	418	493	588	440	221
Dry (24%)	160	81	36	67	71	115	217	372	478	537	396	177
Critical (15%)	125	73	35	45	60	108	223	260	346	402	305	101

Alternative 3 minus No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	-33	-74	7	1	39	19	-13	-25	21	10	7	-192
20%	-48	-95	48	108	20	67	-39	-34	31	14	19	-226
30%	-56	-91	-2	76	-23	25	-27	-9	31	26	14	-120
40%	-43	-71	2	13	20	21	-36	-2	21	37	7	-128
50%	-42	-34	2	7	12	0	-34	-32	11	7	4	-41
60%	-8	-30	-4	1	-11	-11	-41	-30	7	20	6	-3
70%	-2	-11	-5	1	1	-4	-32	-35	1	26	8	-2
80%	-6	-4	-6	-1	1	-3	-26	-11	9	19	14	5
90%	3	-9	-5	-6	5	-1	-23	-3	8	-3	24	0
Long Term												
Full Simulation Period[b]	-25	-43	10	16	10	7	-32	-20	14	19	13	-77
Water Year Types[c]												
Wet (32%)	-39	-56	38	23	13	8	-50	-47	12	22	13	-210
Above Normal (16%)	-27	-34	-13	35	18	13	-65	-35	16	13	10	-104
Below Normal (13%)	-40	-56	-1	38	17	23	-12	-4	15	15	17	23
Dry (24%)	-19	-48	2	-7	4	-4	-16	-3	9	20	4	3
Critical (15%)	7	-4	1	-3	1	4	1	11	24	22	28	13

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-3. CVP Net Generation, Monthly Net Generation

No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	324	257	523	556	567	564	449	560	543	664	474	528
20%	283	220	218	372	491	444	355	513	500	624	446	491
30%	249	195	116	257	358	262	325	468	476	596	427	366
40%	216	162	72	147	163	169	304	441	452	558	418	344
50%	200	112	49	104	110	150	285	424	438	537	405	246
60%	154	96	42	71	94	133	270	404	426	508	381	198
70%	134	71	30	50	71	109	248	383	410	480	366	183
80%	119	56	18	37	54	95	225	327	377	450	347	150
90%	86	40	-1	24	36	72	198	262	332	400	302	104
Long Term												
Full Simulation Period[b]	197	145	139	209	230	243	307	420	443	530	393	295
Water Year Types[c]												
Wet (32%)	236	193	311	433	389	435	397	522	455	551	423	504
Above Normal (16%)	193	143	136	223	363	263	334	443	459	608	419	334
Below Normal (13%)	231	137	43	79	181	144	288	422	478	573	423	198
Dry (24%)	178	128	34	74	67	119	233	376	469	518	391	174
Critical (15%)	118	76	34	48	59	104	221	249	323	380	276	89

Alternative 5

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	323	255	511	557	567	559	451	559	528	654	468	527
20%	285	219	219	356	495	444	360	514	496	620	442	495
30%	233	186	113	253	363	270	330	469	475	589	426	365
40%	217	160	72	146	159	168	310	447	450	551	415	343
50%	194	116	48	104	107	148	294	426	437	531	402	243
60%	158	99	39	72	92	131	274	409	424	509	377	199
70%	134	71	28	52	67	105	254	389	404	485	366	177
80%	110	57	18	38	52	84	237	323	368	425	346	146
90%	84	31	-2	25	35	72	210	288	322	396	304	107
Long Term												
Full Simulation Period[b]	197	144	137	208	229	242	315	427	438	524	390	296
Water Year Types[c]												
Wet (32%)	233	191	307	433	388	431	397	527	454	553	419	506
Above Normal (16%)	190	142	136	221	364	264	335	449	458	608	416	333
Below Normal (13%)	230	135	42	79	175	144	305	428	471	569	420	198
Dry (24%)	179	130	32	75	67	119	250	383	461	508	388	173
Critical (15%)	123	76	34	47	56	102	237	257	314	358	273	97

Alternative 5 minus No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	-1	-1	-12	1	0	-5	1	-1	-14	-9	-6	-1
20%	2	-1	1	-16	4	1	5	1	-5	-4	-4	4
30%	-16	-9	-2	-4	6	8	5	1	-1	-8	-1	-1
40%	1	-2	-1	-1	-3	-1	5	6	-2	-7	-3	-1
50%	-7	4	-2	-1	-3	-2	9	2	-1	-5	-3	-3
60%	3	2	-3	1	-3	-2	4	5	-2	1	-4	1
70%	0	0	-2	1	-4	-4	6	6	-6	5	0	-6
80%	-9	1	0	1	-2	-11	12	-5	-9	-25	-1	-4
90%	-1	-9	-1	1	0	-1	12	26	-10	-4	2	3
Long Term												
Full Simulation Period[b]	0	0	-2	0	-1	-1	9	6	-5	-5	-4	1
Water Year Types[c]												
Wet (32%)	-3	-2	-4	0	0	-3	-1	5	-1	2	-4	2
Above Normal (16%)	-3	-1	0	-2	1	1	0	6	-1	0	-3	-2
Below Normal (13%)	0	-2	-1	-1	-6	0	17	6	-7	-4	-3	0
Dry (24%)	1	2	-2	1	0	0	17	7	-8	-9	-4	-1
Critical (15%)	5	0	0	-1	-3	-2	15	8	-8	-22	-3	8

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-4. CVP Net Generation, Monthly Net Generation

Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	285	162	524	558	567	562	404	561	600	638	480	291
20%	239	132	272	412	486	482	324	519	577	622	463	256
30%	195	103	114	288	296	288	297	481	531	602	438	227
40%	173	87	72	135	208	188	273	461	517	579	422	217
50%	162	81	43	78	114	155	255	444	488	547	405	205
60%	152	75	33	30	74	132	238	413	469	518	393	189
70%	138	58	24	18	53	108	214	384	454	493	369	179
80%	106	50	12	6	20	86	194	343	407	463	356	155
90%	92	32	-10	-8	-7	65	162	292	363	398	321	98
Long Term												
Full Simulation Period[b]	172	100	142	187	215	251	274	431	491	537	401	213
Water Year Types[c]												
Wet (32%)	197	138	336	414	382	455	351	517	533	552	423	289
Above Normal (16%)	169	99	109	211	351	302	263	456	517	611	436	224
Below Normal (13%)	189	87	40	73	176	161	262	444	527	577	438	212
Dry (24%)	158	80	34	35	46	98	219	397	487	530	395	176
Critical (15%)	126	67	28	30	28	90	223	261	346	395	294	98

No Action Alternative

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	324	257	523	556	567	564	449	560	543	664	474	528
20%	283	220	218	372	491	444	355	513	500	624	446	491
30%	249	195	116	257	358	262	325	468	476	596	427	366
40%	216	162	72	147	163	169	304	441	452	558	418	344
50%	200	112	49	104	110	150	285	424	438	537	405	246
60%	154	96	42	71	94	133	270	404	426	508	381	198
70%	134	71	30	50	71	109	248	383	410	480	366	183
80%	119	56	18	37	54	95	225	327	377	450	347	150
90%	86	40	-1	24	36	72	198	262	332	400	302	104
Long Term												
Full Simulation Period[b]	197	145	139	209	230	243	307	420	443	530	393	295
Water Year Types[c]												
Wet (32%)	236	193	311	433	389	435	397	522	455	551	423	504
Above Normal (16%)	193	143	136	223	363	263	334	443	459	608	419	334
Below Normal (13%)	231	137	43	79	181	144	288	422	478	573	423	198
Dry (24%)	178	128	34	74	67	119	233	376	469	518	391	174
Critical (15%)	118	76	34	48	59	104	221	249	323	380	276	89

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	39	95	-2	-1	0	3	45	-2	-58	26	-6	237
20%	44	88	-55	-40	5	-38	32	-6	-76	2	-17	236
30%	54	92	2	-31	61	-26	28	-13	-55	-6	-11	139
40%	43	75	0	11	-45	-19	32	-20	-65	-21	-4	126
50%	38	31	6	27	-4	-5	30	-20	-50	-11	0	42
60%	3	22	9	40	20	1	32	-9	-42	-10	-12	9
70%	-4	12	6	32	18	1	34	-1	-44	-13	-3	4
80%	13	6	6	31	34	9	32	-15	-30	-13	-8	-5
90%	-6	8	10	32	43	7	35	-30	-31	2	-19	6
Long Term												
Full Simulation Period[b]	25	44	-2	21	15	-8	33	-10	-48	-7	-8	82
Water Year Types[c]												
Wet (32%)	38	55	-25	20	7	-20	46	5	-78	-1	0	215
Above Normal (16%)	24	44	28	11	12	-39	71	-13	-58	-3	-17	110
Below Normal (13%)	41	49	3	6	6	-17	27	-22	-49	-4	-15	-14
Dry (24%)	20	48	0	39	21	21	14	-21	-18	-12	-3	-2
Critical (15%)	-8	9	6	18	31	15	-2	-12	-23	-16	-17	-9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-5. CVP Net Generation, Monthly Net Generation

Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	285	162	524	558	567	562	404	561	600	638	480	291
20%	239	132	272	412	486	482	324	519	577	622	463	256
30%	195	103	114	288	296	288	297	481	531	602	438	227
40%	173	87	72	135	208	188	273	461	517	579	422	217
50%	162	81	43	78	114	155	255	444	488	547	405	205
60%	152	75	33	30	74	132	238	413	469	518	393	189
70%	138	58	24	18	53	108	214	384	454	493	369	179
80%	106	50	12	6	20	86	194	343	407	463	356	155
90%	92	32	-10	-8	-7	65	162	292	363	398	321	98
Long Term												
Full Simulation Period[b]	172	100	142	187	215	251	274	431	491	537	401	213
Water Year Types[c]												
Wet (32%)	197	138	336	414	382	455	351	517	533	552	423	289
Above Normal (16%)	169	99	109	211	351	302	263	456	517	611	436	224
Below Normal (13%)	189	87	40	73	176	161	262	444	527	577	438	212
Dry (24%)	158	80	34	35	46	98	219	397	487	530	395	176
Critical (15%)	126	67	28	30	28	90	223	261	346	395	294	98

Alternative 3

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	291	182	530	558	606	583	437	534	563	674	481	336
20%	235	125	266	480	511	511	316	479	531	638	465	266
30%	193	104	114	332	334	287	298	459	508	622	441	246
40%	173	91	74	160	183	189	268	439	473	596	424	216
50%	158	77	52	112	122	150	251	392	448	544	409	205
60%	147	66	39	72	84	122	229	374	433	528	387	195
70%	133	60	25	51	71	106	216	348	411	506	374	181
80%	113	52	12	36	56	92	200	316	387	469	362	155
90%	88	31	-6	18	41	71	174	260	340	397	326	104
Long Term												
Full Simulation Period[b]	172	102	150	224	241	250	275	400	457	549	406	217
Water Year Types[c]												
Wet (32%)	197	137	349	456	402	443	347	475	467	572	436	294
Above Normal (16%)	166	109	123	257	381	276	269	408	475	621	429	230
Below Normal (13%)	190	81	42	117	198	167	276	418	493	588	440	221
Dry (24%)	160	81	36	67	71	115	217	372	478	537	396	177
Critical (15%)	125	73	35	45	60	108	223	260	346	402	305	101

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	6	21	6	0	39	22	32	-27	-37	36	1	45
20%	-4	-7	-6	68	26	29	-7	-40	-45	16	2	10
30%	-2	2	0	45	38	-2	1	-22	-23	20	3	19
40%	-1	4	2	24	-25	1	-5	-22	-44	16	3	-1
50%	-4	-3	8	34	8	-5	-5	-52	-39	-4	5	1
60%	-5	-9	6	42	10	-10	-9	-39	-36	10	-6	6
70%	-5	1	1	33	19	-3	2	-36	-44	13	5	3
80%	6	2	-1	30	35	6	6	-26	-21	6	6	0
90%	-4	-1	5	26	48	6	12	-32	-23	-1	6	6
Long Term												
Full Simulation Period[b]	0	2	8	37	25	0	1	-30	-34	12	5	4
Water Year Types[c]												
Wet (32%)	0	0	13	43	20	-12	-4	-42	-66	21	13	5
Above Normal (16%)	-3	10	14	46	30	-26	6	-48	-43	10	-7	6
Below Normal (13%)	1	-6	3	44	22	5	15	-26	-34	11	2	9
Dry (24%)	2	1	2	32	25	17	-2	-24	-9	7	1	1
Critical (15%)	-1	6	7	15	32	19	0	-1	0	6	11	3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-6. CVP Net Generation, Monthly Net Generation

Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	285	162	524	558	567	562	404	561	600	638	480	291
20%	239	132	272	412	486	482	324	519	577	622	463	256
30%	195	103	114	288	296	288	297	481	531	602	438	227
40%	173	87	72	135	208	188	273	461	517	579	422	217
50%	162	81	43	78	114	155	255	444	488	547	405	205
60%	152	75	33	30	74	132	238	413	469	518	393	189
70%	138	58	24	18	53	108	214	384	454	493	369	179
80%	106	50	12	6	20	86	194	343	407	463	356	155
90%	92	32	-10	-8	-7	65	162	292	363	398	321	98
Long Term												
Full Simulation Period[b]	172	100	142	187	215	251	274	431	491	537	401	213
Water Year Types[c]												
Wet (32%)	197	138	336	414	382	455	351	517	533	552	423	289
Above Normal (16%)	169	99	109	211	351	302	263	456	517	611	436	224
Below Normal (13%)	189	87	40	73	176	161	262	444	527	577	438	212
Dry (24%)	158	80	34	35	46	98	219	397	487	530	395	176
Critical (15%)	126	67	28	30	28	90	223	261	346	395	294	98

Alternative 5

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	323	255	511	557	567	559	451	559	528	654	468	527
20%	285	219	219	356	495	444	360	514	496	620	442	495
30%	233	186	113	253	363	270	330	469	475	589	426	365
40%	217	160	72	146	159	168	310	447	450	551	415	343
50%	194	116	48	104	107	148	294	426	437	531	402	243
60%	158	99	39	72	92	131	274	409	424	509	377	199
70%	134	71	28	52	67	105	254	389	404	485	366	177
80%	110	57	18	38	52	84	237	323	368	425	346	146
90%	84	31	-2	25	35	72	210	288	322	396	304	107
Long Term												
Full Simulation Period[b]	197	144	137	208	229	242	315	427	438	524	390	296
Water Year Types[c]												
Wet (32%)	233	191	307	433	388	431	397	527	454	553	419	506
Above Normal (16%)	190	142	136	221	364	264	335	449	458	608	416	333
Below Normal (13%)	230	135	42	79	175	144	305	428	471	569	420	198
Dry (24%)	179	130	32	75	67	119	250	383	461	508	388	173
Critical (15%)	123	76	34	47	56	102	237	257	314	358	273	97

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	38	94	-13	0	-1	-3	47	-2	-72	16	-12	236
20%	46	87	-54	-56	9	-38	37	-5	-81	-2	-21	240
30%	38	83	-1	-35	67	-18	33	-12	-56	-14	-12	137
40%	43	72	-1	11	-48	-20	37	-14	-67	-28	-7	125
50%	32	35	4	26	-6	-7	39	-18	-51	-16	-2	39
60%	6	24	6	42	18	-1	36	-4	-44	-9	-16	10
70%	-4	12	3	33	14	-3	41	5	-51	-8	-3	-2
80%	3	7	6	32	32	-2	44	-20	-39	-38	-10	-9
90%	-8	-1	8	33	43	7	48	-4	-41	-2	-17	8
Long Term												
Full Simulation Period[b]	25	44	-4	21	13	-9	41	-4	-53	-12	-12	83
Water Year Types[c]												
Wet (32%)	35	54	-29	20	7	-23	46	10	-79	1	-4	217
Above Normal (16%)	21	43	27	9	13	-38	72	-7	-59	-3	-20	108
Below Normal (13%)	41	48	2	6	-1	-17	44	-16	-57	-8	-18	-14
Dry (24%)	22	50	-2	40	22	21	31	-14	-26	-22	-7	-2
Critical (15%)	-3	10	6	17	28	12	14	-4	-32	-38	-20	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

B.5. SWP Total Generating Capacity

Table B-5-1. SWP Total Capacity, Monthly Capacity

No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,222	1,091	1,204	1,178	1,332	1,441	1,351	1,367	1,325	1,331	1,293	1,306
20%	1,074	1,027	1,036	1,033	1,201	1,281	1,297	1,310	1,235	1,282	1,275	1,226
30%	1,037	966	990	940	1,097	1,238	1,263	1,278	1,205	1,270	1,244	1,176
40%	983	879	914	861	989	1,143	1,242	1,236	1,184	1,262	1,212	1,115
50%	887	657	871	797	927	999	1,153	1,178	1,163	1,244	1,174	1,064
60%	642	595	627	664	860	932	1,100	1,101	1,146	1,182	1,072	951
70%	499	425	477	521	747	847	930	1,018	1,090	1,065	908	678
80%	374	351	357	294	651	759	840	964	989	927	591	501
90%	247	223	289	210	399	682	727	803	779	541	393	324
Long Term												
Full Simulation Period[b]	764	700	754	734	907	1,016	1,082	1,119	1,089	1,089	995	911
Water Year Types[c]												
Wet (32%)	920	894	1,000	1,060	1,226	1,313	1,315	1,320	1,245	1,294	1,274	1,252
Above Normal (16%)	708	682	792	827	1,030	1,170	1,217	1,218	1,196	1,270	1,226	1,142
Below Normal (13%)	883	791	814	710	924	998	1,105	1,135	1,146	1,171	1,060	905
Dry (24%)	696	573	575	509	706	829	962	1,047	1,056	985	812	694
Critical (15%)	493	430	423	321	406	534	612	681	636	545	384	286

Alternative 1

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,302	1,326	1,345	1,457	1,480	1,513	1,420	1,432	1,380	1,380	1,341	1,305
20%	1,225	1,200	1,244	1,340	1,469	1,484	1,393	1,408	1,355	1,362	1,289	1,276
30%	1,166	1,148	1,151	1,248	1,420	1,468	1,373	1,386	1,340	1,345	1,243	1,226
40%	1,093	1,085	1,098	1,111	1,293	1,444	1,323	1,357	1,304	1,311	1,218	1,153
50%	1,035	957	998	1,025	1,209	1,373	1,312	1,327	1,294	1,284	1,186	1,097
60%	881	603	768	819	1,116	1,263	1,251	1,293	1,270	1,214	1,113	1,048
70%	621	510	547	512	911	1,044	1,127	1,165	1,186	1,139	1,057	976
80%	496	398	466	355	667	851	912	1,026	1,090	1,068	977	689
90%	299	302	338	233	432	720	809	928	954	624	458	410
Long Term												
Full Simulation Period[b]	878	832	878	891	1,086	1,202	1,181	1,224	1,200	1,164	1,071	1,001
Water Year Types[c]												
Wet (32%)	1,055	1,041	1,136	1,264	1,426	1,488	1,383	1,394	1,334	1,345	1,291	1,280
Above Normal (16%)	793	761	907	1,015	1,283	1,436	1,364	1,380	1,338	1,336	1,235	1,170
Below Normal (13%)	990	954	945	934	1,150	1,263	1,252	1,316	1,294	1,244	1,105	1,000
Dry (24%)	786	721	713	621	859	1,006	1,074	1,140	1,167	1,124	1,004	888
Critical (15%)	640	529	504	357	457	602	659	740	727	579	497	402

Alternative 1 minus No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	80	235	140	279	148	72	69	65	55	50	48	-1
20%	151	173	209	307	268	202	96	98	120	80	14	50
30%	130	182	161	308	323	230	110	108	135	74	-1	50
40%	110	206	184	251	304	301	81	121	120	49	6	38
50%	148	299	127	229	282	374	158	148	130	40	12	33
60%	239	8	141	155	256	331	151	192	124	31	41	98
70%	122	85	70	-9	164	197	198	147	96	74	149	298
80%	121	48	109	60	16	92	72	61	101	141	386	187
90%	52	79	48	23	33	38	82	125	175	83	64	86
Long Term												
Full Simulation Period[b]	114	131	124	157	179	186	99	105	111	75	76	90
Water Year Types[c]												
Wet (32%)	134	147	136	204	200	175	68	74	89	52	17	28
Above Normal (16%)	86	79	115	188	253	267	147	161	143	65	9	28
Below Normal (13%)	106	163	131	225	226	265	147	181	147	72	45	95
Dry (24%)	90	148	137	112	153	177	112	93	111	139	192	194
Critical (15%)	147	99	81	36	51	68	47	59	92	34	114	116

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-2. SWP Total Capacity, Monthly Capacity

No Action Alternative

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,222	1,091	1,204	1,178	1,332	1,441	1,351	1,367	1,325	1,331	1,293	1,306
20%	1,074	1,027	1,036	1,033	1,201	1,281	1,297	1,310	1,235	1,282	1,275	1,226
30%	1,037	966	990	940	1,097	1,238	1,263	1,278	1,205	1,270	1,244	1,176
40%	983	879	914	861	989	1,143	1,242	1,236	1,184	1,262	1,212	1,115
50%	887	657	871	797	927	999	1,153	1,178	1,163	1,244	1,174	1,064
60%	642	595	627	664	860	932	1,100	1,101	1,146	1,182	1,072	951
70%	499	425	477	521	747	847	930	1,018	1,090	1,065	908	678
80%	374	351	357	294	651	759	840	964	989	927	591	501
90%	247	223	289	210	399	682	727	803	779	541	393	324
Long Term												
Full Simulation Period[b]	764	700	754	734	907	1,016	1,082	1,119	1,089	1,089	995	911
Water Year Types[c]												
Wet (32%)	920	894	1,000	1,060	1,226	1,313	1,315	1,320	1,245	1,294	1,274	1,252
Above Normal (16%)	708	682	792	827	1,030	1,170	1,217	1,218	1,196	1,270	1,226	1,142
Below Normal (13%)	883	791	814	710	924	998	1,105	1,135	1,146	1,171	1,060	905
Dry (24%)	696	573	575	509	706	829	962	1,047	1,056	985	812	694
Critical (15%)	493	430	423	321	406	534	612	681	636	545	384	286

Alternative 3

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,319	1,361	1,353	1,424	1,478	1,483	1,401	1,435	1,387	1,388	1,348	1,320
20%	1,221	1,188	1,208	1,246	1,420	1,463	1,366	1,395	1,343	1,370	1,309	1,250
30%	1,150	1,128	1,125	1,098	1,297	1,407	1,340	1,365	1,330	1,345	1,242	1,204
40%	1,052	1,057	1,062	1,042	1,180	1,307	1,315	1,342	1,293	1,299	1,214	1,130
50%	988	821	1,003	966	1,096	1,266	1,293	1,301	1,256	1,272	1,162	1,083
60%	827	631	767	767	960	1,075	1,254	1,259	1,211	1,218	1,105	1,016
70%	555	514	545	579	806	919	1,078	1,131	1,163	1,118	1,028	914
80%	427	375	431	309	681	823	929	995	1,033	992	907	609
90%	244	241	345	264	412	676	727	813	793	550	422	352
Long Term												
Full Simulation Period[b]	850	810	859	846	1,022	1,127	1,158	1,201	1,168	1,143	1,041	955
Water Year Types[c]												
Wet (32%)	1,023	1,020	1,119	1,200	1,365	1,444	1,373	1,397	1,341	1,360	1,297	1,267
Above Normal (16%)	764	775	900	909	1,145	1,327	1,312	1,336	1,294	1,318	1,236	1,156
Below Normal (13%)	985	953	950	886	1,094	1,196	1,248	1,294	1,240	1,236	1,110	1,007
Dry (24%)	770	674	660	608	799	885	1,043	1,110	1,129	1,063	921	789
Critical (15%)	579	488	500	372	456	562	636	698	658	529	412	287

Alternative 3 minus No Action Alternative

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	97	270	148	246	146	42	50	67	62	57	55	13
20%	147	161	173	213	219	182	69	85	108	88	34	24
30%	114	162	135	157	200	169	77	87	125	75	-2	28
40%	69	178	148	181	191	164	74	106	109	37	2	14
50%	101	164	133	169	169	267	139	123	93	28	-12	19
60%	185	37	140	103	100	143	154	159	65	36	34	65
70%	56	89	68	57	60	71	148	113	73	53	120	236
80%	52	24	73	14	31	64	88	31	44	65	317	108
90%	-4	19	55	54	13	-7	0	10	15	10	28	28
Long Term												
Full Simulation Period[b]	86	110	105	113	115	111	76	82	80	54	46	44
Water Year Types[c]												
Wet (32%)	102	127	119	140	139	132	58	77	96	66	23	15
Above Normal (16%)	56	94	108	81	115	157	95	118	99	48	10	14
Below Normal (13%)	102	162	136	177	170	198	143	159	94	65	50	101
Dry (24%)	75	101	85	99	93	56	81	63	73	79	109	95
Critical (15%)	86	58	77	51	49	29	24	17	23	-17	28	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-3. SWP Total Capacity, Monthly Capacity

No Action Alternative

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,222	1,091	1,204	1,178	1,332	1,441	1,351	1,367	1,325	1,331	1,293	1,306
20%	1,074	1,027	1,036	1,033	1,201	1,281	1,297	1,310	1,235	1,282	1,275	1,226
30%	1,037	966	990	940	1,097	1,238	1,263	1,278	1,205	1,270	1,244	1,176
40%	983	879	914	861	989	1,143	1,242	1,236	1,184	1,262	1,212	1,115
50%	887	657	871	797	927	999	1,153	1,178	1,163	1,244	1,174	1,064
60%	642	595	627	664	860	932	1,100	1,101	1,146	1,182	1,072	951
70%	499	425	477	521	747	847	930	1,018	1,090	1,065	908	678
80%	374	351	357	294	651	759	840	964	989	927	591	501
90%	247	223	289	210	399	682	727	803	779	541	393	324
Long Term												
Full Simulation Period[b]	764	700	754	734	907	1,016	1,082	1,119	1,089	1,089	995	911
Water Year Types[c]												
Wet (32%)	920	894	1,000	1,060	1,226	1,313	1,315	1,320	1,245	1,294	1,274	1,252
Above Normal (16%)	708	682	792	827	1,030	1,170	1,217	1,218	1,196	1,270	1,226	1,142
Below Normal (13%)	883	791	814	710	924	998	1,105	1,135	1,146	1,171	1,060	905
Dry (24%)	696	573	575	509	706	829	962	1,047	1,056	985	812	694
Critical (15%)	493	430	423	321	406	534	612	681	636	545	384	286

Alternative 5

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,193	1,103	1,143	1,240	1,347	1,439	1,337	1,354	1,274	1,303	1,291	1,289
20%	1,082	1,023	1,032	1,039	1,215	1,303	1,285	1,298	1,235	1,285	1,271	1,225
30%	1,039	966	977	949	1,104	1,239	1,253	1,275	1,203	1,268	1,242	1,183
40%	991	880	932	860	990	1,106	1,237	1,239	1,181	1,262	1,215	1,117
50%	922	706	875	805	939	1,020	1,152	1,180	1,167	1,245	1,175	1,071
60%	639	594	677	656	836	937	1,106	1,081	1,139	1,174	1,068	958
70%	492	431	475	534	750	851	982	1,014	1,083	1,055	938	707
80%	370	349	357	293	645	760	830	963	984	919	591	492
90%	227	222	326	200	364	658	722	788	776	526	393	294
Long Term												
Full Simulation Period[b]	761	704	754	740	909	1,016	1,079	1,111	1,085	1,088	993	907
Water Year Types[c]												
Wet (32%)	909	888	999	1,081	1,229	1,310	1,303	1,316	1,241	1,294	1,273	1,249
Above Normal (16%)	692	666	783	816	1,028	1,170	1,211	1,214	1,194	1,272	1,227	1,139
Below Normal (13%)	882	821	798	717	932	1,005	1,108	1,121	1,143	1,180	1,074	912
Dry (24%)	699	589	585	514	708	829	966	1,031	1,046	982	808	697
Critical (15%)	504	434	432	317	401	533	615	684	636	535	369	257

Alternative 5 minus No Action Alternative

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-29	12	-61	62	15	-2	-14	-13	-51	-27	-2	-17
20%	8	-4	-3	7	13	22	-12	-13	0	3	-5	-1
30%	3	0	-12	9	7	1	-9	-3	-2	-3	-2	7
40%	9	1	18	0	1	-37	-5	3	-2	0	3	1
50%	35	48	4	8	12	21	-1	1	4	1	1	7
60%	-3	0	50	-8	-24	5	6	-19	-7	-9	-3	7
70%	-7	6	-2	12	3	4	52	-4	-7	-10	30	29
80%	-4	-2	0	-2	-5	1	-10	-1	-4	-8	0	-9
90%	-21	0	37	-10	-35	-25	-5	-15	-3	-15	0	-30
Long Term												
Full Simulation Period[b]	-4	4	0	6	1	0	-3	-7	-4	0	-1	-4
Water Year Types[c]												
Wet (32%)	-11	-5	0	21	3	-3	-13	-4	-4	0	-1	-3
Above Normal (16%)	-16	-16	-9	-12	-2	1	-6	-5	-1	2	1	-4
Below Normal (13%)	-1	30	-17	7	8	8	3	-14	-4	9	14	7
Dry (24%)	4	15	9	5	2	0	4	-16	-10	-2	-3	3
Critical (15%)	11	4	9	-4	-5	-1	3	3	0	-10	-15	-28

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-4. SWP Total Capacity, Monthly Capacity

Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,302	1,326	1,345	1,457	1,480	1,513	1,420	1,432	1,380	1,380	1,341	1,305
20%	1,225	1,200	1,244	1,340	1,469	1,484	1,393	1,408	1,355	1,362	1,289	1,276
30%	1,166	1,148	1,151	1,248	1,420	1,468	1,373	1,386	1,340	1,345	1,243	1,226
40%	1,093	1,085	1,098	1,111	1,293	1,444	1,323	1,357	1,304	1,311	1,218	1,153
50%	1,035	957	998	1,025	1,209	1,373	1,312	1,327	1,294	1,284	1,186	1,097
60%	881	603	768	819	1,116	1,263	1,251	1,293	1,270	1,214	1,113	1,048
70%	621	510	547	512	911	1,044	1,127	1,165	1,186	1,139	1,057	976
80%	496	398	466	355	667	851	912	1,026	1,090	1,068	977	689
90%	299	302	338	233	432	720	809	928	954	624	458	410
Long Term												
Full Simulation Period[b]	878	832	878	891	1,086	1,202	1,181	1,224	1,200	1,164	1,071	1,001
Water Year Types[c]												
Wet (32%)	1,055	1,041	1,136	1,264	1,426	1,488	1,383	1,394	1,334	1,345	1,291	1,280
Above Normal (16%)	793	761	907	1,015	1,283	1,436	1,364	1,380	1,338	1,336	1,235	1,170
Below Normal (13%)	990	954	945	934	1,150	1,263	1,252	1,316	1,294	1,244	1,105	1,000
Dry (24%)	786	721	713	621	859	1,006	1,074	1,140	1,167	1,124	1,004	888
Critical (15%)	640	529	504	357	457	602	659	740	727	579	497	402

No Action Alternative

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,222	1,091	1,204	1,178	1,332	1,441	1,351	1,367	1,325	1,331	1,293	1,306
20%	1,074	1,027	1,036	1,033	1,201	1,281	1,297	1,310	1,235	1,282	1,275	1,226
30%	1,037	966	990	940	1,097	1,238	1,263	1,278	1,205	1,270	1,244	1,176
40%	983	879	914	861	989	1,143	1,242	1,236	1,184	1,262	1,212	1,115
50%	887	657	871	797	927	999	1,153	1,178	1,163	1,244	1,174	1,064
60%	642	595	627	664	860	932	1,100	1,101	1,146	1,182	1,072	951
70%	499	425	477	521	747	847	930	1,018	1,090	1,065	908	678
80%	374	351	357	294	651	759	840	964	989	927	591	501
90%	247	223	289	210	399	682	727	803	779	541	393	324
Long Term												
Full Simulation Period[b]	764	700	754	734	907	1,016	1,082	1,119	1,089	1,089	995	911
Water Year Types[c]												
Wet (32%)	920	894	1,000	1,060	1,226	1,313	1,315	1,320	1,245	1,294	1,274	1,252
Above Normal (16%)	708	682	792	827	1,030	1,170	1,217	1,218	1,196	1,270	1,226	1,142
Below Normal (13%)	883	791	814	710	924	998	1,105	1,135	1,146	1,171	1,060	905
Dry (24%)	696	573	575	509	706	829	962	1,047	1,056	985	812	694
Critical (15%)	493	430	423	321	406	534	612	681	636	545	384	286

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-80	-235	-140	-279	-148	-72	-69	-65	-55	-50	-48	1
20%	-151	-173	-209	-307	-268	-202	-96	-98	-120	-80	-14	-50
30%	-130	-182	-161	-308	-323	-230	-110	-108	-135	-74	1	-50
40%	-110	-206	-184	-251	-304	-301	-81	-121	-120	-49	-6	-38
50%	-148	-299	-127	-229	-282	-374	-158	-148	-130	-40	-12	-33
60%	-239	-8	-141	-155	-256	-331	-151	-192	-124	-31	-41	-98
70%	-122	-85	-70	9	-164	-197	-198	-147	-96	-74	-149	-298
80%	-121	-48	-109	-60	-16	-92	-72	-61	-101	-141	-386	-187
90%	-52	-79	-48	-23	-33	-38	-82	-125	-175	-83	-64	-86
Long Term												
Full Simulation Period[b]	-114	-131	-124	-157	-179	-186	-99	-105	-111	-75	-76	-90
Water Year Types[c]												
Wet (32%)	-134	-147	-136	-204	-200	-175	-68	-74	-89	-52	-17	-28
Above Normal (16%)	-86	-79	-115	-188	-253	-267	-147	-161	-143	-65	-9	-28
Below Normal (13%)	-106	-163	-131	-225	-226	-265	-147	-181	-147	-72	-45	-95
Dry (24%)	-90	-148	-137	-112	-153	-177	-112	-93	-111	-139	-192	-194
Critical (15%)	-147	-99	-81	-36	-51	-68	-47	-59	-92	-34	-114	-116

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-5. SWP Total Capacity, Monthly Capacity

Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,302	1,326	1,345	1,457	1,480	1,513	1,420	1,432	1,380	1,380	1,341	1,305
20%	1,225	1,200	1,244	1,340	1,469	1,484	1,393	1,408	1,355	1,362	1,289	1,276
30%	1,166	1,148	1,151	1,248	1,420	1,468	1,373	1,386	1,340	1,345	1,243	1,226
40%	1,093	1,085	1,098	1,111	1,293	1,444	1,323	1,357	1,304	1,311	1,218	1,153
50%	1,035	957	998	1,025	1,209	1,373	1,312	1,327	1,294	1,284	1,186	1,097
60%	881	603	768	819	1,116	1,263	1,251	1,293	1,270	1,214	1,113	1,048
70%	621	510	547	512	911	1,044	1,127	1,165	1,186	1,139	1,057	976
80%	496	398	466	355	667	851	912	1,026	1,090	1,068	977	689
90%	299	302	338	233	432	720	809	928	954	624	458	410
Long Term												
Full Simulation Period[b]	878	832	878	891	1,086	1,202	1,181	1,224	1,200	1,164	1,071	1,001
Water Year Types[c]												
Wet (32%)	1,055	1,041	1,136	1,264	1,426	1,488	1,383	1,394	1,334	1,345	1,291	1,280
Above Normal (16%)	793	761	907	1,015	1,283	1,436	1,364	1,380	1,338	1,336	1,235	1,170
Below Normal (13%)	990	954	945	934	1,150	1,263	1,252	1,316	1,294	1,244	1,105	1,000
Dry (24%)	786	721	713	621	859	1,006	1,074	1,140	1,167	1,124	1,004	888
Critical (15%)	640	529	504	357	457	602	659	740	727	579	497	402

Alternative 3

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,319	1,361	1,353	1,424	1,478	1,483	1,401	1,435	1,387	1,388	1,348	1,320
20%	1,221	1,188	1,208	1,246	1,420	1,463	1,366	1,395	1,343	1,370	1,309	1,250
30%	1,150	1,128	1,125	1,098	1,297	1,407	1,340	1,365	1,330	1,345	1,242	1,204
40%	1,052	1,057	1,062	1,042	1,180	1,307	1,315	1,342	1,293	1,299	1,214	1,130
50%	988	821	1,003	966	1,096	1,266	1,293	1,301	1,256	1,272	1,162	1,083
60%	827	631	767	767	960	1,075	1,254	1,259	1,211	1,218	1,105	1,016
70%	555	514	545	579	806	919	1,078	1,131	1,163	1,118	1,028	914
80%	427	375	431	309	681	823	929	995	1,033	992	907	609
90%	244	241	345	264	412	676	727	813	793	550	422	352
Long Term												
Full Simulation Period[b]	850	810	859	846	1,022	1,127	1,158	1,201	1,168	1,143	1,041	955
Water Year Types[c]												
Wet (32%)	1,023	1,020	1,119	1,200	1,365	1,444	1,373	1,397	1,341	1,360	1,297	1,267
Above Normal (16%)	764	775	900	909	1,145	1,327	1,312	1,336	1,294	1,318	1,236	1,156
Below Normal (13%)	985	953	950	886	1,094	1,196	1,248	1,294	1,240	1,236	1,110	1,007
Dry (24%)	770	674	660	608	799	885	1,043	1,110	1,129	1,063	921	789
Critical (15%)	579	488	500	372	456	562	636	698	658	529	412	287

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly Capacity (MW)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	17	35	8	-33	-2	-30	-19	2	7	8	8	15
20%	-4	-12	-36	-94	-49	-20	-27	-13	-12	8	20	-26
30%	-16	-20	-26	-150	-123	-61	-33	-21	-10	0	-1	-22
40%	-41	-28	-36	-70	-113	-137	-7	-15	-11	-12	-4	-23
50%	-46	-136	5	-60	-113	-107	-19	-25	-38	-12	-24	-14
60%	-53	28	-2	-52	-156	-187	3	-34	-59	4	-8	-33
70%	-66	4	-2	67	-104	-126	-49	-34	-23	-21	-29	-62
80%	-69	-23	-35	-46	15	-28	16	-31	-57	-76	-70	-80
90%	-56	-60	7	32	-20	-45	-82	-115	-160	-73	-36	-58
Long Term												
Full Simulation Period[b]	-28	-21	-19	-44	-64	-75	-23	-22	-31	-21	-30	-46
Water Year Types[c]												
Wet (32%)	-32	-20	-17	-64	-61	-43	-10	3	7	15	6	-13
Above Normal (16%)	-30	15	-7	-106	-138	-109	-52	-43	-44	-17	1	-14
Below Normal (13%)	-4	0	5	-48	-56	-67	-4	-22	-53	-7	5	6
Dry (24%)	-16	-47	-53	-12	-60	-121	-30	-30	-38	-61	-83	-98
Critical (15%)	-61	-41	-4	15	-1	-39	-23	-42	-69	-50	-86	-115

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-6. SWP Total Capacity, Monthly Capacity

Second Basis of Comparison

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,302	1,326	1,345	1,457	1,480	1,513	1,420	1,432	1,380	1,380	1,341	1,305
20%	1,225	1,200	1,244	1,340	1,469	1,484	1,393	1,408	1,355	1,362	1,289	1,276
30%	1,166	1,148	1,151	1,248	1,420	1,468	1,373	1,386	1,340	1,345	1,243	1,226
40%	1,093	1,085	1,098	1,111	1,293	1,444	1,323	1,357	1,304	1,311	1,218	1,153
50%	1,035	957	998	1,025	1,209	1,373	1,312	1,327	1,294	1,284	1,186	1,097
60%	881	603	768	819	1,116	1,263	1,251	1,293	1,270	1,214	1,113	1,048
70%	621	510	547	512	911	1,044	1,127	1,165	1,186	1,139	1,057	976
80%	496	398	466	355	667	851	912	1,026	1,090	1,068	977	689
90%	299	302	338	233	432	720	809	928	954	624	458	410
Long Term												
Full Simulation Period[b]	878	832	878	891	1,086	1,202	1,181	1,224	1,200	1,164	1,071	1,001
Water Year Types[c]												
Wet (32%)	1,055	1,041	1,136	1,264	1,426	1,488	1,383	1,394	1,334	1,345	1,291	1,280
Above Normal (16%)	793	761	907	1,015	1,283	1,436	1,364	1,380	1,338	1,336	1,235	1,170
Below Normal (13%)	990	954	945	934	1,150	1,263	1,252	1,316	1,294	1,244	1,105	1,000
Dry (24%)	786	721	713	621	859	1,006	1,074	1,140	1,167	1,124	1,004	888
Critical (15%)	640	529	504	357	457	602	659	740	727	579	497	402

Alternative 5

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,193	1,103	1,143	1,240	1,347	1,439	1,337	1,354	1,274	1,303	1,291	1,289
20%	1,082	1,023	1,032	1,039	1,215	1,303	1,285	1,298	1,235	1,285	1,271	1,225
30%	1,039	966	977	949	1,104	1,239	1,253	1,275	1,203	1,268	1,242	1,183
40%	991	880	932	860	990	1,106	1,237	1,239	1,181	1,262	1,215	1,117
50%	922	706	875	805	939	1,020	1,152	1,180	1,167	1,245	1,175	1,071
60%	639	594	677	656	836	937	1,106	1,081	1,139	1,174	1,068	958
70%	492	431	475	534	750	851	982	1,014	1,083	1,055	938	707
80%	370	349	357	293	645	760	830	963	984	919	591	492
90%	227	222	326	200	364	658	722	788	776	526	393	294
Long Term												
Full Simulation Period[b]	761	704	754	740	909	1,016	1,079	1,111	1,085	1,088	993	907
Water Year Types[c]												
Wet (32%)	909	888	999	1,081	1,229	1,310	1,303	1,316	1,241	1,294	1,273	1,249
Above Normal (16%)	692	666	783	816	1,028	1,170	1,211	1,214	1,194	1,272	1,227	1,139
Below Normal (13%)	882	821	798	717	932	1,005	1,108	1,121	1,143	1,180	1,074	912
Dry (24%)	699	589	585	514	708	829	966	1,031	1,046	982	808	697
Critical (15%)	504	434	432	317	401	533	615	684	636	535	369	257

Alternative 5 minus Second Basis of Comparison

	Monthly Capacity (MW)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-109	-223	-201	-217	-134	-74	-84	-78	-105	-77	-49	-15
20%	-143	-177	-212	-301	-254	-181	-108	-111	-120	-77	-19	-51
30%	-127	-182	-174	-299	-316	-229	-119	-111	-138	-77	-1	-43
40%	-101	-205	-165	-251	-304	-338	-85	-118	-122	-49	-3	-36
50%	-113	-251	-123	-221	-270	-354	-159	-147	-126	-38	-11	-26
60%	-241	-9	-91	-164	-280	-325	-145	-212	-131	-40	-44	-91
70%	-129	-79	-72	22	-161	-194	-146	-151	-103	-83	-119	-269
80%	-125	-50	-108	-62	-21	-91	-82	-63	-106	-149	-386	-197
90%	-72	-79	-11	-33	-68	-63	-87	-139	-178	-98	-64	-116
Long Term												
Full Simulation Period[b]	-118	-127	-125	-151	-177	-186	-102	-112	-115	-76	-78	-94
Water Year Types[c]												
Wet (32%)	-146	-152	-137	-183	-197	-178	-81	-78	-92	-51	-18	-31
Above Normal (16%)	-102	-95	-124	-199	-255	-266	-153	-166	-144	-63	-8	-31
Below Normal (13%)	-107	-133	-148	-217	-218	-258	-144	-195	-151	-63	-31	-88
Dry (24%)	-87	-132	-128	-107	-151	-177	-107	-109	-121	-142	-195	-191
Critical (15%)	-136	-95	-73	-40	-56	-69	-44	-56	-91	-44	-128	-144

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

B.6. SWP Total Energy Generation

Table B-6-1. SWP Total Generation, Monthly Generation

No Action Alternative

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	501	396	434	660	675	759	602	704	535	712	619	662
20%	429	355	376	261	551	569	419	532	483	691	605	621
30%	408	328	300	190	238	425	361	443	470	677	581	593
40%	388	311	282	171	169	299	337	411	439	662	553	534
50%	340	285	270	139	131	161	315	380	413	645	518	486
60%	302	255	246	94	110	114	247	329	398	579	481	374
70%	228	199	200	59	72	88	185	272	382	497	374	304
80%	197	158	156	44	55	63	126	247	344	407	295	256
90%	124	85	87	36	45	47	99	207	277	231	195	170
Long Term												
Full Simulation Period[b]	321	272	275	208	245	298	313	408	414	556	458	438
Water Year Types[c]												
Wet (32%)	378	342	347	414	506	592	521	622	487	647	551	630
Above Normal (16%)	290	261	276	172	217	370	331	410	443	697	606	556
Below Normal (13%)	383	295	294	141	138	156	260	343	417	633	516	388
Dry (24%)	294	223	226	96	92	81	183	300	402	483	366	313
Critical (15%)	220	191	182	52	60	72	108	184	243	256	199	145

Alternative 1

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	483	422	475	810	779	852	601	673	636	740	638	505
20%	467	401	396	393	640	698	442	603	591	719	590	481
30%	450	379	355	319	468	596	379	542	557	680	554	470
40%	433	356	338	237	298	492	351	453	533	643	510	434
50%	401	338	303	208	239	330	325	410	496	591	488	402
60%	372	315	285	191	201	281	298	363	458	538	452	387
70%	307	227	261	95	168	165	235	324	421	477	428	362
80%	262	193	197	51	95	125	137	267	384	432	401	328
90%	157	155	151	39	39	51	117	223	356	368	299	244
Long Term												
Full Simulation Period[b]	360	311	325	285	336	409	335	441	489	565	479	395
Water Year Types[c]												
Wet (32%)	405	371	422	542	611	716	517	608	524	638	524	442
Above Normal (16%)	323	265	309	250	370	572	384	486	566	712	588	479
Below Normal (13%)	408	340	305	227	272	291	313	460	558	629	509	418
Dry (24%)	346	291	284	127	147	164	210	327	466	498	456	377
Critical (15%)	281	235	222	80	79	85	117	207	304	300	275	210

Alternative 1 minus No Action Alternative

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-18	26	40	150	104	93	-1	-31	101	27	18	-158
20%	38	46	20	132	89	130	23	72	108	28	-15	-140
30%	43	51	55	129	230	171	18	99	87	3	-27	-123
40%	45	46	55	66	129	194	14	42	94	-19	-43	-100
50%	61	53	33	69	108	169	10	30	83	-55	-30	-84
60%	71	60	38	97	91	167	50	34	60	-41	-29	13
70%	79	28	62	36	96	77	49	52	39	-20	54	58
80%	65	35	41	6	40	63	11	20	40	25	106	72
90%	33	70	64	4	-6	4	18	16	78	137	104	74
Long Term												
Full Simulation Period[b]	39	39	50	76	92	112	22	33	75	9	21	-43
Water Year Types[c]												
Wet (32%)	27	29	74	129	105	124	-4	-14	37	-9	-27	-189
Above Normal (16%)	33	4	33	78	152	201	53	76	123	15	-18	-77
Below Normal (13%)	25	45	11	86	134	135	53	116	141	-4	-7	30
Dry (24%)	52	69	58	31	55	83	27	27	64	15	90	63
Critical (15%)	61	44	40	28	19	13	8	23	60	44	76	66

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-2. SWP Total Generation, Monthly Generation

No Action Alternative

Statistic	Monthly Generation (GWh) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	501	396	434	660	675	759	602	704	535	712	619	662
20%	429	355	376	261	551	569	419	532	483	691	605	621
30%	408	328	300	190	238	425	361	443	470	677	581	593
40%	388	311	282	171	169	299	337	411	439	662	553	534
50%	340	285	270	139	131	161	315	380	413	645	518	486
60%	302	255	246	94	110	114	247	329	398	579	481	374
70%	228	199	200	59	72	88	185	272	382	497	374	304
80%	197	158	156	44	55	63	126	247	344	407	295	256
90%	124	85	87	36	45	47	99	207	277	231	195	170
Long Term												
Full Simulation Period[b]	321	272	275	208	245	298	313	408	414	556	458	438
Water Year Types[c]												
Wet (32%)	378	342	347	414	506	592	521	622	487	647	551	630
Above Normal (16%)	290	261	276	172	217	370	331	410	443	697	606	556
Below Normal (13%)	383	295	294	141	138	156	260	343	417	633	516	388
Dry (24%)	294	223	226	96	92	81	183	300	402	483	366	313
Critical (15%)	220	191	182	52	60	72	108	184	243	256	199	145

Alternative 3

Statistic	Monthly Generation (GWh) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	484	425	486	779	741	795	601	682	597	727	623	493
20%	461	400	385	335	617	641	425	578	567	714	592	474
30%	434	382	356	238	357	550	395	499	534	698	570	448
40%	401	354	317	207	268	435	343	454	513	678	539	408
50%	384	333	295	189	187	293	328	419	496	656	509	391
60%	346	301	280	166	156	196	313	382	475	615	470	375
70%	275	261	257	79	120	114	242	346	448	520	416	344
80%	209	187	189	44	69	88	131	247	381	424	363	286
90%	129	91	131	35	46	49	111	216	295	264	217	176
Long Term												
Full Simulation Period[b]	339	305	313	258	303	367	333	437	476	571	468	368
Water Year Types[c]												
Wet (32%)	398	375	421	507	583	682	514	616	543	659	534	428
Above Normal (16%)	305	284	310	191	284	497	363	463	532	717	596	467
Below Normal (13%)	397	336	306	198	244	263	330	451	503	664	552	383
Dry (24%)	312	266	246	121	119	99	212	332	460	505	411	348
Critical (15%)	244	213	203	76	79	85	114	184	271	251	205	148

Alternative 3 minus No Action Alternative

Statistic	Monthly Generation (GWh) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-17	29	52	119	66	36	-1	-21	62	15	4	-169
20%	32	45	9	74	65	72	5	46	84	22	-13	-148
30%	26	54	56	48	120	126	34	56	64	21	-11	-145
40%	13	44	34	36	99	136	7	42	74	16	-14	-126
50%	43	47	25	51	56	131	13	39	83	11	-9	-95
60%	44	46	34	72	46	82	66	53	77	36	-11	1
70%	47	62	57	20	47	27	56	74	66	23	42	40
80%	12	29	33	-1	14	25	5	1	37	17	67	30
90%	5	6	44	-1	1	2	12	9	17	33	21	6
Long Term												
Full Simulation Period[b]	18	34	38	50	58	69	20	29	62	16	10	-70
Water Year Types[c]												
Wet (32%)	19	33	73	93	76	89	-7	-6	57	12	-17	-203
Above Normal (16%)	15	23	35	20	67	127	32	53	90	20	-10	-89
Below Normal (13%)	15	41	12	57	106	106	70	108	86	31	36	-5
Dry (24%)	18	43	20	25	27	18	29	31	58	22	45	35
Critical (15%)	24	22	21	24	19	12	5	0	28	-5	6	3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-3. SWP Total Generation, Monthly Generation

No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Generation (GWh)											
Probability of Exceedance[a]												
10%	501	396	434	660	675	759	602	704	535	712	619	662
20%	429	355	376	261	551	569	419	532	483	691	605	621
30%	408	328	300	190	238	425	361	443	470	677	581	593
40%	388	311	282	171	169	299	337	411	439	662	553	534
50%	340	285	270	139	131	161	315	380	413	645	518	486
60%	302	255	246	94	110	114	247	329	398	579	481	374
70%	228	199	200	59	72	88	185	272	382	497	374	304
80%	197	158	156	44	55	63	126	247	344	407	295	256
90%	124	85	87	36	45	47	99	207	277	231	195	170
Long Term												
Full Simulation Period[b]	321	272	275	208	245	298	313	408	414	556	458	438
Water Year Types[c]												
Wet (32%)	378	342	347	414	506	592	521	622	487	647	551	630
Above Normal (16%)	290	261	276	172	217	370	331	410	443	697	606	556
Below Normal (13%)	383	295	294	141	138	156	260	343	417	633	516	388
Dry (24%)	294	223	226	96	92	81	183	300	402	483	366	313
Critical (15%)	220	191	182	52	60	72	108	184	243	256	199	145

Alternative 5

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Generation (GWh)											
Probability of Exceedance[a]												
10%	475	413	406	652	685	727	587	692	517	714	622	651
20%	435	357	365	284	538	573	414	532	484	699	607	622
30%	410	329	300	190	221	448	362	434	464	681	589	590
40%	391	314	278	177	184	301	333	406	435	663	561	535
50%	331	291	267	130	153	168	311	380	412	651	535	491
60%	303	252	254	87	93	116	256	308	400	589	468	391
70%	222	205	218	58	72	89	192	266	376	486	380	302
80%	190	171	163	44	54	62	132	244	353	411	307	254
90%	120	90	96	36	44	47	103	202	259	234	197	159
Long Term												
Full Simulation Period[b]	317	275	274	211	244	297	312	401	409	557	462	436
Water Year Types[c]												
Wet (32%)	372	339	344	426	507	590	510	618	479	645	554	624
Above Normal (16%)	280	264	276	162	215	368	326	404	440	698	607	557
Below Normal (13%)	369	316	281	142	141	160	265	328	412	639	534	393
Dry (24%)	298	227	227	96	93	81	194	288	398	490	370	313
Critical (15%)	219	192	189	51	54	73	108	183	239	249	196	140

Alternative 5 minus No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Generation (GWh)											
Probability of Exceedance[a]												
10%	-26	17	-28	-8	11	-32	-15	-11	-18	2	3	-12
20%	6	1	-11	23	-13	4	-5	0	0	8	2	1
30%	2	1	0	0	-17	23	1	-9	-6	4	8	-4
40%	3	4	-4	6	14	2	-4	-5	-5	1	8	1
50%	-9	5	-3	-9	22	6	-4	0	-2	5	18	5
60%	1	-3	7	-7	-17	2	9	-21	2	10	-13	17
70%	-6	6	18	-1	-1	1	6	-6	-5	-11	6	-3
80%	-7	13	7	0	-1	-1	6	-3	9	4	11	-2
90%	-4	6	9	0	-2	0	3	-5	-18	4	1	-11
Long Term												
Full Simulation Period[b]	-4	4	-2	3	0	-1	-1	-8	-5	1	4	-2
Water Year Types[c]												
Wet (32%)	-6	-2	-3	13	1	-2	-11	-5	-8	-1	3	-7
Above Normal (16%)	-9	3	0	-9	-2	-3	-5	-6	-2	1	1	1
Below Normal (13%)	-14	21	-13	1	2	3	5	-16	-5	6	18	5
Dry (24%)	4	5	1	1	1	0	10	-12	-4	7	3	0
Critical (15%)	0	1	8	-1	-6	1	-1	-1	-5	-7	-3	-5

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-4. SWP Total Generation, Monthly Generation

Second Basis of Comparison

	Monthly Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	483	422	475	810	779	852	601	673	636	740	638	505
20%	467	401	396	393	640	698	442	603	591	719	590	481
30%	450	379	355	319	468	596	379	542	557	680	554	470
40%	433	356	338	237	298	492	351	453	533	643	510	434
50%	401	338	303	208	239	330	325	410	496	591	488	402
60%	372	315	285	191	201	281	298	363	458	538	452	387
70%	307	227	261	95	168	165	235	324	421	477	428	362
80%	262	193	197	51	95	125	137	267	384	432	401	328
90%	157	155	151	39	39	51	117	223	356	368	299	244
Long Term												
Full Simulation Period[b]	360	311	325	285	336	409	335	441	489	565	479	395
Water Year Types[c]												
Wet (32%)	405	371	422	542	611	716	517	608	524	638	524	442
Above Normal (16%)	323	265	309	250	370	572	384	486	566	712	588	479
Below Normal (13%)	408	340	305	227	272	291	313	460	558	629	509	418
Dry (24%)	346	291	284	127	147	164	210	327	466	498	456	377
Critical (15%)	281	235	222	80	79	85	117	207	304	300	275	210

No Action Alternative

	Monthly Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	501	396	434	660	675	759	602	704	535	712	619	662
20%	429	355	376	261	551	569	419	532	483	691	605	621
30%	408	328	300	190	238	425	361	443	470	677	581	593
40%	388	311	282	171	169	299	337	411	439	662	553	534
50%	340	285	270	139	131	161	315	380	413	645	518	486
60%	302	255	246	94	110	114	247	329	398	579	481	374
70%	228	199	200	59	72	88	185	272	382	497	374	304
80%	197	158	156	44	55	63	126	247	344	407	295	256
90%	124	85	87	36	45	47	99	207	277	231	195	170
Long Term												
Full Simulation Period[b]	321	272	275	208	245	298	313	408	414	556	458	438
Water Year Types[c]												
Wet (32%)	378	342	347	414	506	592	521	622	487	647	551	630
Above Normal (16%)	290	261	276	172	217	370	331	410	443	697	606	556
Below Normal (13%)	383	295	294	141	138	156	260	343	417	633	516	388
Dry (24%)	294	223	226	96	92	81	183	300	402	483	366	313
Critical (15%)	220	191	182	52	60	72	108	184	243	256	199	145

No Action Alternative minus Second Basis of Comparison

	Monthly Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	18	**-26**	**-40**	**-150**	**-104**	**-93**	1	31	**-101**	**-27**	**-18**	158
20%	**-38**	**-46**	**-20**	**-132**	**-89**	**-130**	**-23**	**-72**	**-108**	**-28**	15	140
30%	**-43**	**-51**	**-55**	**-129**	**-230**	**-171**	**-18**	**-99**	**-87**	**-3**	27	123
40%	**-45**	**-46**	**-55**	**-66**	**-129**	**-194**	**-14**	**-42**	**-94**	19	43	100
50%	**-61**	**-53**	**-33**	**-69**	**-108**	**-169**	**-10**	**-30**	**-83**	55	30	84
60%	**-71**	**-60**	**-38**	**-97**	**-91**	**-167**	**-50**	**-34**	**-60**	41	29	**-13**
70%	**-79**	**-28**	**-62**	**-36**	**-96**	**-77**	**-49**	**-52**	**-39**	20	**-54**	**-58**
80%	**-65**	**-35**	**-41**	**-6**	**-40**	**-63**	**-11**	**-20**	**-40**	**-25**	**-106**	**-72**
90%	**-33**	**-70**	**-64**	**-4**	6	**-4**	**-18**	**-16**	**-78**	**-137**	**-104**	**-74**
Long Term												
Full Simulation Period[b]	**-39**	**-39**	**-50**	**-76**	**-92**	**-112**	**-22**	**-33**	**-75**	**-9**	**-21**	43
Water Year Types[c]												
Wet (32%)	**-27**	**-29**	**-74**	**-129**	**-105**	**-124**	4	14	**-37**	9	27	189
Above Normal (16%)	**-33**	**-4**	**-33**	**-78**	**-152**	**-201**	**-53**	**-76**	**-123**	**-15**	18	77
Below Normal (13%)	**-25**	**-45**	**-11**	**-86**	**-134**	**-135**	**-53**	**-116**	**-141**	4	7	**-30**
Dry (24%)	**-52**	**-69**	**-58**	**-31**	**-55**	**-83**	**-27**	**-27**	**-64**	**-15**	**-90**	**-63**
Critical (15%)	**-61**	**-44**	**-40**	**-28**	**-19**	**-13**	**-8**	**-23**	**-60**	**-44**	**-76**	**-66**

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-5. SWP Total Generation, Monthly Generation

Second Basis of Comparison

	Monthly Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	483	422	475	810	779	852	601	673	636	740	638	505
20%	467	401	396	393	640	698	442	603	591	719	590	481
30%	450	379	355	319	468	596	379	542	557	680	554	470
40%	433	356	338	237	298	492	351	453	533	643	510	434
50%	401	338	303	208	239	330	325	410	496	591	488	402
60%	372	315	285	191	201	281	298	363	458	538	452	387
70%	307	227	261	95	168	165	235	324	421	477	428	362
80%	262	193	197	51	95	125	137	267	384	432	401	328
90%	157	155	151	39	39	51	117	223	356	368	299	244
Long Term												
Full Simulation Period[b]	360	311	325	285	336	409	335	441	489	565	479	395
Water Year Types[c]												
Wet (32%)	405	371	422	542	611	716	517	608	524	638	524	442
Above Normal (16%)	323	265	309	250	370	572	384	486	566	712	588	479
Below Normal (13%)	408	340	305	227	272	291	313	460	558	629	509	418
Dry (24%)	346	291	284	127	147	164	210	327	466	498	456	377
Critical (15%)	281	235	222	80	79	85	117	207	304	300	275	210

Alternative 3

	Monthly Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	484	425	486	779	741	795	601	682	597	727	623	493
20%	461	400	385	335	617	641	425	578	567	714	592	474
30%	434	382	356	238	357	550	395	499	534	698	570	448
40%	401	354	317	207	268	435	343	454	513	678	539	408
50%	384	333	295	189	187	293	328	419	496	656	509	391
60%	346	301	280	166	156	196	313	382	475	615	470	375
70%	275	261	257	79	120	114	242	346	448	520	416	344
80%	209	187	189	44	69	88	131	247	381	424	363	286
90%	129	91	131	35	46	49	111	216	295	264	217	176
Long Term												
Full Simulation Period[b]	339	305	313	258	303	367	333	437	476	571	468	368
Water Year Types[c]												
Wet (32%)	398	375	421	507	583	682	514	616	543	659	534	428
Above Normal (16%)	305	284	310	191	284	497	363	463	532	717	596	467
Below Normal (13%)	397	336	306	198	244	263	330	451	503	664	552	383
Dry (24%)	312	266	246	121	119	99	212	332	460	505	411	348
Critical (15%)	244	213	203	76	79	85	114	184	271	251	205	148

Alternative 3 minus Second Basis of Comparison

	Monthly Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	2	3	12	-31	-38	-57	0	10	-40	-13	-15	-12
20%	-6	-2	-11	-59	-24	-58	-18	-25	-24	-6	2	-7
30%	-16	3	0	-82	-110	-46	16	-43	-22	19	16	-22
40%	-32	-2	-21	-29	-30	-58	-7	1	-20	35	28	-26
50%	-18	-6	-8	-18	-52	-37	3	8	0	66	21	-12
60%	-26	-14	-4	-25	-45	-85	16	19	16	77	18	-12
70%	-32	35	-4	-16	-49	-50	7	22	27	43	-13	-18
80%	-52	-7	-8	-7	-26	-38	-6	-20	-2	-8	-39	-42
90%	-28	-64	-20	-4	7	-2	-6	-7	-61	-104	-83	-68
Long Term												
Full Simulation Period[b]	-20	-5	-12	-26	-33	-43	-2	-4	-12	7	-11	-27
Water Year Types[c]												
Wet (32%)	-7	4	-1	-35	-28	-35	-3	8	20	21	10	-14
Above Normal (16%)	-18	19	2	-59	-85	-75	-21	-23	-33	5	8	-12
Below Normal (13%)	-11	-4	1	-29	-28	-29	17	-8	-54	35	43	-35
Dry (24%)	-34	-26	-38	-5	-29	-66	2	5	-6	7	-45	-29
Critical (15%)	-37	-21	-20	-4	0	-1	-3	-23	-32	-49	-70	-63

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-6. SWP Total Generation, Monthly Generation

Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	483	422	475	810	779	852	601	673	636	740	638	505
20%	467	401	396	393	640	698	442	603	591	719	590	481
30%	450	379	355	319	468	596	379	542	557	680	554	470
40%	433	356	338	237	298	492	351	453	533	643	510	434
50%	401	338	303	208	239	330	325	410	496	591	488	402
60%	372	315	285	191	201	281	298	363	458	538	452	387
70%	307	227	261	95	168	165	235	324	421	477	428	362
80%	262	193	197	51	95	125	137	267	384	432	401	328
90%	157	155	151	39	39	51	117	223	356	368	299	244
Long Term												
Full Simulation Period[b]	360	311	325	285	336	409	335	441	489	565	479	395
Water Year Types[c]												
Wet (32%)	405	371	422	542	611	716	517	608	524	638	524	442
Above Normal (16%)	323	265	309	250	370	572	384	486	566	712	588	479
Below Normal (13%)	408	340	305	227	272	291	313	460	558	629	509	418
Dry (24%)	346	291	284	127	147	164	210	327	466	498	456	377
Critical (15%)	281	235	222	80	79	85	117	207	304	300	275	210

Alternative 5

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	475	413	406	652	685	727	587	692	517	714	622	651
20%	435	357	365	284	538	573	414	532	484	699	607	622
30%	410	329	300	190	221	448	362	434	464	681	589	590
40%	391	314	278	177	184	301	333	406	435	663	561	535
50%	331	291	267	130	153	168	311	380	412	651	535	491
60%	303	252	254	87	93	116	256	308	400	589	468	391
70%	222	205	218	58	72	89	192	266	376	486	380	302
80%	190	171	163	44	54	62	132	244	353	411	307	254
90%	120	90	96	36	44	47	103	202	259	234	197	159
Long Term												
Full Simulation Period[b]	317	275	274	211	244	297	312	401	409	557	462	436
Water Year Types[c]												
Wet (32%)	372	339	344	426	507	590	510	618	479	645	554	624
Above Normal (16%)	280	264	276	162	215	368	326	404	440	698	607	557
Below Normal (13%)	369	316	281	142	141	160	265	328	412	639	534	393
Dry (24%)	298	227	227	96	93	81	194	288	398	490	370	313
Critical (15%)	219	192	189	51	54	73	108	183	239	249	196	140

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-8	-9	-68	-158	-94	-125	-14	19	-120	-25	-16	146
20%	-32	-45	-31	-110	-102	-126	-28	-71	-108	-20	17	141
30%	-40	-50	-55	-129	-247	-148	-17	-108	-92	1	35	119
40%	-42	-42	-59	-60	-114	-191	-18	-47	-99	20	51	101
50%	-70	-48	-35	-78	-86	-162	-14	-30	-85	60	47	88
60%	-69	-63	-31	-104	-108	-166	-41	-55	-58	51	16	4
70%	-85	-22	-44	-37	-97	-76	-43	-58	-45	9	-49	-60
80%	-72	-22	-33	-6	-41	-63	-5	-23	-30	-21	-95	-74
90%	-37	-65	-55	-3	5	-4	-14	-21	-97	-133	-102	-85
Long Term												
Full Simulation Period[b]	-43	-35	-52	-74	-92	-112	-23	-41	-80	-8	-17	41
Water Year Types[c]												
Wet (32%)	-33	-31	-77	-116	-104	-126	-7	10	-45	8	30	182
Above Normal (16%)	-42	-1	-33	-87	-154	-204	-58	-82	-125	-14	19	78
Below Normal (13%)	-39	-24	-24	-85	-132	-132	-48	-132	-146	11	26	-25
Dry (24%)	-48	-64	-57	-30	-55	-83	-16	-39	-68	-8	-86	-63
Critical (15%)	-62	-43	-33	-29	-25	-12	-9	-24	-65	-51	-79	-70

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

B.7. SWP Total Energy Use

Table B-7-1. SWP Total Energy Use, Monthly Energy Use

No Action Alternative

	Monthly Energy Use (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	1,039	953	1,062	785	833	1,001	844	1,019	986	1,124	1,133	1,126
20%	968	879	934	516	639	831	746	883	856	1,062	1,112	1,099
30%	917	836	869	453	501	741	699	814	798	1,017	1,078	1,067
40%	871	769	806	365	405	499	636	769	763	991	1,054	1,003
50%	812	716	759	312	321	304	516	681	736	965	1,038	971
60%	744	587	680	165	290	232	413	495	697	926	991	943
70%	595	497	550	139	166	199	223	416	579	803	804	780
80%	497	443	413	128	129	160	151	403	549	681	641	669
90%	298	270	309	102	82	123	107	285	384	400	402	379
Long Term												
Full Simulation Period[b]	738	657	705	359	397	474	486	644	701	874	900	868
Water Year Types[c]												
Wet (32%)	858	796	802	552	638	810	737	877	866	1,036	1,081	1,048
Above Normal (16%)	693	660	718	366	432	568	595	735	776	993	1,073	1,031
Below Normal (13%)	835	715	806	333	364	398	465	607	704	962	993	943
Dry (24%)	676	556	628	239	224	223	320	507	619	785	765	775
Critical (15%)	541	471	515	156	155	133	121	300	394	463	461	384

Alternative 1

	Monthly Energy Use (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	1,148	1,119	1,145	1,102	1,006	1,103	990	1,106	1,055	1,146	1,146	1,140
20%	1,133	1,091	1,078	1,036	976	1,101	956	1,082	1,008	1,131	1,130	1,135
30%	1,101	1,061	1,052	885	954	1,091	908	1,048	981	1,122	1,120	1,124
40%	1,030	999	971	696	921	1,041	848	977	926	1,049	1,029	1,064
50%	983	947	906	628	757	1,012	786	908	863	988	1,011	1,030
60%	890	867	868	474	619	833	715	838	794	945	976	985
70%	740	636	759	320	498	623	418	530	672	861	950	948
80%	599	536	632	279	318	318	239	423	582	765	875	845
90%	488	486	491	181	233	195	147	396	565	704	742	712
Long Term												
Full Simulation Period[b]	871	840	864	625	678	781	652	801	820	951	975	966
Water Year Types[c]												
Wet (32%)	987	969	966	901	936	1,078	902	1,006	946	1,064	1,075	1,079
Above Normal (16%)	793	746	867	710	824	1,045	910	1,039	973	1,094	1,102	1,103
Below Normal (13%)	981	941	914	698	681	824	700	888	893	1,032	1,034	1,035
Dry (24%)	827	807	815	400	489	540	437	590	702	875	932	934
Critical (15%)	679	627	676	248	271	216	145	371	510	600	640	564

Alternative 1 minus No Action Alternative

	Monthly Energy Use (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	108	167	83	317	173	102	146	87	70	22	13	14
20%	165	211	144	520	337	270	210	199	152	69	18	36
30%	183	225	183	432	453	350	209	234	183	105	41	57
40%	158	229	165	331	516	542	212	208	163	57	-25	60
50%	170	231	147	316	436	708	270	227	127	23	-27	59
60%	147	280	188	309	330	601	302	343	97	19	-15	42
70%	145	138	209	181	331	424	194	114	92	58	146	168
80%	102	93	219	151	189	158	88	20	33	84	234	176
90%	190	215	183	79	150	72	40	111	181	304	340	332
Long Term												
Full Simulation Period[b]	134	183	159	267	281	307	166	157	119	76	75	99
Water Year Types[c]												
Wet (32%)	130	172	164	348	298	268	165	129	79	28	-5	31
Above Normal (16%)	100	86	149	344	393	477	315	304	197	102	29	71
Below Normal (13%)	145	226	108	365	317	426	234	282	188	69	41	92
Dry (24%)	151	251	187	161	265	317	117	83	83	90	166	159
Critical (15%)	139	157	160	92	116	83	24	70	116	137	179	180

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-2. SWP Total Energy Use, Monthly Energy Use

No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Energy Use (GWh)											
Probability of Exceedance[a]												
10%	1,039	953	1,062	785	833	1,001	844	1,019	986	1,124	1,133	1,126
20%	968	879	934	516	639	831	746	883	856	1,062	1,112	1,099
30%	917	836	869	453	501	741	699	814	798	1,017	1,078	1,067
40%	871	769	806	365	405	499	636	769	763	991	1,054	1,003
50%	812	716	759	312	321	304	516	681	736	965	1,038	971
60%	744	587	680	165	290	232	413	495	697	926	991	943
70%	595	497	550	139	166	199	223	416	579	803	804	780
80%	497	443	413	128	129	160	151	403	549	681	641	669
90%	298	270	309	102	82	123	107	285	384	400	402	379
Long Term												
Full Simulation Period[b]	738	657	705	359	397	474	486	644	701	874	900	868
Water Year Types[c]												
Wet (32%)	858	796	802	552	638	810	737	877	866	1,036	1,081	1,048
Above Normal (16%)	693	660	718	366	432	568	595	735	776	993	1,073	1,031
Below Normal (13%)	835	715	806	333	364	398	465	607	704	962	993	943
Dry (24%)	676	556	628	239	224	223	320	507	619	785	765	775
Critical (15%)	541	471	515	156	155	133	121	300	394	463	461	384

Alternative 3

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Energy Use (GWh)											
Probability of Exceedance[a]												
10%	1,138	1,105	1,067	983	981	1,101	942	1,098	1,018	1,137	1,130	1,135
20%	1,091	1,087	1,029	857	895	1,093	910	1,047	970	1,124	1,118	1,126
30%	1,052	1,047	986	585	804	995	873	999	920	1,101	1,089	1,096
40%	1,026	1,006	956	513	633	871	845	952	891	1,063	1,066	1,065
50%	974	932	887	470	513	780	774	882	834	1,018	1,049	1,030
60%	883	856	830	416	438	520	727	831	796	981	1,018	983
70%	700	700	694	170	338	276	423	542	705	926	992	925
80%	523	518	581	134	160	199	196	423	590	741	760	764
90%	282	333	376	111	108	142	136	323	438	426	454	425
Long Term												
Full Simulation Period[b]	831	817	798	482	541	653	643	780	785	926	940	919
Water Year Types[c]												
Wet (32%)	975	971	902	754	855	1,037	896	1,014	948	1,084	1,091	1,087
Above Normal (16%)	756	797	844	444	603	863	838	966	894	1,063	1,086	1,074
Below Normal (13%)	961	921	891	499	529	719	730	879	837	1,026	1,056	993
Dry (24%)	764	733	706	308	299	281	444	587	696	859	865	877
Critical (15%)	592	551	593	212	207	156	135	300	415	456	475	393

Alternative 3 minus No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Energy Use (GWh)											
Probability of Exceedance[a]												
10%	99	152	5	197	148	100	98	79	32	14	-3	10
20%	123	208	95	341	257	262	164	165	114	62	6	27
30%	135	211	117	133	303	254	175	186	121	84	10	29
40%	154	236	150	148	228	372	209	184	128	71	12	62
50%	162	216	128	159	192	476	258	201	98	53	10	59
60%	139	268	149	251	148	288	314	336	100	55	27	41
70%	105	202	144	30	172	77	200	126	126	123	189	145
80%	26	75	168	5	31	39	45	20	41	60	119	95
90%	-16	62	67	9	26	19	28	38	53	26	52	45
Long Term												
Full Simulation Period[b]	93	159	94	124	144	179	157	136	84	52	40	52
Water Year Types[c]												
Wet (32%)	117	175	101	201	217	227	159	137	81	48	11	39
Above Normal (16%)	63	136	127	78	172	295	243	232	119	70	13	42
Below Normal (13%)	126	206	85	166	165	322	265	273	133	63	63	49
Dry (24%)	88	177	78	70	75	58	124	79	77	74	100	101
Critical (15%)	51	80	77	56	52	23	14	-1	21	-8	14	10

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-3. SWP Total Energy Use, Monthly Energy Use

No Action Alternative

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,039	953	1,062	785	833	1,001	844	1,019	986	1,124	1,133	1,126
20%	968	879	934	516	639	831	746	883	856	1,062	1,112	1,099
30%	917	836	869	453	501	741	699	814	798	1,017	1,078	1,067
40%	871	769	806	365	405	499	636	769	763	991	1,054	1,003
50%	812	716	759	312	321	304	516	681	736	965	1,038	971
60%	744	587	680	165	290	232	413	495	697	926	991	943
70%	595	497	550	139	166	199	223	416	579	803	804	780
80%	497	443	413	128	129	160	151	403	549	681	641	669
90%	298	270	309	102	82	123	107	285	384	400	402	379
Long Term												
Full Simulation Period[b]	738	657	705	359	397	474	486	644	701	874	900	868
Water Year Types[c]												
Wet (32%)	858	796	802	552	638	810	737	877	866	1,036	1,081	1,048
Above Normal (16%)	693	660	718	366	432	568	595	735	776	993	1,073	1,031
Below Normal (13%)	835	715	806	333	364	398	465	607	704	962	993	943
Dry (24%)	676	556	628	239	224	223	320	507	619	785	765	775
Critical (15%)	541	471	515	156	155	133	121	300	394	463	461	384

Alternative 5

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	995	932	982	856	881	1,018	786	943	905	1,082	1,137	1,112
20%	950	869	887	518	621	830	726	846	833	1,043	1,101	1,081
30%	910	847	840	461	541	702	681	809	789	1,024	1,075	1,049
40%	875	787	795	390	425	519	626	769	765	990	1,052	1,005
50%	828	723	768	279	341	316	484	638	731	974	1,036	980
60%	750	654	708	168	218	237	423	518	704	926	1,000	915
70%	590	518	542	140	172	197	270	399	579	839	809	782
80%	449	457	433	130	133	155	118	380	545	700	637	655
90%	317	265	315	102	80	123	91	261	351	405	381	395
Long Term												
Full Simulation Period[b]	726	668	696	366	396	473	468	622	690	869	900	861
Water Year Types[c]												
Wet (32%)	845	802	792	588	638	799	703	857	847	1,023	1,074	1,035
Above Normal (16%)	665	651	714	342	436	572	579	719	772	994	1,074	1,033
Below Normal (13%)	796	770	767	334	372	407	456	572	697	970	1,017	952
Dry (24%)	683	568	621	240	225	224	313	482	612	788	769	772
Critical (15%)	543	472	529	152	136	132	105	285	385	445	446	365

Alternative 5 minus No Action Alternative

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-44	-21	-80	71	48	17	-58	-76	-81	-42	4	-14
20%	-18	-11	-47	1	-17	-1	-20	-37	-23	-19	-11	-18
30%	-7	11	-30	9	40	-39	-17	-5	-9	7	-4	-18
40%	4	17	-11	25	20	19	-10	1	2	-2	-2	2
50%	15	6	9	-33	20	12	-32	-43	-5	9	-3	9
60%	6	66	28	3	-72	4	10	23	7	0	9	-28
70%	-5	21	-8	0	5	-2	47	-17	0	35	6	2
80%	-48	15	20	1	5	-5	-33	-23	-4	19	-4	-13
90%	19	-5	6	0	-2	0	-16	-24	-33	5	-21	15
Long Term												
Full Simulation Period[b]	-12	11	-9	8	-1	-1	-19	-22	-11	-5	0	-6
Water Year Types[c]												
Wet (32%)	-13	6	-9	36	0	-10	-34	-20	-20	-13	-7	-13
Above Normal (16%)	-27	-9	-4	-24	4	3	-16	-16	-4	1	1	1
Below Normal (13%)	-39	55	-39	1	8	9	-9	-34	-7	8	25	8
Dry (24%)	7	12	-7	2	1	1	-7	-25	-7	3	3	-3
Critical (15%)	2	1	13	-3	-19	0	-16	-15	-9	-19	-15	-19

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-4. SWP Total Energy Use, Monthly Energy Use

Second Basis of Comparison

	Monthly Energy Use (GWh)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,148	1,119	1,145	1,102	1,006	1,103	990	1,106	1,055	1,146	1,146	1,140
20%	1,133	1,091	1,078	1,036	976	1,101	956	1,082	1,008	1,131	1,130	1,135
30%	1,101	1,061	1,052	885	954	1,091	908	1,048	981	1,122	1,120	1,124
40%	1,030	999	971	696	921	1,041	848	977	926	1,049	1,029	1,064
50%	983	947	906	628	757	1,012	786	908	863	988	1,011	1,030
60%	890	867	868	474	619	833	715	838	794	945	976	985
70%	740	636	759	320	498	623	418	530	672	861	950	948
80%	599	536	632	279	318	318	239	423	582	765	875	845
90%	488	486	491	181	233	195	147	396	565	704	742	712
Long Term												
Full Simulation Period[b]	871	840	864	625	678	781	652	801	820	951	975	966
Water Year Types[c]												
Wet (32%)	987	969	966	901	936	1,078	902	1,006	946	1,064	1,075	1,079
Above Normal (16%)	793	746	867	710	824	1,045	910	1,039	973	1,094	1,102	1,103
Below Normal (13%)	981	941	914	698	681	824	700	888	893	1,032	1,034	1,035
Dry (24%)	827	807	815	400	489	540	437	590	702	875	932	934
Critical (15%)	679	627	676	248	271	216	145	371	510	600	640	564

No Action Alternative

	Monthly Energy Use (GWh)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,039	953	1,062	785	833	1,001	844	1,019	986	1,124	1,133	1,126
20%	968	879	934	516	639	831	746	883	856	1,062	1,112	1,099
30%	917	836	869	453	501	741	699	814	798	1,017	1,078	1,067
40%	871	769	806	365	405	499	636	769	763	991	1,054	1,003
50%	812	716	759	312	321	304	516	681	736	965	1,038	971
60%	744	587	680	165	290	232	413	495	697	926	991	943
70%	595	497	550	139	166	199	223	416	579	803	804	780
80%	497	443	413	128	129	160	151	403	549	681	641	669
90%	298	270	309	102	82	123	107	285	384	400	402	379
Long Term												
Full Simulation Period[b]	738	657	705	359	397	474	486	644	701	874	900	868
Water Year Types[c]												
Wet (32%)	858	796	802	552	638	810	737	877	866	1,036	1,081	1,048
Above Normal (16%)	693	660	718	366	432	568	595	735	776	993	1,073	1,031
Below Normal (13%)	835	715	806	333	364	398	465	607	704	962	993	943
Dry (24%)	676	556	628	239	224	223	320	507	619	785	765	775
Critical (15%)	541	471	515	156	155	133	121	300	394	463	461	384

No Action Alternative minus Second Basis of Comparison

	Monthly Energy Use (GWh)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-108	-167	-83	-317	-173	-102	-146	-87	-70	-22	-13	-14
20%	-165	-211	-144	-520	-337	-270	-210	-199	-152	-69	-18	-36
30%	-183	-225	-183	-432	-453	-350	-209	-234	-183	-105	-41	-57
40%	-158	-229	-165	-331	-516	-542	-212	-208	-163	-57	25	-60
50%	-170	-231	-147	-316	-436	-708	-270	-227	-127	-23	27	-59
60%	-147	-280	-188	-309	-330	-601	-302	-343	-97	-19	15	-42
70%	-145	-138	-209	-181	-331	-424	-194	-114	-92	-58	-146	-168
80%	-102	-93	-219	-151	-189	-158	-88	-20	-33	-84	-234	-176
90%	-190	-215	-183	-79	-150	-72	-40	-111	-181	-304	-340	-332
Long Term												
Full Simulation Period[b]	-134	-183	-159	-267	-281	-307	-166	-157	-119	-76	-75	-99
Water Year Types[c]												
Wet (32%)	-130	-172	-164	-348	-298	-268	-165	-129	-79	-28	5	-31
Above Normal (16%)	-100	-86	-149	-344	-393	-477	-315	-304	-197	-102	-29	-71
Below Normal (13%)	-145	-226	-108	-365	-317	-426	-234	-282	-188	-69	-41	-92
Dry (24%)	-151	-251	-187	-161	-265	-317	-117	-83	-83	-90	-166	-159
Critical (15%)	-139	-157	-160	-92	-116	-83	-24	-70	-116	-137	-179	-180

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-5. SWP Total Energy Use, Monthly Energy Use

Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,148	1,119	1,145	1,102	1,006	1,103	990	1,106	1,055	1,146	1,146	1,140
20%	1,133	1,091	1,078	1,036	976	1,101	956	1,082	1,008	1,131	1,130	1,135
30%	1,101	1,061	1,052	885	954	1,091	908	1,048	981	1,122	1,120	1,124
40%	1,030	999	971	696	921	1,041	848	977	926	1,049	1,029	1,064
50%	983	947	906	628	757	1,012	786	908	863	988	1,011	1,030
60%	890	867	868	474	619	833	715	838	794	945	976	985
70%	740	636	759	320	498	623	418	530	672	861	950	948
80%	599	536	632	279	318	318	239	423	582	765	875	845
90%	488	486	491	181	233	195	147	396	565	704	742	712
Long Term												
Full Simulation Period[b]	871	840	864	625	678	781	652	801	820	951	975	966
Water Year Types[c]												
Wet (32%)	987	969	966	901	936	1,078	902	1,006	946	1,064	1,075	1,079
Above Normal (16%)	793	746	867	710	824	1,045	910	1,039	973	1,094	1,102	1,103
Below Normal (13%)	981	941	914	698	681	824	700	888	893	1,032	1,034	1,035
Dry (24%)	827	807	815	400	489	540	437	590	702	875	932	934
Critical (15%)	679	627	676	248	271	216	145	371	510	600	640	564

Alternative 3

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,138	1,105	1,067	983	981	1,101	942	1,098	1,018	1,137	1,130	1,135
20%	1,091	1,087	1,029	857	895	1,093	910	1,047	970	1,124	1,118	1,126
30%	1,052	1,047	986	585	804	995	873	999	920	1,101	1,089	1,096
40%	1,026	1,006	956	513	633	871	845	952	891	1,063	1,066	1,065
50%	974	932	887	470	513	780	774	882	834	1,018	1,049	1,030
60%	883	856	830	416	438	520	727	831	796	981	1,018	983
70%	700	700	694	170	338	276	423	542	705	926	992	925
80%	523	518	581	134	160	199	196	423	590	741	760	764
90%	282	333	376	111	108	142	136	323	438	426	454	425
Long Term												
Full Simulation Period[b]	831	817	798	482	541	653	643	780	785	926	940	919
Water Year Types[c]												
Wet (32%)	975	971	902	754	855	1,037	896	1,014	948	1,084	1,091	1,087
Above Normal (16%)	756	797	844	444	603	863	838	966	894	1,063	1,086	1,074
Below Normal (13%)	961	921	891	499	529	719	730	879	837	1,026	1,056	993
Dry (24%)	764	733	706	308	299	281	444	587	696	859	865	877
Critical (15%)	592	551	593	212	207	156	135	300	415	456	475	393

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-10	-14	-78	-120	-26	-2	-48	-9	-38	-9	-16	-4
20%	-42	-4	-50	-179	-80	-8	-46	-35	-38	-7	-12	-9
30%	-48	-14	-67	-299	-150	-95	-35	-48	-61	-21	-31	-28
40%	-4	7	-15	-183	-288	-170	-3	-25	-35	14	37	2
50%	-8	-15	-20	-157	-244	-233	-11	-26	-29	30	37	0
60%	-7	-11	-38	-58	-182	-313	12	-7	3	35	42	-2
70%	-40	64	-65	-151	-159	-347	5	12	33	65	43	-23
80%	-77	-18	-51	-145	-157	-119	-43	0	8	-24	-115	-81
90%	-206	-153	-115	-70	-124	-53	-11	-73	-127	-277	-289	-287
Long Term												
Full Simulation Period[b]	-41	-23	-66	-143	-137	-128	-9	-21	-35	-24	-35	-47
Water Year Types[c]												
Wet (32%)	-12	3	-64	-147	-81	-41	-7	8	2	21	16	7
Above Normal (16%)	-37	51	-23	-266	-221	-182	-72	-72	-79	-31	-16	-29
Below Normal (13%)	-20	-20	-23	-199	-152	-104	30	-9	-56	-6	22	-43
Dry (24%)	-63	-74	-109	-91	-190	-259	7	-4	-6	-16	-66	-57
Critical (15%)	-88	-77	-83	-36	-64	-60	-10	-71	-95	-145	-165	-171

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-6. SWP Total Energy Use, Monthly Energy Use

Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	1,148	1,119	1,145	1,102	1,006	1,103	990	1,106	1,055	1,146	1,146	1,140
20%	1,133	1,091	1,078	1,036	976	1,101	956	1,082	1,008	1,131	1,130	1,135
30%	1,101	1,061	1,052	885	954	1,091	908	1,048	981	1,122	1,120	1,124
40%	1,030	999	971	696	921	1,041	848	977	926	1,049	1,029	1,064
50%	983	947	906	628	757	1,012	786	908	863	988	1,011	1,030
60%	890	867	868	474	619	833	715	838	794	945	976	985
70%	740	636	759	320	498	623	418	530	672	861	950	948
80%	599	536	632	279	318	318	239	423	582	765	875	845
90%	488	486	491	181	233	195	147	396	565	704	742	712
Long Term												
Full Simulation Period[b]	871	840	864	625	678	781	652	801	820	951	975	966
Water Year Types[c]												
Wet (32%)	987	969	966	901	936	1,078	902	1,006	946	1,064	1,075	1,079
Above Normal (16%)	793	746	867	710	824	1,045	910	1,039	973	1,094	1,102	1,103
Below Normal (13%)	981	941	914	698	681	824	700	888	893	1,032	1,034	1,035
Dry (24%)	827	807	815	400	489	540	437	590	702	875	932	934
Critical (15%)	679	627	676	248	271	216	145	371	510	600	640	564

Alternative 5

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	995	932	982	856	881	1,018	786	943	905	1,082	1,137	1,112
20%	950	869	887	518	621	830	726	846	833	1,043	1,101	1,081
30%	910	847	840	461	541	702	681	809	789	1,024	1,075	1,049
40%	875	787	795	390	425	519	626	769	765	990	1,052	1,005
50%	828	723	768	279	341	316	484	638	731	974	1,036	980
60%	750	654	708	168	218	237	423	518	704	926	1,000	915
70%	590	518	542	140	172	197	270	399	579	839	809	782
80%	449	457	433	130	133	155	118	380	545	700	637	655
90%	317	265	315	102	80	123	91	261	351	405	381	395
Long Term												
Full Simulation Period[b]	726	668	696	366	396	473	468	622	690	869	900	861
Water Year Types[c]												
Wet (32%)	845	802	792	588	638	799	703	857	847	1,023	1,074	1,035
Above Normal (16%)	665	651	714	342	436	572	579	719	772	994	1,074	1,033
Below Normal (13%)	796	770	767	334	372	407	456	572	697	970	1,017	952
Dry (24%)	683	568	621	240	225	224	313	482	612	788	769	772
Critical (15%)	543	472	529	152	136	132	105	285	385	445	446	365

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly Energy Use (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-153	-187	-163	-246	-126	-85	-204	-164	-151	-64	-9	-28
20%	-182	-222	-191	-519	-355	-270	-230	-237	-175	-88	-29	-54
30%	-190	-214	-213	-424	-413	-389	-227	-239	-192	-98	-45	-75
40%	-155	-212	-175	-306	-496	-523	-222	-208	-160	-59	22	-58
50%	-155	-224	-139	-349	-416	-696	-302	-269	-131	-14	25	-49
60%	-140	-213	-160	-306	-402	-597	-292	-320	-90	-19	24	-70
70%	-150	-117	-217	-181	-326	-426	-147	-131	-92	-22	-140	-165
80%	-150	-79	-200	-149	-184	-163	-121	-44	-37	-65	-238	-190
90%	-171	-220	-177	-79	-152	-72	-55	-135	-214	-298	-362	-317
Long Term												
Full Simulation Period[b]	-145	-172	-168	-259	-282	-308	-184	-179	-130	-81	-75	-105
Water Year Types[c]												
Wet (32%)	-143	-167	-174	-312	-298	-278	-199	-149	-99	-41	-2	-44
Above Normal (16%)	-127	-95	-153	-368	-388	-473	-331	-320	-201	-100	-27	-70
Below Normal (13%)	-185	-172	-146	-364	-309	-416	-244	-316	-195	-62	-16	-84
Dry (24%)	-144	-239	-194	-159	-264	-315	-124	-108	-90	-87	-163	-162
Critical (15%)	-137	-155	-147	-95	-135	-84	-40	-86	-125	-155	-194	-199

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

B.8. SWP Net Energy Generation

Table B-8-1. SWP Net Generation, Monthly Net Generation

No Action Alternative

	Monthly Net Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	-174	-168	-177	-9	6	-11	8	-82	-120	-197	-242	-253
20%	-291	-247	-254	-55	-36	-53	-34	-109	-183	-235	-325	-333
30%	-352	-294	-338	-67	-68	-82	-58	-145	-217	-252	-402	-392
40%	-400	-345	-422	-88	-103	-104	-86	-166	-254	-281	-435	-413
50%	-450	-382	-463	-115	-134	-131	-133	-193	-284	-297	-474	-437
60%	-476	-451	-498	-187	-180	-157	-222	-254	-311	-321	-494	-454
70%	-506	-497	-535	-221	-221	-193	-293	-333	-343	-360	-514	-496
80%	-540	-541	-592	-260	-292	-353	-341	-394	-377	-405	-539	-523
90%	-591	-561	-620	-312	-367	-452	-387	-420	-448	-456	-577	-618
Long Term												
Full Simulation Period[b]	-417	-386	-430	-150	-152	-176	-173	-235	-287	-318	-442	-430
Water Year Types[c]												
Wet (32%)	-479	-454	-454	-138	-132	-217	-216	-255	-380	-389	-530	-417
Above Normal (16%)	-403	-400	-442	-194	-214	-198	-264	-325	-333	-296	-467	-476
Below Normal (13%)	-453	-420	-512	-191	-225	-241	-205	-263	-287	-330	-477	-555
Dry (24%)	-381	-333	-402	-143	-132	-142	-137	-207	-217	-302	-399	-462
Critical (15%)	-321	-280	-333	-104	-95	-60	-13	-117	-151	-207	-263	-239

Alternative 1

	Monthly Net Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	-326	-290	-313	-118	-84	-102	-35	-139	-185	-301	-403	-450
20%	-347	-349	-388	-161	-139	-162	-79	-167	-220	-315	-447	-496
30%	-414	-427	-450	-230	-244	-224	-142	-201	-238	-341	-484	-529
40%	-498	-521	-513	-252	-284	-311	-259	-304	-267	-367	-500	-569
50%	-571	-587	-579	-274	-336	-392	-339	-374	-315	-382	-509	-603
60%	-602	-632	-616	-354	-376	-445	-409	-415	-361	-399	-516	-615
70%	-630	-663	-640	-443	-452	-510	-486	-471	-399	-414	-533	-635
80%	-664	-686	-685	-503	-525	-550	-537	-529	-433	-430	-554	-661
90%	-680	-711	-738	-695	-603	-655	-572	-572	-526	-458	-584	-690
Long Term												
Full Simulation Period[b]	-512	-530	-539	-341	-341	-372	-317	-360	-331	-386	-496	-572
Water Year Types[c]												
Wet (32%)	-582	-598	-544	-358	-325	-362	-385	-398	-422	-426	-551	-638
Above Normal (16%)	-470	-481	-558	-460	-455	-473	-526	-553	-407	-382	-514	-624
Below Normal (13%)	-573	-601	-609	-470	-409	-532	-387	-429	-335	-403	-525	-617
Dry (24%)	-481	-516	-531	-273	-341	-375	-227	-263	-236	-378	-476	-557
Critical (15%)	-398	-393	-453	-168	-192	-131	-28	-164	-207	-300	-366	-354

Alternative 1 minus No Action Alternative

	Monthly Net Generation (GWh)											
Statistic	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Probability of Exceedance[a]												
10%	-151	-122	-136	-109	-90	-90	-42	-57	-64	-104	-160	-197
20%	-56	-102	-134	-106	-103	-110	-46	-58	-36	-80	-122	-163
30%	-63	-134	-112	-163	-176	-141	-84	-57	-21	-89	-82	-137
40%	-97	-176	-91	-165	-181	-207	-173	-138	-13	-86	-65	-156
50%	-121	-205	-116	-159	-202	-261	-206	-181	-31	-85	-35	-166
60%	-127	-181	-118	-167	-196	-288	-187	-161	-49	-78	-22	-161
70%	-124	-166	-105	-222	-231	-317	-193	-138	-56	-54	-18	-139
80%	-124	-145	-93	-243	-233	-197	-196	-135	-56	-25	-15	-137
90%	-89	-151	-118	-383	-236	-203	-185	-152	-78	-2	-7	-71
Long Term												
Full Simulation Period[b]	-95	-144	-109	-190	-189	-195	-144	-124	-44	-67	-54	-142
Water Year Types[c]												
Wet (32%)	-103	-143	-90	-220	-193	-144	-169	-143	-42	-37	-21	-220
Above Normal (16%)	-67	-82	-116	-265	-240	-275	-261	-228	-74	-87	-47	-149
Below Normal (13%)	-120	-181	-97	-279	-183	-291	-182	-165	-48	-74	-48	-62
Dry (24%)	-99	-183	-130	-130	-210	-233	-90	-56	-19	-76	-77	-95
Critical (15%)	-77	-113	-120	-64	-97	-70	-16	-48	-56	-93	-103	-115

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-2. SWP Net Generation, Monthly Net Generation

No Action Alternative

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-174	-168	-177	-9	6	-11	8	-82	-120	-197	-242	-253
20%	-291	-247	-254	-55	-36	-53	-34	-109	-183	-235	-325	-333
30%	-352	-294	-338	-67	-68	-82	-58	-145	-217	-252	-402	-392
40%	-400	-345	-422	-88	-103	-104	-86	-166	-254	-281	-435	-413
50%	-450	-382	-463	-115	-134	-131	-133	-193	-284	-297	-474	-437
60%	-476	-451	-498	-187	-180	-157	-222	-254	-311	-321	-494	-454
70%	-506	-497	-535	-221	-221	-193	-293	-333	-343	-360	-514	-496
80%	-540	-541	-592	-260	-292	-353	-341	-394	-377	-405	-539	-523
90%	-591	-561	-620	-312	-367	-452	-387	-420	-448	-456	-577	-618
Long Term												
Full Simulation Period[b]	-417	-386	-430	-150	-152	-176	-173	-235	-287	-318	-442	-430
Water Year Types[c]												
Wet (32%)	-479	-454	-454	-138	-132	-217	-216	-255	-380	-389	-530	-417
Above Normal (16%)	-403	-400	-442	-194	-214	-198	-264	-325	-333	-296	-467	-476
Below Normal (13%)	-453	-420	-512	-191	-225	-241	-205	-263	-287	-330	-477	-555
Dry (24%)	-381	-333	-402	-143	-132	-142	-137	-207	-217	-302	-399	-462
Critical (15%)	-321	-280	-333	-104	-95	-60	-13	-117	-151	-207	-263	-239

Alternative 3

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-171	-220	-216	-62	-33	-52	-26	-98	-147	-201	-261	-257
20%	-302	-317	-305	-74	-72	-84	-65	-142	-203	-265	-385	-465
30%	-425	-427	-414	-100	-116	-142	-129	-186	-229	-308	-458	-532
40%	-524	-540	-480	-132	-174	-176	-262	-286	-282	-333	-487	-582
50%	-566	-574	-539	-211	-230	-256	-353	-372	-307	-362	-504	-605
60%	-589	-627	-590	-246	-273	-354	-419	-423	-327	-387	-515	-628
70%	-628	-655	-620	-285	-323	-411	-463	-453	-357	-404	-544	-646
80%	-661	-680	-643	-316	-391	-481	-509	-501	-422	-431	-561	-666
90%	-675	-703	-678	-475	-492	-540	-555	-578	-506	-453	-583	-702
Long Term												
Full Simulation Period[b]	-491	-512	-485	-224	-238	-287	-310	-342	-309	-355	-472	-552
Water Year Types[c]												
Wet (32%)	-577	-596	-482	-246	-272	-355	-382	-398	-405	-426	-557	-659
Above Normal (16%)	-451	-512	-534	-253	-319	-366	-474	-503	-362	-346	-490	-607
Below Normal (13%)	-564	-585	-585	-301	-285	-457	-400	-428	-334	-362	-504	-609
Dry (24%)	-452	-467	-460	-187	-180	-182	-232	-255	-236	-354	-454	-529
Critical (15%)	-348	-337	-390	-136	-128	-71	-22	-116	-144	-205	-271	-246

Alternative 3 minus No Action Alternative

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	3	-52	-39	-52	-39	-41	-34	-16	-27	-3	-18	-4
20%	-11	-70	-51	-18	-37	-31	-31	-33	-20	-31	-60	-132
30%	-73	-133	-76	-33	-48	-60	-71	-41	-12	-57	-56	-140
40%	-124	-195	-58	-45	-71	-72	-176	-120	-29	-52	-52	-169
50%	-115	-191	-76	-96	-95	-125	-220	-179	-23	-65	-30	-167
60%	-113	-176	-92	-59	-93	-196	-197	-169	-15	-66	-22	-175
70%	-122	-158	-85	-63	-102	-218	-170	-120	-14	-44	-30	-150
80%	-120	-139	-51	-56	-99	-128	-168	-108	-45	-27	-23	-142
90%	-83	-142	-57	-164	-126	-88	-168	-158	-58	3	-6	-84
Long Term												
Full Simulation Period[b]	-75	-126	-56	-74	-86	-111	-136	-107	-22	-36	-31	-122
Water Year Types[c]												
Wet (32%)	-98	-142	-27	-108	-140	-138	-165	-143	-25	-37	-27	-241
Above Normal (16%)	-48	-113	-92	-58	-105	-168	-210	-179	-29	-50	-22	-131
Below Normal (13%)	-111	-165	-73	-110	-60	-216	-195	-165	-47	-32	-27	-54
Dry (24%)	-71	-134	-58	-44	-49	-40	-95	-48	-19	-52	-56	-67
Critical (15%)	-27	-57	-56	-32	-33	-11	-9	1	7	2	-8	-7

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-3. SWP Net Generation, Monthly Net Generation

No Action Alternative

Statistic	Monthly Net Generation (GWh) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-174	-168	-177	-9	6	-11	8	-82	-120	-197	-242	-253
20%	-291	-247	-254	-55	-36	-53	-34	-109	-183	-235	-325	-333
30%	-352	-294	-338	-67	-68	-82	-58	-145	-217	-252	-402	-392
40%	-400	-345	-422	-88	-103	-104	-86	-166	-254	-281	-435	-413
50%	-450	-382	-463	-115	-134	-131	-133	-193	-284	-297	-474	-437
60%	-476	-451	-498	-187	-180	-157	-222	-254	-311	-321	-494	-454
70%	-506	-497	-535	-221	-221	-193	-293	-333	-343	-360	-514	-496
80%	-540	-541	-592	-260	-292	-353	-341	-394	-377	-405	-539	-523
90%	-591	-561	-620	-312	-367	-452	-387	-420	-448	-456	-577	-618
Long Term												
Full Simulation Period[b]	-417	-386	-430	-150	-152	-176	-173	-235	-287	-318	-442	-430
Water Year Types[c]												
Wet (32%)	-479	-454	-454	-138	-132	-217	-216	-255	-380	-389	-530	-417
Above Normal (16%)	-403	-400	-442	-194	-214	-198	-264	-325	-333	-296	-467	-476
Below Normal (13%)	-453	-420	-512	-191	-225	-241	-205	-263	-287	-330	-477	-555
Dry (24%)	-381	-333	-402	-143	-132	-142	-137	-207	-217	-302	-399	-462
Critical (15%)	-321	-280	-333	-104	-95	-60	-13	-117	-151	-207	-263	-239

Alternative 5

Statistic	Monthly Net Generation (GWh) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-181	-165	-196	-39	6	-25	23	-69	-136	-190	-220	-247
20%	-264	-265	-252	-62	-32	-58	-4	-105	-186	-230	-326	-339
30%	-356	-315	-322	-72	-66	-85	-39	-129	-209	-247	-413	-379
40%	-406	-351	-411	-89	-103	-101	-60	-150	-256	-280	-447	-401
50%	-442	-407	-464	-113	-120	-122	-124	-178	-289	-299	-472	-424
60%	-469	-454	-507	-178	-162	-156	-193	-234	-305	-321	-490	-459
70%	-496	-502	-529	-214	-238	-189	-277	-306	-330	-363	-515	-492
80%	-534	-532	-573	-263	-301	-349	-330	-374	-368	-393	-525	-554
90%	-583	-552	-611	-303	-364	-449	-371	-419	-431	-425	-554	-599
Long Term												
Full Simulation Period[b]	-409	-393	-423	-155	-152	-176	-156	-221	-281	-312	-438	-426
Water Year Types[c]												
Wet (32%)	-472	-462	-448	-162	-131	-210	-194	-239	-368	-377	-520	-411
Above Normal (16%)	-385	-387	-438	-179	-221	-204	-253	-315	-331	-296	-468	-476
Below Normal (13%)	-427	-453	-487	-192	-231	-247	-191	-245	-286	-331	-483	-558
Dry (24%)	-384	-341	-395	-144	-132	-143	-119	-194	-213	-298	-399	-459
Critical (15%)	-324	-281	-339	-102	-81	-59	3	-102	-147	-196	-250	-226

Alternative 5 minus No Action Alternative

Statistic	Monthly Net Generation (GWh) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-7	3	-19	-30	0	-13	15	12	-16	8	23	7
20%	26	-18	2	-7	4	-5	29	5	-3	4	-1	-5
30%	-4	-21	16	-4	2	-3	18	15	8	4	-11	13
40%	-6	-7	11	-1	0	2	26	15	-3	1	-12	12
50%	9	-25	-2	2	15	9	8	15	-5	-1	2	13
60%	7	-3	-8	9	19	1	29	20	6	0	4	-5
70%	10	-5	6	7	-17	3	16	27	13	-3	0	4
80%	6	8	19	-3	-9	4	11	20	9	12	14	-31
90%	8	9	9	9	2	3	15	1	17	31	24	20
Long Term												
Full Simulation Period[b]	7	-7	7	-5	0	1	17	14	6	6	4	4
Water Year Types[c]												
Wet (32%)	7	-8	6	-24	1	8	23	15	12	12	10	6
Above Normal (16%)	18	12	4	15	-6	-6	11	10	2	0	-1	0
Below Normal (13%)	25	-33	26	0	-5	-6	14	19	2	-1	-6	-3
Dry (24%)	-3	-7	7	-1	-1	-1	18	13	4	4	0	3
Critical (15%)	-3	-1	-6	2	14	1	16	15	4	11	12	14

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-4. SWP Net Generation, Monthly Net Generation

Second Basis of Comparison

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	-326	-290	-313	-118	-84	-102	-35	-139	-185	-301	-403	-450
20%	-347	-349	-388	-161	-139	-162	-79	-167	-220	-315	-447	-496
30%	-414	-427	-450	-230	-244	-224	-142	-201	-238	-341	-484	-529
40%	-498	-521	-513	-252	-284	-311	-259	-304	-267	-367	-500	-569
50%	-571	-587	-579	-274	-336	-392	-339	-374	-315	-382	-509	-603
60%	-602	-632	-616	-354	-376	-445	-409	-415	-361	-399	-516	-615
70%	-630	-663	-640	-443	-452	-510	-486	-471	-399	-414	-533	-635
80%	-664	-686	-685	-503	-525	-550	-537	-529	-433	-430	-554	-661
90%	-680	-711	-738	-695	-603	-655	-572	-572	-526	-458	-584	-690
Long Term												
Full Simulation Period[b]	-512	-530	-539	-341	-341	-372	-317	-360	-331	-386	-496	-572
Water Year Types[c]												
Wet (32%)	-582	-598	-544	-358	-325	-362	-385	-398	-422	-426	-551	-638
Above Normal (16%)	-470	-481	-558	-460	-455	-473	-526	-553	-407	-382	-514	-624
Below Normal (13%)	-573	-601	-609	-470	-409	-532	-387	-429	-335	-403	-525	-617
Dry (24%)	-481	-516	-531	-273	-341	-375	-227	-263	-236	-378	-476	-557
Critical (15%)	-398	-393	-453	-168	-192	-131	-28	-164	-207	-300	-366	-354

No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	-174	-168	-177	-9	6	-11	8	-82	-120	-197	-242	-253
20%	-291	-247	-254	-55	-36	-53	-34	-109	-183	-235	-325	-333
30%	-352	-294	-338	-67	-68	-82	-58	-145	-217	-252	-402	-392
40%	-400	-345	-422	-88	-103	-104	-86	-166	-254	-281	-435	-413
50%	-450	-382	-463	-115	-134	-131	-133	-193	-284	-297	-474	-437
60%	-476	-451	-498	-187	-180	-157	-222	-254	-311	-321	-494	-454
70%	-506	-497	-535	-221	-221	-193	-293	-333	-343	-360	-514	-496
80%	-540	-541	-592	-260	-292	-353	-341	-394	-377	-405	-539	-523
90%	-591	-561	-620	-312	-367	-452	-387	-420	-448	-456	-577	-618
Long Term												
Full Simulation Period[b]	-417	-386	-430	-150	-152	-176	-173	-235	-287	-318	-442	-430
Water Year Types[c]												
Wet (32%)	-479	-454	-454	-138	-132	-217	-216	-255	-380	-389	-530	-417
Above Normal (16%)	-403	-400	-442	-194	-214	-198	-264	-325	-333	-296	-467	-476
Below Normal (13%)	-453	-420	-512	-191	-225	-241	-205	-263	-287	-330	-477	-555
Dry (24%)	-381	-333	-402	-143	-132	-142	-137	-207	-217	-302	-399	-462
Critical (15%)	-321	-280	-333	-104	-95	-60	-13	-117	-151	-207	-263	-239

No Action Alternative minus Second Basis of Comparison

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly Net Generation (GWh)											
Probability of Exceedance[a]												
10%	151	122	136	109	90	90	42	57	64	104	160	197
20%	56	102	134	106	103	110	46	58	36	80	122	163
30%	63	134	112	163	176	141	84	57	21	89	82	137
40%	97	176	91	165	181	207	173	138	13	86	65	156
50%	121	205	116	159	202	261	206	181	31	85	35	166
60%	127	181	118	167	196	288	187	161	49	78	22	161
70%	124	166	105	222	231	317	193	138	56	54	18	139
80%	124	145	93	243	233	197	196	135	56	25	15	137
90%	89	151	118	383	236	203	185	152	78	2	7	71
Long Term												
Full Simulation Period[b]	95	144	109	190	189	195	144	124	44	67	54	142
Water Year Types[c]												
Wet (32%)	103	143	90	220	193	144	169	143	42	37	21	220
Above Normal (16%)	67	82	116	265	240	275	261	228	74	87	47	149
Below Normal (13%)	120	181	97	279	183	291	182	165	48	74	48	62
Dry (24%)	99	183	130	130	210	233	90	56	19	76	77	95
Critical (15%)	77	113	120	64	97	70	16	48	56	93	103	115

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-5. SWP Net Generation, Monthly Net Generation

Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-326	-290	-313	-118	-84	-102	-35	-139	-185	-301	-403	-450
20%	-347	-349	-388	-161	-139	-162	-79	-167	-220	-315	-447	-496
30%	-414	-427	-450	-230	-244	-224	-142	-201	-238	-341	-484	-529
40%	-498	-521	-513	-252	-284	-311	-259	-304	-267	-367	-500	-569
50%	-571	-587	-579	-274	-336	-392	-339	-374	-315	-382	-509	-603
60%	-602	-632	-616	-354	-376	-445	-409	-415	-361	-399	-516	-615
70%	-630	-663	-640	-443	-452	-510	-486	-471	-399	-414	-533	-635
80%	-664	-686	-685	-503	-525	-550	-537	-529	-433	-430	-554	-661
90%	-680	-711	-738	-695	-603	-655	-572	-572	-526	-458	-584	-690
Long Term												
Full Simulation Period[b]	-512	-530	-539	-341	-341	-372	-317	-360	-331	-386	-496	-572
Water Year Types[c]												
Wet (32%)	-582	-598	-544	-358	-325	-362	-385	-398	-422	-426	-551	-638
Above Normal (16%)	-470	-481	-558	-460	-455	-473	-526	-553	-407	-382	-514	-624
Below Normal (13%)	-573	-601	-609	-470	-409	-532	-387	-429	-335	-403	-525	-617
Dry (24%)	-481	-516	-531	-273	-341	-375	-227	-263	-236	-378	-476	-557
Critical (15%)	-398	-393	-453	-168	-192	-131	-28	-164	-207	-300	-366	-354

Alternative 3

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-171	-220	-216	-62	-33	-52	-26	-98	-147	-201	-261	-257
20%	-302	-317	-305	-74	-72	-84	-65	-142	-203	-265	-385	-465
30%	-425	-427	-414	-100	-116	-142	-129	-186	-229	-308	-458	-532
40%	-524	-540	-480	-132	-174	-176	-262	-286	-282	-333	-487	-582
50%	-566	-574	-539	-211	-230	-256	-353	-372	-307	-362	-504	-605
60%	-589	-627	-590	-246	-273	-354	-419	-423	-327	-387	-515	-628
70%	-628	-655	-620	-285	-323	-411	-463	-453	-357	-404	-544	-646
80%	-661	-680	-643	-316	-391	-481	-509	-501	-422	-431	-561	-666
90%	-675	-703	-678	-475	-492	-540	-555	-578	-506	-453	-583	-702
Long Term												
Full Simulation Period[b]	-491	-512	-485	-224	-238	-287	-310	-342	-309	-355	-472	-552
Water Year Types[c]												
Wet (32%)	-577	-596	-482	-246	-272	-355	-382	-398	-405	-426	-557	-659
Above Normal (16%)	-451	-512	-534	-253	-319	-366	-474	-503	-362	-346	-490	-607
Below Normal (13%)	-564	-585	-585	-301	-285	-457	-400	-428	-334	-362	-504	-609
Dry (24%)	-452	-467	-460	-187	-180	-182	-232	-255	-236	-354	-454	-529
Critical (15%)	-348	-337	-390	-136	-128	-71	-22	-116	-144	-205	-271	-246

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	154	70	97	57	51	50	9	41	37	100	142	193
20%	45	32	83	88	67	78	14	25	16	50	62	31
30%	-10	0	36	130	127	81	13	16	9	33	26	-3
40%	-26	-20	33	120	110	135	-3	18	-16	34	13	-13
50%	6	13	40	63	107	136	-14	2	8	20	5	-2
60%	14	5	26	108	103	91	-10	-8	34	12	0	-13
70%	2	8	20	159	128	99	23	18	42	10	-11	-11
80%	4	6	42	187	134	69	28	27	11	-1	-7	-5
90%	6	9	61	219	110	115	17	-6	20	5	2	-12
Long Term												
Full Simulation Period[b]	20	18	54	117	103	85	7	17	22	31	24	20
Water Year Types[c]												
Wet (32%)	5	2	63	112	53	6	4	0	17	0	-6	-21
Above Normal (16%)	19	-31	24	207	136	107	51	49	45	36	24	17
Below Normal (13%)	9	16	24	170	123	75	-13	1	1	41	21	8
Dry (24%)	29	49	71	86	161	193	-5	8	0	23	21	29
Critical (15%)	51	56	63	32	64	59	7	49	63	95	95	108

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-6. SWP Net Generation, Monthly Net Generation

Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-326	-290	-313	-118	-84	-102	-35	-139	-185	-301	-403	-450
20%	-347	-349	-388	-161	-139	-162	-79	-167	-220	-315	-447	-496
30%	-414	-427	-450	-230	-244	-224	-142	-201	-238	-341	-484	-529
40%	-498	-521	-513	-252	-284	-311	-259	-304	-267	-367	-500	-569
50%	-571	-587	-579	-274	-336	-392	-339	-374	-315	-382	-509	-603
60%	-602	-632	-616	-354	-376	-445	-409	-415	-361	-399	-516	-615
70%	-630	-663	-640	-443	-452	-510	-486	-471	-399	-414	-533	-635
80%	-664	-686	-685	-503	-525	-550	-537	-529	-433	-430	-554	-661
90%	-680	-711	-738	-695	-603	-655	-572	-572	-526	-458	-584	-690
Long Term												
Full Simulation Period[b]	-512	-530	-539	-341	-341	-372	-317	-360	-331	-386	-496	-572
Water Year Types[c]												
Wet (32%)	-582	-598	-544	-358	-325	-362	-385	-398	-422	-426	-551	-638
Above Normal (16%)	-470	-481	-558	-460	-455	-473	-526	-553	-407	-382	-514	-624
Below Normal (13%)	-573	-601	-609	-470	-409	-532	-387	-429	-335	-403	-525	-617
Dry (24%)	-481	-516	-531	-273	-341	-375	-227	-263	-236	-378	-476	-557
Critical (15%)	-398	-393	-453	-168	-192	-131	-28	-164	-207	-300	-366	-354

Alternative 5

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-181	-165	-196	-39	6	-25	23	-69	-136	-190	-220	-247
20%	-264	-265	-252	-62	-32	-58	-4	-105	-186	-230	-326	-339
30%	-356	-315	-322	-72	-66	-85	-39	-129	-209	-247	-413	-379
40%	-406	-351	-411	-89	-103	-101	-60	-150	-256	-280	-447	-401
50%	-442	-407	-464	-113	-120	-122	-124	-178	-289	-299	-472	-424
60%	-469	-454	-507	-178	-162	-156	-193	-234	-305	-321	-490	-459
70%	-496	-502	-529	-214	-238	-189	-277	-306	-330	-363	-515	-492
80%	-534	-532	-573	-263	-301	-349	-330	-374	-368	-393	-525	-554
90%	-583	-552	-611	-303	-364	-449	-371	-419	-431	-425	-554	-599
Long Term												
Full Simulation Period[b]	-409	-393	-423	-155	-152	-176	-156	-221	-281	-312	-438	-426
Water Year Types[c]												
Wet (32%)	-472	-462	-448	-162	-131	-210	-194	-239	-368	-377	-520	-411
Above Normal (16%)	-385	-387	-438	-179	-221	-204	-253	-315	-331	-296	-468	-476
Below Normal (13%)	-427	-453	-487	-192	-231	-247	-191	-245	-286	-331	-483	-558
Dry (24%)	-384	-341	-395	-144	-132	-143	-119	-194	-213	-298	-399	-459
Critical (15%)	-324	-281	-339	-102	-81	-59	3	-102	-147	-196	-250	-226

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly Net Generation (GWh)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	144	125	117	79	90	77	57	70	48	111	183	204
20%	82	84	136	99	107	105	75	62	33	85	122	158
30%	59	112	128	158	178	138	103	72	29	94	71	150
40%	92	169	101	164	181	209	199	153	10	86	53	168
50%	130	180	115	161	217	270	214	196	26	83	37	178
60%	134	178	109	176	214	289	216	181	56	78	26	156
70%	133	161	111	229	214	320	209	165	69	51	18	143
80%	130	154	112	240	223	200	207	155	65	37	29	106
90%	97	159	127	392	238	206	200	153	95	33	31	91
Long Term												
Full Simulation Period[b]	102	137	116	185	190	196	161	139	50	74	58	146
Water Year Types[c]												
Wet (32%)	110	136	96	196	194	152	192	159	54	49	31	226
Above Normal (16%)	85	94	120	280	234	269	272	238	76	87	46	148
Below Normal (13%)	145	148	122	279	178	285	196	184	49	72	42	59
Dry (24%)	96	175	137	129	209	232	108	69	23	79	77	99
Critical (15%)	75	112	114	66	110	71	32	62	60	104	115	128

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Appendix 9A

Special-Status Aquatic Species

Table 9A.1 presents a list special-status aquatic species that occur within the study area and could be affected by changes under Alternatives 1 through 5 as compared to the No Action Alternative and Second Basis of Comparison.

Special status aquatic species that occur or may occur within areas potentially affected by actions that could occur under Alternatives 1 through 5 related to the Central Valley Project and State Water Project operations or ecosystem restoration activities. Impact potential is based on the likelihood of operational changes or restoration actions to impact suitable habitat occurring in defined area of analysis.

The area of analysis for operational changes includes open water areas of reservoirs, rivers, and creeks; adjacent riparian vegetation; wetlands supported by these waterbodies; and potential restoration areas in Yolo Bypass and Suisun Marsh. Aquatic species are presented in alphabetical order based on scientific name.

Table 9A.1 Special-Status Aquatic Species

Species or Population	Federal Status	State Status	Occurrence within Area of Analysis
River Lamprey	None	None	Feather River, American River, Sacramento River, Delta and Suisun Marsh, Stanislaus River, San Joaquin River
Pacific Lamprey	None	None	Trinity River, Klamath River, Clear Creek , Feather River, Sacramento River, American River, Delta, Stanislaus River, San Joaquin River
Green Sturgeon Southern DPS	Threatened	Species of Special Concern	Trinity River, Klamath River, Feather River , Sacramento River, Delta and Suisun Marsh
White Sturgeon	None	None	Trinity River, Klamath River, Feather River, Sacramento River, American River, San Joaquin River, Delta and Suisun Marsh
Eulachon Southern DPS	Threatened	None	Klamath River
Coho Salmon Southern Oregon/ Northern California Coast ESU	Threatened	Threatened	Trinity River, Klamath River

Species or Population	Federal Status	State Status	Occurrence within Area of Analysis
Spring-run Chinook Salmon Upper Klamath-Trinity River ESU	Candidate	Species of Special Concern	Trinity River, Klamath River
Fall-/Late-Fall-run Chinook Salmon Central Valley ESU	None	Species of Special Concern	Clear Creek, Feather River, Sacramento River, American River, Stanislaus River, San Joaquin River, Delta and Suisun Marsh
Winter-run Chinook Salmon Sacramento River ESU	Endangered	Endangered	Sacramento River, Delta and Suisun Marsh
Spring-run Chinook Salmon Central Valley ESU	Threatened	Threatened	Clear Creek, Sacramento River, Feather River, American River, Delta and Suisun Marsh
Steelhead (winter- and summer-run) Klamath Mountains Province DPS	None	Species of Special Concern	Trinity River, Klamath River
Steelhead Central Valley DPS	Threatened	None	Clear Creek, Feather River, Sacramento River, American River, Stanislaus River, San Joaquin River, Delta and Suisun Marsh
Steelhead Central California Coast DPS	Threatened	None	San Francisco Bay region
Delta Smelt	Threatened	Endangered	Delta and Suisun Marsh
Longfin Smelt Bay Delta DPS	Candidate	Threatened	Delta and Suisun Marsh
Sacramento Splittail	None	Species of Special Concern	Feather River, American River, Sacramento River, Delta and Suisun Marsh, San Joaquin River
Hardhead	None	Species of Special Concern	Clear Creek, Feather River, Sacramento River, American River, Delta, Stanislaus River, San Joaquin River
Sacramento-San Joaquin Roach	None	Species of Special Concern	Clear Creek, Feather River, American River, Sacramento River, Delta, Stanislaus River, San Joaquin River

Species or Population	Federal Status	State Status	Occurrence within Area of Analysis
Striped Bass	None	None	Feather River, American River, Sacramento River, Delta and Suisun Marsh, Stanislaus River, San Joaquin River
American Shad	None	None	Trinity River, Feather River, American River, Sacramento River, Delta and Suisun Marsh, Stanislaus River, San Joaquin River
Black Bass (largemouth, smallmouth, spotted)	None	None	Trinity River, Feather River, American River, Sacramento River, Delta and Suisun Marsh, Stanislaus River, San Joaquin River
Killer Whale Southern Resident DPS	Endangered	None	Pacific Coast

Notes:
DPS = distinct population segment
ESU = evolutionarily significant unit

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Appendix 9B

Aquatic Species Life History Accounts

This appendix provides additional information on the life history characteristics of the target aquatic species assessed in the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS). This information is intended to provide a more holistic understanding of how these species use the water bodies influenced by operation of the CVP and SWP and to help clarify relationships that provide the logical foundation for conclusions regarding the potential environmental consequences associated with changes in operation.

This appendix addresses the following species:

- River Lamprey
- Pacific Lamprey
- Green Sturgeon
- White Sturgeon
- Chinook Salmon
  - Winter-run Chinook Salmon
  - Central Valley Spring-run Chinook Salmon
  - Central Valley Fall-run and Late Fall-run Chinook Salmon
  - Upper Klamath and Trinity Rivers Spring-run Chinook Salmon
- Central Valley Steelhead
- Klamath Mountains Province Steelhead
- Sacramento Splittail
- Longfin Smelt
- American Shad
- Eulachon
- Striped Bass
- Southern Resident Killer Whale

9B.1 River Lamprey (*Lampetra ayresii*)

9B.1.1 Legal Status

Federal: None
State: Species of Special Concern

River Lamprey was petitioned for listing by a number of conservation groups in 2003, along with three other lamprey species (Klamath-Siskiyou Wildlands Center et al. 2003). The petition was declined by the U.S. Fish and Wildlife Service (USFWS) in 2004 because of insufficient evidence that listing was warranted.

9B.1.2 Distribution

River Lamprey are found in large coastal streams from just north of Juneau, Alaska, to the San Francisco Bay (Vladykov and Follett 1958, Wydoski and Whitney 1979). The Sacramento and San Joaquin basins are at the southern edge of their range (Moyle et al. 2009). Little is known regarding their abundance and distribution within California; they seem to be primarily associated with the lower portions of certain large river systems, and most records for the state are from the lower Sacramento-San Joaquin system, especially the Stanislaus and Tuolumne rivers (Moyle et al. 1989, Moyle 2002). In the Sacramento River, they have been documented upstream to at least Red Bluff Diversion Dam (RBDD) (Hanni et al. 2006, Moyle et al. 2009). River Lamprey have also been collected in the Feather River, American River, Mill and Cache creeks (Vladykov and Follett 1958, Hanni et al. 2006, Moyle et al. 2009). River Lamprey have not been documented during rotary screw trapping efforts in Clear, Battle, and Deer creeks, or in the Yuba River (Hanni et al. 2006). Other streams where they have been found in California outside of the Central Valley include the Napa and Russian rivers, and Alameda, Sonoma, and Salmon creeks (DWR et al. 2013).

9B.1.3 Life History and Habitat Requirements

River Lamprey are a small parasitic anadromous species. Most studies of their biology have been conducted in British Columbia; relatively little is known regarding their life history and habitat requirements in California (Moyle 2002).

Adult River Lamprey migrate from the ocean into spawning areas in the fall. Adults of both sexes construct nests in gravel at the upstream end of riffles (Wydoski and Whitney 1979, Beamish and Youson 1987, Moyle 2002). Eggs are deposited and fertilized in these depressions, after which the adults typically die, similar to other species of lampreys. In the Sacramento-San Joaquin basin of California, most spawning is believed to occur in April and May (Vladykov and Follett 1958; Scott and Crossman 1973) at temperatures of about 55 to 56 degrees Fahrenheit (°F) (Wang 1986). Two females in Cache Creek were reported to have 11,400 and 37,300 eggs each (Vladykov and Follett 1958).

After hatching, young ammocoetes (the larval stage of lamprey) drift downstream to settle in the silt-sand substrates of backwaters, eddies, and pools, where they remain burrowed for approximately 3 to 5 years (Moyle 2002). At this stage, they are filter feeders, with a diet consisting of algae (primarily diatoms) and other organic detritus and microorganisms (Wydoski and Whitney 1979). Good water quality and temperatures not exceeding 77°F are believed to be necessary for their survival (Moyle 2002). Their metamorphosis into adults begins in July when they reach about 12 centimeters (cm) (4.7 in) (Beamish 1980), and is not complete for about 9 to 10 months until around April the following spring, when the esophagus opens and adults are able to osmoregulate (Beamish and Youson 1987, Moyle 2002). This is a more extended period of metamorphosis than observed in other lamprey species. During this time, they are believed to live in deep waters of the river channel. Just prior to the completion of metamorphosis, the juvenile lampreys (macropthalmia) congregate immediately upstream of salt water and enter the estuary or ocean from May to July (Beamish and Youson 1987).

Adults spend 3 to 4 months in salt water, remaining close to shore and growing to lengths of about 25 to 31 cm. In the estuary or ocean, River Lamprey are obligate parasites, typically killing their host in the process of feeding. They most commonly parasitize fishes 10 to 30 cm long, feeding near the surface on smelt, herring, and mid-size salmonids (Beamish 1980, Roos et al. 1973, Beamish and Neville 1995). In Canada, they have been documented to be an important source of mortality on salmon (Beamish and Neville 1995). In the fall, adults migrate back upstream into spawning areas and cease to feed. Fidelity to the streams in which they were spawned remains unknown.

The species is expected to use Delta habitats primarily as a migration corridor (DWR et al. 2013), and have been collected in Suisun Bay, Montezuma Slough, and Delta sloughs during California Department of Fish and Wildlife (DFW) plankton sampling efforts. CVP and SWP salvage data indicate that they are found in the salvage primarily from December through March (DWR et al. 2013). Juveniles are weak swimmers, frequently becoming entrained in water diversions or turbine intakes of hydroelectric projects or becoming impinged on screens meant to bypass juvenile salmonids or other fish (USFWS 2007).

Very little is known regarding the distribution, habitat use, and life history of this species in the action area. Numerous adults (less than 200 millimeters [mm]), presumably of spawning age, have been captured in rotary screw traps at RBDD from March through June (Hanni et al. 2006). Individuals smaller than most adults (greater than 200 mm), likely outmigrating macropthalmia, have been captured at RBDD and Feather River rotary screw traps from late September through early June (Hanni et al. 2006). Factors limiting River Lamprey populations in the Sacramento River are likely similar to those limiting salmonids (Moyle et al. 2009). Quantitative data on populations are extremely limited, but loss and degradation of historical habitats suggest populations have likely declined (Moyle et al. 2009).

9B.1.4 References

Beamish, R. J. 1980. Adult biology of the River Lamprey (*Lampetra ayresi*) and the Pacific lamprey (*Lamptera tridentata*) from the Pacific Coast of Canada. *Canadian Journal of Fisheries and Aquatic Science* 37:1906-1923.

Beamish, R. J., and J. H. Youson. 1987. Life history and abundance of young adult *Lampetra ayresi* in the Fraser River and their possible impact on salmon and herring stocks in the Strait of Georgia. *Canadian Journal of Fisheries and Aquatic Science* 44:525-537.

Beamish, R. J., and C. M. Neville. 1995. Pacific salmon and Pacific herring mortalities in the Fraser River plume caused by River Lamprey (*Lampetra ayresi*). *Canadian Journal of Fisheries and Aquatic Sciences* 52: 644-650.

DWR (California Department of Water Resources), Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2013. *Environmental impact report/ environmental impact statement for the Bay*

Delta Conservation Plan. Draft. Prepared by ICF International, Sacramento, California. March.

Hanni, J., B. Poytress, and H. N. Blalock-Herod. 2006. *Spatial and temporal distribution patterns of Pacific and River Lamprey in the Sacramento and San Joaquin rivers and delta.* U.S. Fish and Wildlife Service.

Klamath-Siskiyou Wildlands Center, Siskiyou Regional Education Project, Umpqua Watersheds, Friends of the Eel, North Coast Environmental Center, Environmental Protection Information Center, Native Fish Society, Center for Biological Diversity, Oregon Natural Resources Council, Washington Trout, and Umpqua Valley Audubon Society. 2003. *A petition for rules to list: Pacific lamprey (Lampetra tridentate), River Lamprey (Lampetra ayresi), western brook lamprey (Lampetra richardsoni); and Kern brook lamprey (Lampetra hubbsi) as threatened or endangered under the Endangered Species Act.*

Moyle, P. B. 2002. *Inland fishes of California. Second edition.* University of California Press, Berkeley.

Moyle, P. B., L. R. Brown, S. D. Chase, and R. M. Quinones. 2009. Status and conservation of lampreys in California. *American Fisheries Society Symposium* 72: 279-292.

Moyle, P. B., R,N, Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. *Fish species of special concern of California*. Department of Wildlife and Fisheries Biology, University of California, Davis.

Roos, J. F., P. Gilhousen, S. R. Killick, and E. R. Zyblut. 1973. Parasitism on juvenile Pacific salmon (*Oncorhynchus*) and Pacific herring (*Clupea harengus pallasi*) in the Straight of Georgia by the River Lamprey (*Lampetra ayresi*). *Journal of the Fisheries Research Board of Canada* 30:565-568.

Scott, W .B., and E. J. Crossman. 1973. *Freshwater fishes of Canada*. Fisheries Research Board of Canada Bulletin No. 184.

USFWS (U.S. Fish and Wildlife Service). 2007. *Fact sheet. Pacific lamprey - Lampetra tridentata.* Portland, Oregon.

Vladykov, V. D., and W. I. Follett. 1958. Redescription of *Lampetra ayersi* (Gunther) of western North America, a species of lamprey (Petromyzontidae) distinct from *Lampetra fluviatilis* (Linnaeus) of Europe. *Journal of the Fisheries Research Board of Canada* 15: 47-77.

Wang, J. C. S. 1986. *Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: a guide to the early life histories.* Technical Report 9. Prepared for the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary by California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service.

Wydoski, R., and R. Whitney. 1979. *Inland fishes of Washington.* University of Seattle Press, Seattle.

9B.2 Pacific Lamprey (*Entosphenus tridentatus*)

9B.2.1 Legal Status

Federal: None
State: None

The Pacific Lamprey was petitioned for listing by 12 conservation groups in 2003, along with three other lamprey species (Klamath-Siskiyou Wildlands Center et al. 2003). The petition was declined by USFWS in 2004 because of insufficient evidence that listing was warranted (USFWS 2004).

9B.2.2 Distribution

The Pacific Lamprey is a widely distributed anadromous species found in river systems along the northern margin of the Pacific Ocean from central Baja California north along the west coast of North America to the Bering Sea in Alaska (Ruiz-Campos and Gonzales-Guzman 1996, Lin et al. 2008). Historically, Pacific Lamprey were generally distributed wherever salmon and steelhead occurred and sometimes upstream of waterfalls that are impassable to anadromous salmonids. In California, they were historically found along the entire coast and far inland (Moyle et al. 2009). However, recent data and anecdotal accounts indicate that distribution of the Pacific Lamprey has been reduced in many river systems, including the Sacramento-San Joaquin (Moyle et al. 2009). Although widely distributed in the Sacramento-San Joaquin basin, the species is absent from as much as 80 percent of its historical spawning habitats, primarily due to migratory barriers (Moyle et al. 2009).

9B.2.3 Life History and Habitat Requirements

9B.2.3.1 Adult Migration

Pacific Lamprey are anadromous, rearing in freshwater before outmigrating to the ocean, where they grow to full size prior to returning to their natal streams to spawn. Pacific Lamprey are thought to remain in the ocean for approximately 18 to 40 months before returning to freshwater as sexually immature adults, typically from late winter until early summer (Kan 1975, Beamish 1980). After entering freshwater from the ocean, adult Pacific Lamprey typically spend approximately 1 year in freshwater prior to spawning (Robinson and Bayer 2005, Clemens et al. 2009, Stillwater Sciences 2010, Lampman 2011). The adult freshwater residence period can be divided into three distinct stages: (1) Initial migration from the ocean to holding areas, (2) pre-spawning holding, and (3) secondary migration to spawn (Robinson and Bayer 2005; Clemens et al. 2010, 2012).

The initial migration from the ocean to upstream holding areas occurs from approximately January until early August (Stillwater Sciences 2010, McCovey 2011, Clemens et al. 2012). In the Eel River and the nearby Klamath River, where ample information exists, entry into freshwater from the ocean generally begins in January and ends by June (Petersen-Lewis 2009, McCovey 2010, Stillwater Sciences 2010). Most individuals cease upstream migration by mid-July, although some individuals continue moving into August (McCovey 2010). Data from mid-water trawls in Suisun Bay and the lower Sacramento and San Joaquin rivers indicate that adults likely migrate into the Sacramento-San Joaquin Basin from late winter through early summer (Hanni and Blalock-Herod 2006).

The pre-spawning holding stage begins when individuals cease upstream movement in the summer, and continues until fish began their secondary migration to spawn, generally in late winter or early spring (Robinson and Bayer 2005, McCovey 2010). During this holding period, most fish remain stationary throughout the summer and fall, but some individuals undergo additional upstream movements in the winter following high flow events (Robinson and Bayer 2005, McCovey 2010). In the Sacramento River, adults, likely either in the holding or spawning stage, have been detected at Glenn-Colusa Irrigation District (GCID) from December through July and nearly year-round at RBDD (Hanni and Blalock-Herod 2006). It is expected that adult Pacific Lamprey with varying levels of sexual maturity are present in the Sacramento-San Joaquin Basin throughout the year.

After the pre-spawning holding period, individuals undergo a secondary migration from holding areas to spawning areas. This migration generally begins in late winter and continues through July, by which time most individuals have spawned and died (Robinson and Bayer 2005, Stillwater Sciences 2010, Lampman 2011). During this secondary migration, movement to spawning areas can be both upstream and downstream (Robinson and Bayer 2005, Lampman 2011).

Unlike Pacific salmon and steelhead (and like the Great Lakes Sea Lamprey; Bergstedt and Seelye 1995), Pacific Lamprey do not necessarily home to natal spawning streams (Moyle et al. 2009). Instead, migratory lampreys may select spawning locations based on the presence of a pheromone-like substance secreted by ammocoetes (Bjerselius et al. 2000, Vrieze and Sorensen 2001, Yun et al. 2011). Results of recent genetics research supports lack of homing by the Pacific Lamprey. A study of Pacific Lamprey population structure found few genetic differences among individuals sampled at widely dispersed sites across their range, indicating substantial genetic exchange among populations from different streams (Goodman et al. 2006).

9B.2.3.2 Spawning

Spawning typically takes place from March through July depending on water temperature and local conditions such as seasonal flow regimes (Kan 1975, Brumo et al. 2009, Gunckel et al. 2009). Evidence from the Santa Clara River in southern California suggests that individuals in the southern portion of the species' range can spawn as early as January, with peak spawning from February to April (Chase 2001), whereas inland and northern populations initiate spawning considerably later in the spring (Kan 1975, Beamish 1980, Brumo et al. 2009). Hannon and Deason (2007) have documented Pacific Lamprey spawning in the American River between early January and late May, with peak spawning typically occurring in early April. Spawning occurs in both the mainstem of medium-sized rivers and smaller tributaries (Luzier et al. 2006, Brumo et al. 2009, Gunckel et al. 2009), and generally takes place in pool and run tailouts and low gradient riffles. Both males and females build redds that are approximately 40-by-40 cm in area and are constructed in gravel and cobble substrate (Brumo 2006, Gunckel et al. 2009). Spawning substrate size typically ranges from approximately 25 to 90 mm (1.0 to 3.5 inches), with a median of 48 mm (1.9 inches) (Gunckel et al. 2009). Water velocity above redds ranges from 0.2 to 1.0 meters per second (m/s) (median 0.6 m/s), and depth varies from approximately 0.2 to 1.1 m (0.7 to 3.6 feet [ft]) (Gunckel et al. 2009). Depending on their size, females lay between 30,000 and 240,000 eggs (Kan 1975), which are approximately 1.4 mm (0.06 inch) in diameter (Meeuwig et al. 2004). In comparison, Chinook Salmon generally lay approximately 4,000 to 12,000 eggs (Jasper and Evensen 2006). During spawning, eggs are released in clutches of about 500 every 2 to 5 minutes (Pletcher 1963). Upon fertilization, eggs adhere to sandy substrate in the gravel redd (Pletcher 1963).

Depending on water temperature, hatching occurs in approximately 2 to 3 weeks, and yolk-sac larvae known as prolarvae remain in redd gravels for approximately 2 to 3 more weeks before emerging at night as 8-to-9-mm larvae, and drift downstream to rear in depositional areas (Meeuwig et al. 2005, Brumo 2006). Pacific Lamprey typically die soon after spawning (Kan 1975; Brumo 2006), although there is some anecdotal evidence that this is not always the case (Moyle 2002; Michael 1980; Michael 1984).

9B.2.3.3 Juvenile Rearing and Outmigration

After larvae emerge from redds drifting downstream, the eyeless, toothless larvae known as ammocoetes settle out of the water column and burrow into fine silt and sand substrate in low-velocity, depositional areas such as pools, alcoves, and side channels (Moore and Mallatt 1980, Torgensen and Close 2004, Stone and Barndt 2005). Ammocoete presence has also been shown to be associated with presence of woody debris (Roni 2003, Graham and Brun 2006). Rearing Pacific Lamprey ammocoetes appear to prefer rearing temperatures below 68°F (20 degrees Celsius [°C]) (BioAnalysts, Inc. 2000); and temperatures above 82.4°F (28°C) result in mortality of ammocoetes (van de Wetering and Ewing 1999). Depending on factors influencing their growth rates, they remain in this habitat from 4 to 10 years, filter-feeding on algae and detrital matter prior to metamorphosing into an adult form (Pletcher 1963, Moore and Mallatt 1980, Beamish and Levings 1991, van de Wetering 1998). During the ammocoete stage, individuals may periodically move and relocate in response to changing water levels, channel adjustments, or substrate movements (ULEP 1998). These factors generally result in a gradual downstream movement that may lead to higher densities in downstream reaches (Richards 1980). During metamorphosis, individuals develop eyes, a suctoral disc, sharp teeth, and more-defined fins (McGree et al. 2008). After metamorphosis, smolt-like individuals known as macropthalmia migrate to the ocean—typically in conjunction with high-flow events between fall and spring (van de Wetering 1998). Data from rotary screw trapping at sites in the Sacramento-San Joaquin Basin indicate that emigration of Pacific Lamprey macropthalmia peaks from early winter through early summer; however, some outmigration has been observed year-round in the mainstem Sacramento River at both RBDD and GCID (Hanni and Blalock-Herod 2006). When abundant, outmigrating Pacific Lamprey may act to buffer predation on juvenile and smolt salmon because they are easier to capture than salmonids (Close et al. 2002).

9B.2.3.4 Ocean Residence

In the ocean, adult Pacific Lamprey feed parasitically on a variety of marine and anadromous fishes such as salmon, flatfish, rockfish, and pollock. Pacific Lamprey are preyed upon by sharks, sea lions, and other marine animals (Richards and Beamish 1981, Beamish and Levings 1991, Close et al. 2002), and have been captured in depths from 300 to 2,600 ft and as far as 62 miles off the coast (USFWS 2007).

9B.2.4 Population Trends

In recent years, state, federal, and tribal agencies have expressed concern at the apparent decline of lamprey populations in the Northwestern United States (Close et al. 2002; Moser and Close 2003; CRBLTW 2005). Widespread anecdotal accounts of decreased Pacific Lamprey spawning and carcasses have been supported by a substantial reduction in counts of migrating individuals at dams since the late 1960s (Moser and Close 2003, Klamath-Siskiyou Wildlands Center et al. 2003). Very few data on Pacific Lamprey populations are available to assess status in the Sacramento-San Joaquin Basin; however, loss of access to historical habitat throughout California indicates that populations are greatly suppressed compared with historical levels (Moyle et al. 2009).

Factors limiting Pacific Lamprey populations are numerous and interrelated (Moser and Close 2003, Moyle et al. 2009). Although very little data or published studies are available for Pacific Lamprey in the region, parallels in their life cycle with salmon and steelhead suggest that these species are adversely affected by many of the same factors. Lack of access to historical spawning habitats because of dams, entrainment by water diversions, agricultural practices, urban development, harvesting, mining, transportation, estuary modification, prey abundance, and nonnative invasive species have all been cited as important anthropogenic factors limiting the viability of Pacific Lamprey populations in California (Moyle et al. 2009). In the Delta, the impacts of agricultural practices, development, estuary modification, and predation by nonnative species are expected to be particularly pronounced.

9B.2.5 References

Beamish, R. J. 1980. Adult biology of the River Lamprey (*Lampetra ayresi*) and the Pacific Lamprey (*Lampetra tridentata*) from the Pacific coast of Canada. *Canadian Journal of Fisheries and Aquatic Science* 37: 1906–1923.

Beamish, R. J., and C. D. Levings. 1991. Abundance and freshwater migrations of the anadromous parasitic lamprey, *Lampetra tridentata*, in a tributary of the Fraser River, British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 48: 1250–1263.

Bergstedt, R. A., and J. G. Seelye. 1995. Evidence for lack of homing by sea lampreys. *Transactions of the American Fisheries Society* 124: 235–239.

BioAnalysts, Inc. 2000. *A status of Pacific lamprey in the mid-Columbia region. Rocky Reach Hydroelectric Project, FERC Project No. 2145*. Prepared for Public Utility District No. 1 of Chelan County, Wenatchee, Washington.

Bjerselius, R., W. Li, J. H. Teeter, J. G. Seelye, P. B. Johnsen, P. J. Maniak, G. C. Grant, C. N. Polkinghorne, and P. W. Sorensen. 2000. Direct behavioral evidence that unique bile acids released by larval sea lamprey (*Petromyzon marinus*) function as a migratory pheromone. *Canadian Journal of Fisheries and Aquatic Sciences* 57: 557–569.

Brumo, A. F. 2006. Spawning, larval recruitment, and early life survival of Pacific lampreys in the South Fork Coquille River, Oregon. Master's thesis. Oregon State University, Corvallis.

Brumo, A. F., L. Grandmontagne, S. N. Namitz, and D. F. Markle. 2009. *Evaluation of approaches used to monitor Pacific lamprey spawning populations in a coastal Oregon stream.* Biology, management, and conservation of lampreys in North America. Edited by L. R. Brown, S. D. Chase, M. G. Mesa, R. J. Beamish, and P. B. Moyle. Pp. 204–222. American Fisheries Society, Symposium 72, Bethesda, Maryland.

Chase, S. D. 2001. Contributions to the life history of adult Pacific lamprey (*Lampetra tridentate*) in the Santa Clara river of southern California. *Bulletin of the Southern California Academy of Sciences* 100: 74–85.

Clemens, B. J., S. J. van de Wetering, J. Kaufman, R. A. Holt, and C. B. Schreck. 2009. Do summer temperatures trigger spring maturation in adult Pacific lamprey, *Entosphenus tridentatus*? *Ecology of Freshwater Fish* 18: 418-426.

Clemens, B. J., T. R. Binder, M. F. Docker, M. L. Moser, and S. A. Sower. 2010. Similarities, differences, and unknowns in biology and management of three parasitic lampreys of North America. *Fisheries* 35: 580-594.

Clemens, B. J., M. G. Mesa, R. J. Magie, D. A. Young, and C. B. Schreck. 2012. Pre-spawning migration of adult Pacific lamprey, *Entosphenus tridentatus*, in the Willamette River, Oregon, U.S.A. *Environmental Biology of Fishes* 93: 245–254.

Close, D. A., M. S. Fitzpatrick, and H. W. Li. 2002. The ecological and cultural importance of a species at risk of extinction, Pacific lamprey. *Fisheries* 27:19–25

CRBLTW (Columbia River Basin Lamprey Technical Workgroup). 2005. April 19. *Critical uncertainties for lamprey in the Columbia River Basin: results from a strategic planning retreat of the Columbia River Lamprey Technical Workgroup.* http://www.fws.gov/columbiariver/lampreywg/docs/CritUncertFinal.pdf

Goodman, D., S. Reid, and M. Docker. 2006. *A phylogeographic analysis of the Pacific lamprey Entosphenus tridentatus*. Revised final project report. Prepared for U.S. Fish and Wildlife Service, Portland, Oregon.

Graham, J. C., and C. V. Brun. 2006. *Determining lamprey species composition, larval distribution, and adult abundance in the Deschutes River, Oregon, subbasin*. 2005 Annual Report. Bonneville Power Administration, Portland, Oregon.

Gunckel, S. L., K. K. Jones, and S. E. Jacobs. 2009. *Spawning distribution and habitat use of adult Pacific and western brook lampreys in Smith River, Oregon.* Edited by L. R. Brown, S. D. Chase, M. G. Mesa, R. J. Beamish, and P. B. Moyle. Pp. 173–189. Biology, management, and conservation of lampreys in North America. American Fisheries Society, Symposium 72, Bethesda, Maryland.

Hanni, J., and H. N. Blalock-Herod. 2006. *Spatial and temporal distribution patterns of Pacific and River Lamprey in the Sacramento and San Joaquin rivers and delta.* U.S. Fish and Wildlife Service, Stockton and Sacramento, California.

Hannon, J., and B. Deason. 2008. *American River steelhead (Oncorhynchus mykiss) spawning, 2001-2007.* U.S. Bureau of Reclamation, Sacramento, California.

Jasper J. R., and D. F. Evensen. 2006. *Length-girth, length-weight, and fecundity of Yukon River Chinook salmon, Oncorhynchus tshawytscha. Fishery Data Series No. 06-70.* Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage.

Kan, T. T. 1975. *Systematics, variation, distribution, and biology of lampreys of the genus Lampetra in Oregon.* Doctoral dissertation. Oregon State University, Corvallis.

Klamath-Siskiyou Wildlands Center, Siskiyou Regional Education Project, Umpqua Watersheds, Friends of the Eel, Northcoast Environmental Center, Environmental Protection Information Center, Native Fish Society, Center for Biological Diversity, Oregon Natural Resources Council, Washington Trout, and Umpqua Valley Audubon Society. 2003. *A petition for rules to list: Pacific lamprey (Lampetra tridentata); River Lamprey (Lampetra ayresi); western brook lamprey (Lampetra richardsoni); and Kern brook lamprey (Lampetra hubbsi) as threatened or endangered under the Endangered Species Act.* Submitted to the U.S. Fish and Wildlife Service.

Lampman, R. T. 2011. *Passage, migration, behavior, and autoecology of adult Pacific lamprey at Winchester Dam and within the North Umpqua River Basin, OR.* Master's thesis, Oregon State University, Department of Fisheries and Wildlife, Corvallis.

Lin, B., Z. Zhang, Y. Wang, K. P. Currens, A. Spidle, Y. Yamazaki, and D. A. Close. 2008. Amplified fragment length polymorphism assessment of genetic diversity in Pacific lampreys. *North American Journal of Fisheries Management* 28: 1182-1193.

Luzier, C. W., G. Silver, and T. A. Whitesel. 2006. *Evaluate habitat use and population dynamics of lampreys in Cedar Creek.* 2005 Annual Report. Bonneville Power Administration, Portland, Oregon.

McCovey, B. W., Jr. 2011. *A small scale radio bio-telemetry study to monitor migrating Pacific lamprey (Lampetra tridentata) within the Klamath River basin.* Final progress report. Yurok Tribal Fisheries Program, Klamath River Division, Hoopa, California.

McGree M., T. A. Whitesel, and J. Stone. 2008. Larval metamorphosis of individual Pacific lampreys reared in captivity. *Transactions of the American Fisheries Society* 137: 1866–1878.

Meeuwig, M., J. M. Bayer, and R. Reiche. 2004. *Identification of larval Pacific lampreys (Lampetra tridentata), River Lampreys (L. ayresi), and western brook lampreys (L. richardsoni) and thermal requirements of early life history stages of lampreys.* 2000 Annual Report. Bonneville Power Administration, Portland, Oregon.

Meeuwig, M. H., J. M. Bayer, and J. G. Seelye. 2005. Effects of temperature on survival and development of early life stage Pacific and western brook lampreys. *Transactions of the American Fisheries Society* 134:19–27.

Michael, J. H. 1980. Repeat spawning of Pacific lamprey. *California Fish and Game Notes* 66:186–187.

Michael, J. H. 1984. Additional notes on the repeat spawning by Pacific lamprey. *California Fish and Game Notes* 70:186–188.

Moore, J. W., and J. M. Mallatt. 1980. Feeding of larval lamprey. *Canadian Journal of Fisheries and Aquatic Sciences* 37: 1658–1664.

Moser, M. L., and D. A. Close. 2003. Assessing Pacific lamprey status in the Columbia River Basin. *Northwest Science* 77: 116–125.

Moyle, P. B. 2002. *Inland fishes of California.* Revised edition. University of California Press, Berkeley.

Moyle, P. B., L. R. Brown, S. D. Chase, and R. M. Quinones. 2009. *Status and conservation of lampreys in California*. Edited by L. R. Brown, S. D. Chase, M. G. Mesa, R. J. Beamish, and P. B. Moyle. Pp. 279–292. Biology, management, and conservation of lampreys in North America. American Fisheries Society, Symposium 72, Bethesda, Maryland.

Petersen-Lewis, R. S. 2009. *Yurok and Karuk traditional ecological knowledge: insights into Pacific lamprey populations of the lower Klamath Basin.* Edited by L. R. Brown, S. D. Chase, M. G. Mesa, R. J. Beamish, and P. B. Moyle. Pp. 1-40. Biology, management, and conservation of lampreys in North America. American Fisheries Society, Symposium 72, Bethesda, Maryland.

Pletcher, F. T. 1963. *The life history and distribution of lampreys in the Salmon and certain other rivers in British Columbia, Canada.* Master's thesis. University of British Columbia, Vancouver.

Richards, J. E. 1980. *Freshwater biology of the anadromous Pacific lamprey Lampetra tridentata.* Master's thesis. University of Guelph, Guelph, Ontario. As cited in Oregon Department of Fish and Wildlife *Oregon Lampreys: Natural History Status and Analysis of Management Issues,* February 25, 2002.

Richards, J. E., and F. W. H. Beamish. 1981. Initiation of feeding and salinity tolerance in the Pacific lamprey *Lampetra tridentata*. *Marine Biology* 63: 73–77.

Robinson, T. C., and J. M. Bayer. 2005. Upstream migration of Pacific lampreys in the John Day River, Oregon: behavior, timing, and habitat use. *Northwest Science* 79: 106-119.

Roni, P. 2003. Responses of benthic fishes and giant salamanders to placement of large woody debris in small Pacific Northwest streams. *North American Journal of Fisheries Management* 23: 1087–1097.

Ruiz-Campos, G., and S. Gonzalez-Guzman. 1996. First freshwater record of Pacific lamprey, *Lampetra tridentata*, from Baja California, Mexico. *California Fish and Game* 82: 144–146.

Stillwater Sciences. 2010. *Pacific lamprey in the Eel River basin: a summary of current information and identification of research needs*. Prepared by Stillwater Sciences, Arcata, California for Wiyot Tribe, Loleta, California.

Stone, J., and S. Barndt. 2005. Spatial distribution and habitat use of Pacific lamprey (*Lampetra tridentata*) ammocoetes in a western Washington stream. *Journal of Freshwater Ecology* 20: 171-185.

Torgensen C. E., and D. A. Close. 2004. Influence of habitat heterogeneity on the distribution of larval Pacific lamprey (*Lampetra tridentata*) at two spatial scales. Freshwater Biology 49: 614–630.

ULEP (Umpqua Land Exchange Project). 1998. *Mapping rules for Pacific lamprey (Lampetra tridentata).* ULEP, Roseburg, Oregon. As cited by Friant Water Usesrs Authority and Natural Resources Defense Council *Draft Restoration Strategies for the San Joaquin River*, February 2003.

USFWS (U.S. Fish and Wildlife Service). 2004. Endangered and threatened wildlife and plants; 90-day finding on a petition to list three species of lampreys as threatened or endangered. Federal Register 69: 77158–77167.

_____. 2007. *Fact sheet: Pacific lamprey - Lampetra tridentata.* Portland, Oregon. http://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/Documents/012808PL-FactSheet.pdf

van de Wetering, S. J. 1998. *Aspects of life history characteristics and physiological processes in smolting pacific lamprey (Lampetra tridentata) in a central Oregon coast stream.* Master's thesis. Oregon State University, Corvallis.

van de Wetering, S. J., and R. E. Ewing. 1999. *Lethal temperatures for larval Pacific lamprey, Lampetra tridentata.* Confederated Tribes of the Siletz Indians, Siletz, Oregon. As cited by Confederated Tribes of Warm Springs Reservation of Oregon *Pacific Lamprey Passage Evaluation and Mitigation Plan: Phase I*, March 2012.

Vrieze, L. A., and P. W. Sorensen. 2001. Laboratory assessment of the role of a larval pheromone and natural stream odor in spawning stream localization by migratory sea lamprey (*Petromyzon marinus*). *Canadian Journal of Fisheries and Aquatic Sciences* 58: 2374–2385.

Yun, S.-S., A. J. Wildbill, M. J. Siefkes, M. L. Moser, A. H. Dittman, S. C. Corbett, W. Li, and D. A. Close. 2011. Identification of putative migratory pheromones from Pacific lamprey (*Lampetra tridentata*). *Canadian Journal of Fisheries and Aquatic Sciences* 68: 2194–2203.

9B.3 Green Sturgeon (*Acipenser medirostris*)

9B.3.1 Legal Status

Federal: Threatened, Designated Critical Habitat
State: Species of Special Concern

The National Marine Fisheries Service (NMFS) has divided North American Green Sturgeon into two Distinct Population Segments (DPSs) using the Eel River in California as the line of demarcation (Adams et al. 2002). The Southern DPS of North American Green Sturgeon includes all coastal and Central Valley populations south of the Eel River, including the Sacramento River basin

(NMFS 2006). Although the Southern DPS is considered a separate population from the Northern DPS based on genetic data and spawning locations, their ranges outside the spawning season overlap (DFG 2002, Israel et al. 2004, Moser and Lindley 2007).

After a status review was completed in 2002 (Adams et al. 2002), NMFS determined that the Southern DPS did not warrant listing as threatened or endangered but should be identified as a Species of Concern. This determination was challenged in April 2003, and NMFS was asked to consider new information on the species. NMFS updated its status review in February 2005 and determined that the Southern DPS should be listed as threatened under the Federal Endangered Species Act (ESA) (NMFS 2005a). NMFS published a final rule (NMFS 2006) in April 2006 that listed the Southern DPS as threatened; the rule took effect on June 6, 2006.

NMFS made a final critical habitat designation for the Southern DPS in October 2009 (74 *Federal Register* [FR] 52300). Designated critical habitat in California includes the Sacramento, lower Feather, and lower Yuba rivers; the Delta; and Suisun, San Pablo, and San Francisco bays (NMFS 2014). NMFS published a final 4(d) rule to apply ESA take prohibitions to the Southern DPS in July 2010 (75 FR 30714). In California, Green Sturgeon is a Class 1 Species of Special Concern (qualifying as threatened under the California Endangered Species Act).

9B.3.2 Distribution

North American Green Sturgeon are the most wide-ranging sturgeon species, with ocean migrations ranging between northern Mexico and southern Alaska (Adams et al. 2002). Ocean abundance and densities of Green Sturgeon increase north of the Golden Gate because both the Southern DPS and Northern DPS generally migrate northward along the coast when at sea (NMFS 2005b), as confirmed by radio telemetry studies conducted on Sacramento River Green Sturgeon (DFG 2002). Subadult and adult Green Sturgeon migrate thousands of miles along the western coast of the United States, often venturing into coastal estuaries like Willapa Bay and Grays Harbor in Washington, where they concentrate during summer (Adams et al. 2002). Two adults tagged in Willapa Bay have been detected by radio telemetry stations in the Sacramento River (Heublein et al. 2009), indicating that Green Sturgeon from the Sacramento River migrate as far north as Washington before returning to the Sacramento River to spawn. Concentrations of Green Sturgeon have also been detected near Vancouver Island in Canada (NMFS 2005b).

Though Green Sturgeon migrate thousands of miles through rivers, estuaries, and ocean, they do not readily establish new spawning populations; they are known from only three river systems: the Sacramento, Rogue, and Klamath. However, data suggest there may be spawning populations in both the Eel River and the Umpqua River in Oregon (NMFS 2005b), which could indicate previously undetected relict populations or the seeds of new subpopulations. The population that spawns in the Sacramento River constitutes the only known spawning population in the Southern DPS. Populations may have formerly spawned in the

San Joaquin and South Fork Trinity rivers, but have since been extirpated (Israel and Klimley 2008).

Green Sturgeon juveniles, subadults, and adults are widely distributed in the Sacramento-San Joaquin Delta and estuary areas including San Pablo Bay (Beamesderfer et al. 2004). The Sacramento-San Joaquin Delta serves as a migratory corridor, feeding area, and juvenile rearing area for North American Green Sturgeon in the Southern DPS.

9B.3.2.1 Current Distribution in Sacramento River

Within the Sacramento River, data only support an approximation of spawning locations. Larval Green Sturgeon have been captured routinely, but in small numbers in the RBDD rotary screw traps (River Mile [RM] 243.5) and the GCID fish facility (RM 206), suggesting that spawning generally occurs upstream of Hamilton City (RM 199), though spawning may occur as far downstream as Chico Landing (RM 194) (Heublein et al. 2009). Adult Green Sturgeon have been observed congregating below RBDD during late spring and early summer when the gates are down (Beamesderfer et al. 2004), suggesting that these may be ripe adults trying to migrate upstream to spawn. Spawning may occur in reaches upstream of RBDD (DFG 2002), but the upstream extent of spawning is unknown. In 1999, USFWS placed egg mats in the Sacramento River from Anderson Cottonwood Irrigation District (ACID) Dam (RM 298.4) to 10 miles downstream of RBDD to identify Green Sturgeon spawning sites; however, only two eggs were captured, both at mats downstream of RBDD, so the study did not clarify the location of specific spawning sites or the upstream extent of spawning (Beamesderfer et al. 2004). A radio telemetry study detected two adult Green Sturgeon migrating past a remote monitoring station above RBDD, suggesting possible spawning migration upstream (Heublein et al. 2009).

9B.3.2.2 Historical Distribution in Sacramento River

The location and character of spawning sites in the Rogue and Klamath rivers suggest that Green Sturgeon spawned in the Sacramento River above Keswick Dam (RM 302), including in the Pit, McCloud, and Little Sacramento rivers (Nakamoto et al. 1995, NMFS 2005b). The timing of upstream migration (February through July) corresponds with winter base and high flows and spring snowmelt. Adult Green Sturgeon likely entered the Sacramento River during winter, holding in pools in the middle and upper Sacramento River until high-flow events triggered upstream migration; high flows would have allowed adults to navigate through areas that might otherwise act as passage barriers at lower flows, providing them with access to steeper reaches with higher-velocity flows and coarser substrates for broadcast spawning. Such areas may have resulted in higher egg survival—crevices between substrate particles would provide the Green Sturgeon’s relatively non-adhesive eggs to settle in areas less accessible to egg predators.

The location and characteristics of preferred Green Sturgeon spawning habitats in the Rogue and Klamath rivers suggest that most of the historical spawning habitat in the Sacramento River likely occurred upstream of Keswick Dam (RM 302), with dam construction in the 1940s creating a permanent barrier that eliminated access to the majority of spawning habitat. Upstream passage may have been impeded even earlier by the seasonal operation of the ACID Dam, which began in 1916. Later-arriving adults would have even less access to spawning habitat because of the operation of RBDD, which blocked upstream passage when the gates were lowered in mid-May. Beginning in the late 1800s, those adults that successfully spawned upstream might have had their larvae entrained by water diversions such as the GCID diversion near Hamilton City.

9B.3.3 Life History and Habitat Requirements

Sturgeon live 40 to 50 years, delay maturation to large sizes (125 cm total length), and spawn multiple times over their lifespan. This life history strategy has been successful through normal environmental variation in the large river habitats where spawning occurs. Their long lifespan, repeat spawning in multiple years, and high fecundity allow them to persist through periodic droughts and environmental catastrophes. The high fecundity associated with large size allows them to produce large numbers of offspring when suitable spawning conditions occur and compensate for years of poor reproductive and juvenile rearing conditions. Adult Green Sturgeon do not spawn every year, and only a fraction of the population enters fresh water where they might be at risk of a catastrophic event (Beamesderfer et al. 2007). Though there are general descriptions of preferred habitat conditions for Green Sturgeon, much of this information is derived from Rogue River and Klamath River data, and little is known about specific spawning, rearing, or holding locations in the Sacramento River.

9B.3.3.1 Adult Migration

Though Green Sturgeon spend most of their life in marine and estuarine environments, they periodically migrate into freshwater streams to spawn, spending up to 6 months in fresh water during their spawning migration. Upstream migration generally begins in February and may last until late July (Adams et al. 2002). In the Rogue River, telemetry studies have shown that adult Green Sturgeon hold in low-velocity, deep-water habitats prior to migrating upstream to spawn (Erickson et al. 2002). The adults move around in the pools and may stray short distances, but the scope of their movement is limited. In the Sacramento River, adult Green Sturgeon begin their upstream spawning migrations into the San Francisco Bay in March and reach Knights Landing on the Sacramento River during April (Heublein et al. 2006).

9B.3.3.2 Spawning

Spawning occurs between March and July, peaking between mid-April and mid-June (Emmett et al. 1991). Based on the distribution of sturgeon eggs, larvae, and juveniles in the Sacramento River, DFG (2002) indicated that Green Sturgeon spawn in late spring and early summer above Hamilton City, possibly up to Keswick Dam (Brown 2007). Israel and Klimley (2008) state that Green Sturgeon spawn in the mainstem from the confluence of Battle Creek (river kilometer 438) to the area upstream of Molinos, but may also spawn below RBDD closer to GCID in some years. Adults spawn within about a week, and females appear to spawn regardless of habitat conditions (Beamesderfer et al. 2007).

Green Sturgeon prefer areas of fast, deep, turbulent water in mainstem channels for spawning (Moyle 2002). They spawn in a variety of substrates, from clean sand to bedrock, but prefer bed surfaces composed of coarse cobble (Moyle 2002). In the Rogue River, suspected spawning sites (inferred from the movement of radio-tagged Green Sturgeon) have beds composed of cobbles and boulders, with water depths greater than 10 to 15 feet (3 to 4.6 meters) and turbulent water over slope breaks in the channel (Wildlife Conservation Society 2005). The interstitial spaces between large particles may provide eggs with cover from predation (Moyle 2002). Eggs and larvae require cool water temperatures and high dissolved oxygen concentrations while digesting their yolk sac (Van Eenennaam et al. 2005).

Female Green Sturgeon produce 59,000 to 242,000 eggs, about 4.34 mm in diameter (Van Eenennaam et al. 2001, 2006). Green Sturgeon eggs have the largest mean diameter of any sturgeon species (Cech et al. 2000), but they lay fewer eggs. The larger eggs may allow embryos to grow larger before hatching and emerging from cover, increasing their survival relative to other sturgeon species. Fecundity peaks at around age 24 years (Beamesderfer et al. 2007).

9B.3.3.3 Juvenile Rearing

Hatchling Green Sturgeon embryos seek nearby cover and remain under rocks (Deng et al. 2002). After about 6 to 9 days, the hatchings develop into larvae and initiate exogenous foraging on the benthos (Deng et al. 2002, Kynard et al. 2005). After a day or so, larvae disperse downstream for 1 to 2 weeks. Movements and foraging activity during this period are nocturnal (Cech et al. 2000, Kynard et al. 2005). Larval Green Sturgeon are regularly captured during this dispersal stage at about 2 weeks old (24- to 34-mm fork length) in rotary screw traps at RBDD (DFG 2002, USFWS 2002) and 3 weeks old when captured farther downstream at the GCID fish facility (Van Eenennaam et al. 2001). Following emergence in early summer, larval Green Sturgeon migrating downstream with snowmelt flows between May and July, growing quickly and becoming more tolerant of increasing water temperatures and salinities. The upper thermal limit for optimal development and hatching is between 17 to 18°C; temperatures higher than this may affect development and hatching success, and complete mortality occurs at temperatures above 23°C (Van Eenennaam et al. 2005).

Young Green Sturgeon appear to rear for the first 1 to 2 months in the Sacramento River between Keswick Dam and Hamilton City (DFG 2002). Larvae and post-larvae are present in the lower Sacramento River and North Delta between May and October, primarily in June and July (DFG 2002). Little is known of distribution and movements of young-of-the-year and riverine juveniles, but observations suggest they may be distributed primarily in the mainstem Sacramento River downstream of Anderson and in the brackish portions of the north and interior Delta (Israel and Klimley 2008). Juvenile Green Sturgeon have been captured in the Delta during all months of the year (Borthwick et al. 1999, DFG 2002). Catches of 1- and 2-year-old Southern DPS Green Sturgeon on the shoals in the lower San Joaquin River, at the CVP/SWP fish salvage facilities, and in Suisun and San Pablo bays indicate that some fish rear in the estuary for at least 2 years (DFG 2002). Larger juvenile and subadult Green Sturgeon occur throughout the estuary, possibly temporarily, after spending time in the ocean (DFG 2002, Kelly et al. 2007).

The rearing habitat preferences of Green Sturgeon larvae and juveniles in the Sacramento River are not well understood. Laboratory research has identified water temperature thresholds for larval Green Sturgeon. Water temperatures above 68°F (20°C) were found to be lethal to Green Sturgeon embryos by Cech et al. (2000), and temperatures above 63 to 64°F (17 to 18°C) were found to be stressful by Van Eenennaam et al. (2005). Cech et al. (2000) found that optimal growth of larvae occurred at 59°F (15°C), with growth slowing at temperatures below 52°F (11°C) and above 62°F (19°C).

Several studies suggest that juvenile Green Sturgeon rear in fresh water for 1 to 4 years, acclimating gradually to brackish environments before migrating to the ocean (Beamesderfer and Webb 2002, Nakamoto et al. 1995). Larval Green Sturgeon are captured at RBDD and the GCID fish facility between May and August, with peak capture at RBDD in June and July and at the GCID fish facility in July (Adams et al. 2002). Green Sturgeon larvae trapped at RBDD average 1.1 inches (2.9 cm) in length, while larvae trapped at the GCID fish facility average 1.4 inches (3.6 cm) (Adams et al. 2002), suggesting that larvae move downstream soon after hatching; however, it is not clear how long larval and juvenile Green Sturgeon remain in the middle Sacramento River. Larval Green Sturgeon grow quickly, reaching 2.9 inches (74 mm) by the time they become juveniles at around 45 days posthatching (Deng 2000). Klamath River studies indicate that juvenile Green Sturgeon can grow to 12 inches (30 cm) in their first year and 24 inches (60 cm) within 2 to 3 years (Nakamoto et al. 1995). The small size of salvaged juvenile Green Sturgeon at the CVP and SWP fish facilities indicates that they move downstream to rear in the Bay-Delta estuary (Adams et al. 2002), though it is unclear how long they remain before migrating to the ocean.

While in the riverine environment, juveniles occupy low-light habitat and are active at night (Kynard et al. 2005). Older juveniles may be adapted to move through habitats with variable gradients of salinity, temperature, and dissolved oxygen (Kelly et al. 2007, Moser and Lindley 2007). Their diet during their Sacramento River residence is unknown, but likely consists of drifting and benthic aquatic macroinvertebrates (Israel and Klimley 2008).

Stomach contents from adult and juvenile Green Sturgeon captured in the Sacramento-San Joaquin Delta included shrimp, mollusks, amphipods, and small fish (Radtke 1966, Houston 1988, Moyle et al. 1992). Stomachs of Green Sturgeon caught in Suisun Bay contained *Corophium* sp. (amphipod), *Cragon franciscorum* (bay shrimp), *Neomysis awatchensis* (Opossum shrimp: synonymous with *Neomysis mercedis*), and annelid worms (Ganssle 1966). Stomachs of Green Sturgeon caught in San Pablo Bay contained *C. franciscorum*, *Macoma* sp. (clam), *Photis californica* (amphipod), *Corophium* sp., *Synidotea laticauda* (isopod), and unidentified crab and fish (Ganssle 1966). Stomachs of Green Sturgeon caught in the Delta contained *Corophium* sp. and *N. awatchensis* (Radtke 1966). As a result of recent changes in the species composition of macroinvertebrates inhabiting the Bay-Delta estuary due to nonnative species introductions, the current diet of Green Sturgeon is likely to differ from that reported in the 1960s.

In the Rogue River, adults hold in deep pools after spawning until late fall or early winter, when they emigrate to downstream estuaries or the ocean, perhaps cued by winter freshets that cause water temperatures to drop (Erickson et al. 2002). Erickson et al. (2002) noted that adult downstream migration appeared correlated with water temperatures below 50°F (10°C).

9B.3.3.4 Ocean Residence

Green Sturgeon from the Southern DPS pass through the San Francisco Bay to the ocean where they commingle with other sturgeon populations (DFG 2002). Subadult and adult sturgeon tagged in San Pablo Bay oversummer in bays and estuaries along the coast of California, Oregon, and Washington, between Monterey Bay and Willapa Bay, before moving farther north in the fall to overwinter north of Vancouver Island. Individual Southern DPS Green Sturgeon tagged by DFW in the San Francisco estuary have been recaptured off Santa Cruz, California; in Winchester Bay on the southern Oregon coast; at the mouth of the Columbia River; and in Grays Harbor, Washington (USFWS 1993, Moyle 2002). Most Southern DPS Green Sturgeon tagged in the San Francisco estuary have been returned from outside that estuary (Moyle 2002).

Subadult and adult Green Sturgeon generally migrate north along the coast once they reach the ocean, concentrating in coastal estuaries like Willapa Bay, Grays Harbor, and the Columbia River estuary during summer (Adams et al. 2002). The strategy underlying summer visits to coastal estuaries is unclear because sampling indicates they have relatively empty stomachs, suggesting they may not be entering the estuaries to feed (Beamesderfer 2000). Females reach sexual maturity after about 17 years and males after about 15 years (Adams et al. 2002). Spawning was believed to occur every 3 to 5 years (Tracy 1990), but may occur as frequently as every 2 years (NMFS 2005a).

9B.3.4 Population Trends

Empirical estimates of Green Sturgeon abundance are not available for any west coast population including the Sacramento River population. Interpretations of available time series of abundance index data for Green Sturgeon are confounded by small sample sizes, intermittent reporting, fishery-dependent data, lack of directed sampling, subsamples representing only a portion of the population, and potential confusion with White Sturgeon (Adams et al. 2002). Musick et al. (2000) noted that the North American Green Sturgeon population has declined by 88 percent throughout much of its range. The current population status of Southern DPS Green Sturgeon is unknown (Beamesderfer et al. 2007, Adams et al. 2007). Based on captures of Green Sturgeon during surveys for White

Sturgeon in San Francisco Bay (USFWS 1995), the population is believed to range from several hundred to a few thousand adults.

Population estimates of Green Sturgeon in the Sacramento River have been derived from data collected by monitoring programs that generally focus on other species because few monitoring programs specifically address Green Sturgeon in the Sacramento River. Green Sturgeon larvae are captured annually in the RBDD rotary screw traps, the GCID fish screen, and the CVP/SWP fish salvage facilities in the South Delta. DFW conducts annual trammel net surveys in San Pablo Bay to track the White Sturgeon population, and Green Sturgeon often form part of the incidental catch. Eggs, larvae, and post-larval Green Sturgeon are now commonly reported in sampling directed at Green Sturgeon and other species (Beamesderfer et al. 2004, Brown 2007). Young-of-the-year Green Sturgeon have been observed annually since the late 1980s in fish sampling efforts at RBDD and the Glenn-Colusa Canal (Beamesderfer et al. 2004). Green Sturgeon in the Sacramento River are believed to have declined over the last 2 decades, with fewer than 50 spawning adults observed annually in the best spawning habitat along the middle section of the Sacramento River (Israel and Klimley 2008).

Similar to other anadromous fish, Green Sturgeon in the Sacramento River likely exhibit seasonal behavioral patterns in response to changes in flows, water temperature, or other environmental cues affected by flows, but it is not clear if anthropogenically induced changes in the flow regime have contributed to the apparent decline in Green Sturgeon spawners. Researchers have hypothesized that high spring flows, or the turbidity associated with them, may act as an upstream migration cue. The annual catch of larval sturgeon at the RBDD and GCID fish screens suggests that spawning occurs in the Sacramento River in most years, regardless of water year type; however, it is unclear how many adults return to spawn each year and whether there is a relationship between flows and the number of adult spawners in any given year. The relationship between flow and water temperature in the Sacramento River may influence Green Sturgeon through controlling the amount of suitable rearing habitat available for larvae and juveniles (Adams et al. 2002).

The most consistent sample data for Sacramento Green Sturgeon are for subadults captured in San Pablo Bay during periodic White Sturgeon assessments since 1948. The California Department of Fish and Game (now DFW) measured and identified 15,901 sturgeon of both species between 1954 and 1991 (USFWS 1996). Catches of subadult and adult North American Green Sturgeon by the Interagency Ecological Program between 1996 and 2004 ranged from 1 to 212 Green Sturgeon per year, with the highest catch in 2001. Various attempts have been made to infer Green Sturgeon abundance based on White Sturgeon mark-recapture estimates and relative numbers of White and Green Sturgeon in the catch (USFWS 1996, Moyle 2002). However, low catches of Green Sturgeon preclude estimates or indices of Green Sturgeon abundance from these data (Schaffter and Kohlhorst 1999, Gingras 2005). It is unclear if the high annual variability in length distributions in these samples reflects variable recruitment and abundance or is an artifact of small sample sizes, pooling of sample years, or variable distribution patterns between freshwater and ocean portions of the population.

Anecdotal information is also available on young-of-the-year Green Sturgeon from juvenile fish monitoring efforts at RBDD and the GCID pumping facility on the upper Sacramento River. Fish traps at these facilities captured between 0 and 2,068 juvenile Green Sturgeon per year (Adams et al. 2002), which suggests that at least some Green Sturgeon reproduction occurred during the 1990s.

Approximately 3,000 juvenile Green Sturgeon have been observed in rotary screw traps operated for juvenile salmon at RBDD from 1994 to 2000. Annual catches have declined from 1995 through 2000 although the relationship of these catches to actual abundance is unknown. Recent data indicate that little production occurred in 2007 and 2008 (13 and 3 larvae, respectively, were captured in the rotary screw traps at RBDD) (Poytress et al. 2009). Larger production occurred in 2009, 2010, and 2011 (45, 122, and 643 larvae, respectively, were captured using a benthic D-net), and no larvae were captured in 2012 (Poytress et al. 2010, 2011, 2012, 2013).

More than 2,000 juvenile Green Sturgeon have been collected in fyke and rotary screw traps operated at the GCID diversion from 1986 to 2003. Operation of the screw trap at the GCID site began in 1991 and has continued year-round with the exception of 1998. Juvenile Green Sturgeon at the GCID site were consistently larger in average size, but the number captured varied widely with no apparent patterns in abundance between the two sites. Abundance of juveniles peaked during June and July with a slightly earlier peak at RBDD (Adams et al. 2002).

Variable numbers of juvenile Green Sturgeon are observed each year from two south Delta water diversion facilities (DFG 2002). When water is exported through the CVP/SWP export facilities, fish become entrained into the diversion. Since 1957, Reclamation has salvaged fish at the CVP Tracy Fish Collection Facility. DFW’s Fish Facilities Unit, in cooperation with DWR, began salvaging fish at the SWP Skinner Delta Fish Protective Facility in 1968. The salvaged fish are trucked daily and released at several sites in the western Delta. Salvage of fish at both facilities is conducted 24 hours a day, 7 days a week, at regular intervals. Salvaged fish are subsampled for species composition and numbers. Numbers of Green Sturgeon observed at these fish facilities have declined since the 1980s, which contributed to NMFS’ decision to list the Southern DPS as a threatened species. From the SWP Skinner Fish Facility, Green Sturgeon counts averaged 87 individuals per year between 1981 and 2000 and 20 individuals per year from 2001 through 2007. From the CVP Tracy Fish Collection Facility, Green Sturgeon counts averaged 246 individuals per year between 1981 and 2000 and 53 individuals per year from 2001 through 2007 (Reclamation 2008). Patterns were similar between total numbers per year and numbers adjusted for water export volumes, which increased during the 1970s and 1980s. Annual counts of Green Sturgeon from the SWP and CVP fish facilities are not significantly correlated (Beamesderfer 2005).

USFWS (1996) reported substantial uncertainty in the interpretation of salvage data for Green Sturgeon because of poor quality control on both counts and species identification, expansions from small sample sizes, variability in sturgeon dispersal patterns and collection vulnerability in response to complex changes in Delta flow dynamics, and changes in configuration and operations over time. Estimated sturgeon salvage numbers are expanded from subsamples, and actual numbers of Green Sturgeon observed are substantially smaller. Historical expansions were based on variable expansion rates (subsample duration) ranging from 15 seconds per 2 hours when fish numbers were high to 100 percent counting during periods when fish numbers were low. Under current conditions, NMFS (2004) requires sampling of fish salvage at both the SWP and CVP facilities at intervals of no less than 10 minutes every 2 hours. Green Sturgeon salvage estimates reported for years before 1993 may be in error because of uncertainty whether smaller sturgeon were correctly identified (USFWS 1996, DFG 2002). Reclamation and DWR recommended that only more recent (from 1993 and later) CVP and SWP salvage data be used to analyze the effects of water project operations on Green Sturgeon and other anadromous fishes.

9B.3.5 References

Adams, P. B., C. B. Grimes, J. E. Hightower, S. T. Lindley, and M. L. Moser. 2002. *Status review for North American green sturgeon,* Acipenser medirostris. National Marine Fisheries Service, Santa Cruz, California.

Adams, P. B., C. B. Grimes, J. E. Hightower, S. T. Lindley, M. L. Moser, and M. J. Parsley. 2007. Population Status of North American Green Sturgeon, *Acipenser medirostris*. *Environmental Biology of Fishes* 79:339–356.

Beamesderfer, R. C. 2000. *Agenda and notes for green sturgeon workshop, 22-23 March 2000, Weitchpec, California.* Oregon Department of Fish and Wildlife, Portland.

______. 2005. *Technical Review of Recent Status Review and Proposed Listing of Green Sturgeon*. Prepared for State Water Contractors. Available at: http://www.fishsciences.net/reports/2005/tech_review_recent_status.pdf.

Beamesderfer, R. C. P., and M. A. H. Webb. 2002. *Green sturgeon status review information*. S.P. Cramer and Associates, Gresham, Oregon.

Beamesderfer, R., M. Simpson, G. Kopp, J. Inman, A. Fuller, and D. Demko. 2004. *Historical and current information on green sturgeon occurrence in the Sacramento and San Joaquin rivers and tributaries.* S.P. Cramer & Associates, Oakdale, California. Prepared for State Water Contractors, Sacramento, California.

Beamesderfer, R. C. P., M. L. Simpson, and G. J. Kopp. 2007. Use of life history information in a population model for Sacramento green sturgeon. *Environmental Biology of Fishes* 79: 315-337.

Borthwick, S. M., R. R. Corwin, and C. R. Liston. 1999. *Investigations of fish entrainment by archimededs and internal helical pumps at the Red Bluff Research Pumping Plant, Sacramento California: February 1997-June 1998.* Bureau of Reclamation, Red Bluff, California.

Brown, K. 2007. *Evidence of spawning by green sturgeon,* Acipenser medirostris*, in the upper Sacramento River, California.*

Cech, J. J. Jr., S. I. Doroshov, G. P. Moberg, B. P. May, R. G. Schaffter, and D. M. Kohlhorst. 2000. *Biological assessment of green sturgeon in the Sacramento-San Joaquin watershed (Phase 1)*. Project No. 98-C-15, Contract No. B-81738. Final report to CALFED Bay-Delta Program. As cited by Adams et al. 2002.

Deng, X. 2000. *Artificial reproduction and early life stages of the green surgeon (*Acipenser medirostris*)*. Doctoral dissertation. University of California, Davis. As cited by Adams et al. 2002.

Deng X, J. P. Van Eenennaam, and S. I. Doroshov. 2002. *Comparison of early life stages and growth of green and white sturgeon.* Biology, management, and protection of North American sturgeon. Edited by W. Van Winkle, P. J. Anders, D. H. Secor, and D. A. Dixon, 237-248. Symposium 28. American Fisheries Society, Bethesda, Maryland.

DFG (California Department of Fish and Game). 2002. *California Department of Fish and Game comments to NMFS regarding green sturgeon listing.* Sacramento.

Emmett, R. L., S. L. Stone, S. A. Hinton, and M. E. Monaco. 1991. *Distribution and abundance of fishes and invertebrates in west coast estuaries.* Volume 2: Species life history summaries. ELMR Report No. 8. NOS/NOAA Strategic Environmental Assessment Division, Rockville, Maryland.

Erickson, D. L., J. A. North, J. E. Hightower, J. Weber, and L. Lauck. 2002. Movement and habitat use of green sturgeon *Acipenser medirostris* in the Rogue River, Oregon, USA. *Journal of Applied Ichthyology* 18: 565-569.

Ganssle, D. 1966. *Fishes and decapods of San Pablo and Suisun bays.* Ecological studies of the Sacramento-San Joaquin Estuary, Part 1. Compiled by D. W. Kelley, 1-40. California Department of Fish and Game Bulletin 133.

Gingras, M. 2005. (San Pablo Bay white sturgeon abundance) X (green sturgeon:white sturgeon catch ratio): is the product an index of green sturgeon abundance? Symposium on green sturgeon and their environment at Cal-Neva American Fisheries Society Annual Meeting. Sacramento, California. As cited by Beamesderfer, R.C.P, G. Kopp, D. Demko *Review of the Distribution, Life History and Population Dynamics of Green Sturgeon with Reference to California's Central Valley*, 2005.

Heublein, J. C., J. T. Kelly, and A. P. Klimley. 2006. *Spawning migration and habitat of green sturgeon,* Acipenser medirostris*, in the Sacramento River.* Presentation at the CALFED Science Conference, Sacramento California. As cited in DWR et al. 2013

Heublein, J. C., J. T. Kelly, C. E. Crocker, A. P. Klimley, and S. T. Lindley. 2009. Migration of green sturgeon *Acipenser medirostris* in the Sacramento River. *Environmental Biology of Fishes* 84: 245-258.

Israel, J. A., J. F. Cordes, M. A. Blumberg, and B. May. 2004. Geographic patterns of genetic differentiation among western U.S. collections of North American green sturgeon *(Acipenser medirostris)*. *North American Journal of Fisheries Management* 24:922-931.

Israel, J. A., and A. P. Klimley. 2008. *Life history conceptual model for North American green sturgeon (*Acipenser medirostris*)*. Prepared for the Delta Regional Ecosystem Restoration and Implementation Plan (DRERIP) by University of California, Davis.

Kelly, J. T., A. P. Klimley, and C. E. Crocker. 2007. Movements of green sturgeon, *Acipenser medrostris*, in the San Francisco Bay Estuary, California. *Environmental Biology of Fishes* 79: 281-295.

Kynard, B., E. Parker, and T. Parker. 2005. Behavior of early life intervals of Klamath River green sturgeon, *Acipenser medirostris,* with a note on body color. *Environmental Biology of Fishes* 72:85-97.

Moser, M. L., and S. T. Lindley. 2007. Use of Washington estuaries by subadult and adult green sturgeon. *Environmental Biology of Fishes* 79: 243-253.

Moyle, P. B. 2002. *Inland fishes of California.* Revised edition. University of California Press, Berkeley.

Moyle, P. B., P. J. Foley, and R. M. Yoshiyama. 1992. *Status of green sturgeon,* Acipenser medirostris*, in California.* Report by University of California at Davis to the National Marine Fisheries Service, Terminal Island, California.

Musick, J. A., M. M. Harbin, S. A. Berkeley, G. H. Burgess, A. M. Eklund, L. Findley, R. G. Gilmore, J. T. Golden, D. S. Ha, G. R. Huntsman, J. C. McGovern, S. J. Parker, S. G. Poss, E. Sala, T. W. Schmidt, G. R. Sedberry, H. Weeks, and S. G. Wright. 2000. Marine, Estuarine, and Diadromous fish stocks at Risk of Extinction in North America (exclusive of Pacific Salmonids). *Fisheries* 25(11):6–30.

Nakamoto, R. J., T. T. Kisanuki, and G. H. Goldsmith. 1995. *Age and growth of Klamath River green sturgeon (*Acipenser medirostris*)*. Project 93-FP-13. U.S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office, Arcata, California.

NMFS (National Marine Fisheries Service). 2004. *Endangered Species Act – Section 7 consultation biological opinion on the long-term Central Valley*

Project and state water project operations, criteria, and plan (OCAP BO). Southwest Region. Long Beach, California.

_____. 2005a. *Green Sturgeon* (Acipenser medirostris) *Status Review Update*. NOAA Fisheries, Southwest Fisheries Science Center.

_____. 2005b. Endangered and threatened wildlife and plants: proposed threatened status for Southern Distinct Population Segment of North American green sturgeon. *Federal Register* 70: 17386-17401.

_____. 2006. Endangered and threatened wildlife and plants: threatened status for Southern Distinct Population Segment of North American green sturgeon: final rule. *Federal Register* 71: 17757-17766.

_____. 2014. Green Sturgeon. NOAA Fisheries Office of Protected Resources. Available at: http://www.nmfs.noaa.gov/pr/species/fish/greensturgeon.htm. Updated June 2, 2014.

Piper, R. G., I. B. McElwain, L. E. Orme, J. P. McCraren, L. G. Fowler, and J. R. Leonard. 1982. *Fish hatchery management.* U.S. Fish and Wildlife Service.

Poytress, W. R., J. J. Gruber, D. A. Trachtenbarg, and J. P. Van Eenennaam. 2009. *2008 Upper Sacramento River Green Sturgeon Spawning Habitat and Larval Migration Surveys.* March. Annual Report of U.S. Fish and Wildlife Service to Bureau of Reclamation, Red Bluff Fish Passage Program, Red Bluff, CA.

Poytress, W. R., J. J. Gruber, and J. Van Eenennaam. 2010. *2009 Upper Sacramento River Green Sturgeon Spawning Habitat and Larval Migration Surveys.* Final Annual Report. July. Annual Report of U.S. Fish and Wildlife Service to Bureau of Reclamation, Red Bluff Fish Passage Program, Red Bluff, CA.

_____. 2011. *2010 Upper Sacramento River Green Sturgeon Spawning Habitat and Larval Migration Surveys.* Final Annual Report. February. Annual Report of U.S. Fish and Wildlife Service to Bureau of Reclamation, Red Bluff Fish Passage Program, Red Bluff, CA.

_____. 2012. *2011 Upper Sacramento River Green Sturgeon Spawning Habitat and Larval Migration Surveys.* Final Annual Report. March. Annual Report of U.S. Fish and Wildlife Service to Bureau of Reclamation, Red Bluff Fish Passage Program, Red Bluff, CA.

Poytress, W. R., J. J. Gruber, C. E., Praetorius, and J. P. Van Eenennaam. 2013. *2012 Upper Sacramento River Green Sturgeon Spawning Habitat and Young of the Year Migration Surveys.* Annual Report of U.S. Fish and Wildlife Service to Bureau of Reclamation, Red Bluff, CA.

Radtke, L. D. 1966. Distribution of smelt, juvenile sturgeon, and starry flounder in the Sacramento-San Joaquin Delta with observations on food of sturgeon. Ecological studies of the Sacramento-San Joaquin Estuary. Part

II. Edited by Turner, J. L. and D. W. Kelly. California Department of Fish and Game. *Fish Bulletin* 136: 115-119.

Reclamation (Bureau of Reclamation). 2008. *Long-term Central Valley Project and State Water Project Operations, Criteria, and Plan (OCAP)*. Biological assessment.

Schaffter, R. G, and D. W. Kohlhorst. 1999. Status of white sturgeon in the Sacramento-San Joaquin Estuary. *California Fish and Game 85*: 37-41.

Tracy, C. 1990. *Green sturgeon meeting and comments*. Memorandum. Washington Department of Fisheries. As cited by Adams et al. 2002.

USFWS (U.S. Fish and Wildlife Service). 1993. *Endangered and threatened wildlife and plants: determination of threatened status for the delta smelt.* Federal Register 58:2854–12863.

_____. 1995. *Working Paper: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California*. Volume 2. May 9. Prepared under the direction of the Anadromous Fish Restoration Program Core Group, Stockton, CA.

_____. 1996. *Recovery plan for the Sacramento-San Joaquin Delta native fishes.* U.S. Fish and Wildlife Service, Portland Oregon.

_____. 2002. *Spawning areas of green sturgeon* Acipenser medirostris *in the upper Sacramento River, California.* U.S. Fish and Wildlife Service, Red Bluff, California.

Van Eenennaam, J. P., M. A. H. Webb, X. Deng, S. I. Doroshov, R. B. Mayfield, J. J. Cech Jr., D. C. Hillemeier, and T. E. Willson. 2001. Artificial spawning and larval rearing of Klamath River green sturgeon. *Transactions of the American Fisheries Society* 130: 159-165.

Van Eenennaam, J. P., J. Linares-Casenave, X. Deng, and S. I. Doroshov. 2005. Effect of incubation temperature on green sturgeon embryos, *Acipenser medirostris*. *Environmental Biology of Fishes* 72: 145-154.

Van Eenennaam, J. P., J. Linares-Casenave, S. I. Dorsohov, D. C. Hillemeier, T. E. Wilson, and A. A. Nova. 2006. Reproductive conditions of Klamath River green sturgeon. *Transactions of the American Fisheries Society* 135:151-163.

Wildlife Conservation Society. 2005. Research on green sturgeon spawning in the Rogue River received by Michael Fainter, Stillwater Sciences, Berkeley, California, on July 14, 2005, via phone conversation with Dan Erickson, Wildlife Conservation Society.

9B.4 White Sturgeon (*Acipenser transmontanus*)

9B.4.1 Legal Status

Federal: None
State: None

9B.4.2 Distribution

White Sturgeon have a marine distribution spanning from the Gulf of Alaska south to Mexico, but a spawning distribution ranging only from the Sacramento River northward. Currently, self-sustaining spawning populations are only known to occur in the Sacramento, Fraser, and Columbia rivers.

In California, the largest numbers are in the San Francisco Bay estuary, with spawning occurring mainly in the Sacramento and Feather rivers. White Sturgeon historically ranged into upper portions of the Sacramento system including the Pit River, and a substantial number were trapped in and above Lake Shasta when Shasta Dam was closed in 1944 and successfully reproduced until the early 1960s (State Water Contractors 2004). They may have occurred historically in the San Joaquin River based on habitat similarities with these other watersheds.

Adult sturgeon were caught in the sport fishery industry in the San Joaquin River between Mossdale and the confluence with the Merced River in late winter and early spring, suggesting this was a spawning run (Kohlhorst 1976). Kohlhorst et al. (1991) estimated that approximately 10 percent of the Sacramento River system spawning population migrated up the San Joaquin River. Spawning may occur in the San Joaquin River when flows and water quality permit; however, no evidence of spawning is present (Kohlhorst1976, Kohlhorst et al. 1991).

Landlocked populations are located above major dams in the Columbia River basin, and residual non-reproducing fish above the Shasta Dam and Friant Dam have been occasionally found.

Adult White Sturgeon are occasionally noted in the San Joaquin River during DFW fall midwater trawls, DFW summer townet surveys, and University of California Davis Suisun Marsh fisheries monitoring. White Sturgeon spawning has recently been confirmed in the lower San Joaquin River (Jackson and Van Eenennaam 2013), and the U.S. Geological Survey (USGS) is currently mapping and characterizing White Sturgeon spawning habitat in the lower portion of the river (USGS 2015).

9B.4.3 Life History and Habitat Requirements

White Sturgeon are long-lived, late maturing, and have a high fecundity (Israel et al. 2015) Because White Sturgeon require a long time to mature, large year classes are typically associated with years of high outflow (Kohlhorst et al. 1991, Schaffter and Kohlhorst 1999), and population size can fluctuate to extremes (Schaffter and Kohlhorst 1999).

Reports of maximum size and age of White Sturgeon are as great as 6 meters fork length (FL) (820 kilograms) and greater than 100 years, although they generally do not exceed 2 meters FL or 27 years of age. Males mature in 10 to 12 years (75 to 105 centimeters FL) and females in 12 to 16 years (95 to 135 centimeters FL). Maturation depends largely on temperature and photoperiod.

9B.4.3.1 Adult Migrations and Spawning

White Sturgeon migrate upstream in late winter. Upstream migration is usually initiated by a large pulse flow (Schaffter 1997), and not all adults will spawn each year. Because of this, successful year classes tend to occur at irregular intervals, and therefore numbers of adult fish within a population can fluctuate significantly. Although males may spawn each year, females usually spawn once every 2 to 4 years. White Sturgeon have high fecundities, and typical females may have as many as 200,000 eggs. Spawning occurs over deep gravel riffles or in deep pools with swift currents and rock bottoms between late February and early June when temperatures are between 8°C and 19°C. Eggs become adhesive subsequent to fertilization, and adhere to the substrate until they hatch 4 to 12 days later, depending on temperature. Once the eggs have been deposited, the adults move back downstream to the estuary. Larvae hatch in 1 to 2 weeks, depending on temperature. Once the yolk sac is absorbed (approximately 1 week after hatching), the larvae can begin to actively forage along the benthos.

In the Sacramento River, most White Sturgeon spawn downstream of the Glenn-Colusa Irrigation Dam.

9B.4.3.2 Juvenile Rearing

White Sturgeon are benthic feeders, and adults may move into food-rich areas to forage. Juveniles consume mainly crustaceans, especially amphipods and opossum shrimp. Adult diets include invertebrates (mainly clams, crabs, and shrimp), as well as fish, especially herring, anchovy, Striped Bass, and smelt. White Sturgeon are opportunistic predators and may feed on many introduced species.

Juvenile sturgeon are often found in upper reaches of estuaries in comparison to adults, which suggests that there is a correlation between size and salinity tolerance.

9B.4.3.3 Estuary and Ocean Residence

White Sturgeon primarily live in brackish portions of estuaries where they tend to concentrate in deep sections having soft substrate. They move according to salinity changes, and may swim into intertidal zones to feed at high tide.

Recent stomach content analysis of White Sturgeon from the San Francisco Bay estuary indicates that the invasive overbite clam, *Corbula amurensis*, may now be a major component of the White Sturgeon diet (Zeug et al. 2014), and unopened clams were often observed throughout the alimentary canal (Kogut 2008). Kogut's study found that at least 91 percent of clams that passed through sturgeon digestive tracts were alive. This suggests sturgeon are potential vehicles for transport of adult overbite clams and also raise concern about the effect of this invasive clam on sturgeon nutrition and contaminant exposure.

In the ocean, White Sturgeon have been known to migrate long distances, but spend most of their life in brackish portions of large river estuaries.

9B.4.4 Population Trends

There is a relatively strong relationship between Delta outflow and year class strength during the period when white sturgeon are spawning and young white sturgeon are migrating downstream (March-July). There is a threshold at about 50,000 cfs such that year classes are generally strong when flows are above the threshold (Gingras et al. 2014). NMFS (2005) also noted a relationships between flow and apparent White Sturgeon spawning success. A sturgeon population study conducted by the California Department of Fish and Wildlife has been ongoing intermittently since 1967. In 2014, catch per 100 net-fathom hour of white sturgeon within the current slot limit (102-152 cm FL) was 0.46 ± 0.05 (SE); in 2013, catch per 100 net-fathom hour of white sturgeon within the current slot limit was 0.4 ± 0.1 (SE). Both of these values are well below the historical average of 2.8 (DuBois et al. 2014). Large numbers of young white sturgeon have only been produced twice in the last 15 years, in 1998 and 2006 (Gingras et al. 2014). The 2010-2014 White Sturgeon length frequency distributions show: (1) strong cohorts (from mid-to-late 1990s) within the legally-harvestable size range have substantially diminished; and (2) the progression of a strong cohort (from 2006) toward harvestable size (DuBois et al. 2014). Given the trends in catch-per-unit-effort (CPUE) and harvest, the amount of harvest, and harvest rates, it's quite clear that harvest is the main reason CPUE and abundance have declined so steeply (Gingras et al. 2014).

Periodic high flows in the 1990s produced small increases in White Sturgeon salvage catches, but salvage numbers were much lower than prior to 1985. USFWS (1996) in the *Sacramento/San Joaquin Delta Native Fishes Recovery Plan* also reported that juvenile sturgeon are probably more vulnerable to entrainment at the SWP and CVP at low to intermediate flows during those years when river and Delta inflow are normal or below normal.

9B.4.5 References

Brown, L. R., and P. B. Moyle. 1993. Distribution, ecology, and status of fishes of the San Joaquin River drainage, California. *California Fish and Game Bulletin* 79:96-113.

DuBois, J., M. Harris, and L. Warkentin. 2014. 2014 Field Season Summary for the Sturgeon Population Study. California Department of Fish and Wildlife, Bay Delta Region (Stockton). 18 November 2014.

Gingras, M., J. DuBois, and M. Fish. 2014. Impact of Water Operations and Overfishing on White Sturgeon. Presentation at the IEP Annual Workshop, Folsom, CA, 27 February 2014.

Israel. J., A. Drauch, and M. Gingras. 2015. Life History Conceptual Model for White Sturgeon (*Acipenser transmontanus*). DRERIP Delta Conceptual Model. Sacramento (CA): Delta Regional Ecosystem Restoration Implementation Plan. http://www.dfg.ca.gov/ERP/drerip_conceptual_models.asp (*Accessed October 17, 2015*).

Jackson, Z. J., and J. P. Van Eenennaam. 2013. *2012 San Joaquin River Sturgeon Spawning Survey*. Stockton Fish and Wildlife Office, Anadromous Fish Restoration Program, U.S. Fish and Wildlife Service, Lodi, California.

Kogut, N. 2008. Overbite clams, *Corbula amerensis*, defecated alive by White Sturgeon, *Acipenser transmontanus*. *California Fish and Game* 94:143-149.

Kohlhorst, D. W. 1976. Sturgeon spawning in the Sacramento River in 1973, as determined by distribution of larvae. *California Fish and Game* 62:32-40.

Kohlhorst, D. W., L. W. Botsford, J. S. Brennan, and G. M. Cailliet. 1991. Aspects of the structure and dynamics of an exploited central California population of White Sturgeon *(Acipenser transmontanus)*. In *Acipenser*, pp. 277-293. Edited by P. Williot. CEMAGREF, Bordeaux, France.

Moyle, P. B. 2002. *Inland Fishes of California.* Revised edition. University of California Press, Berkeley.

NMFS (National Marine Fisheries Service). 2005. Endangered and threatened wildlife and plants: proposed threatened status for Southern Distinct Population Segment of North American Green Sturgeon. *Federal Register* 70: 17386-17401.

Schaffter, R. G. 1997. White Sturgeon spawning migrations and location of spawning habitat in the Sacramento River, California. *California Fish and Game* 83: 1-20.

Schaffter, R. G., and D. W. Kohlhorst. 1999. Status of White Sturgeon in the Sacramento-San Joaquin Estuary. *California Fish and Game* 85: 37-41.

State Water Contractors. 2004. *Historical and Current Information on Green Sturgeon Occurrence in the Sacramento and San Joaquin Rivers and Tributaries.* Prepared by R. Beamesderfer, M. Simpson, G. Kopp, J. Inman, A. Fuller, and D. Demko, S.P. Cramer and Associates, Oakdale, California, for State Water Contractors, Sacramento, California.

USFWS (U.S. Fish and Wildlife Service). 1996. *Sacramento-San Joaquin Delta Native Fishes Recovery Plan*. Portland, Oregon.

USGS (U.S. Geological Survey). 2015. Mapping Sturgeon Spawning Habitat in the Lower San Joaquin River. http://ca.water.usgs.gov/projects/2011-20.html. Website accessed on June 2, 2015.

Zeug, S.C., A. Brodsky, N. Kogut, A.R. Stewart, and J.E. Merz. 2014. Ancient fish and recent invaders: white sturgeon *Acipenser transmontanus* diet response to invasivespecies-mediated changes in a benthic prey assemblage. Mar. Ecol. Prog. Ser. Vol. 514: 163-174, 2014. doi: 10.3354/meps11002

9B.5 Chinook Salmon (*Oncorhynchus tshawytscha*)

9B.5.1 Introduction

The Sacramento-San Joaquin Delta functions as a migration corridor and potential rearing area for adult and juvenile Chinook Salmon in the Sacramento and San Joaquin River basins. The Sacramento River basin supports four runs of Chinook Salmon: winter-run, spring-run, fall-run, and late fall-run. The San Joaquin River basin currently supports fall-run (and possibly late fall-run) Chinook Salmon in its lower tributaries: the Merced, Tuolumne, and Stanislaus rivers. The winter-run consists of a single population spawning in the Sacramento River mainstem below Keswick Dam. The other runs consist of populations that spawn in multiple tributaries. Three ESUs of Chinook Salmon are represented in the combined basins: Sacramento River winter-run (federally listed as endangered), Sacramento River spring-run (federally listed as threatened), and Central Valley fall-run and late fall-run (species of concern). Each of these runs exhibits a variety of different life-history strategies.

9B.5.2 Chinook Salmon Habitat Requirements

The Sacramento River basin is the largest watershed in California (about 27,000 mi^2) and empties into the largest estuary on the west coast of the United States. This diverse basin is unique in that it supports four runs of Chinook Salmon, including the winter-run, which only occurs in the Sacramento River basin. Because the four runs exhibit a variety of different life-history strategies, anthropogenic activities in the basin have affected each of the runs differently. The habitat requirements and the life-history strategies of the four runs are discussed below.

9B.5.2.1 Upstream Migration and Holding

Adult Chinook Salmon require water deeper than 0.8 ft (24 cm) and water velocities less than 8 ft/s (2.4 m/s) for successful upstream migration (Thompson 1972). Adult Chinook Salmon appear to be less capable of negotiating fish ladders, culverts, and waterfalls during upstream migration than Coho Salmon or steelhead (Nicholas and Hankin 1989), due in part to slower swimming speeds and inferior jumping ability compared to steelhead (Reiser and Peacock 1985, Bell 1986). The maximum jumping height for Chinook Salmon has been calculated to be approximately 7.9 ft (2.4 m) (Bjornn and Reiser 1991).

Both winter-run and spring-run Chinook Salmon return to the Sacramento River when reproductively immature, typically holding for a few months in deep pools near spawning areas until spawning. Adult winter-run and spring-run Chinook Salmon require large, deep pools with flowing water for summer holding, tending to hold in pools with depths greater than 4.9 ft (greater than 1.5 m) that contain cover from undercut banks, overhanging vegetation, boulders, or woody debris (Lindsay et al. 1986), and have water velocities ranging from 0.5 to 1.2 ft/s (15 to 37 cm/s) (Marcotte 1984). Water temperatures for adult Chinook holding are reportedly best when less than 60.8°F (less than 16°C), and lethal when greater than 80.6°F (greater than 27°C) (Moyle et al. 1995). Spring-run Chinook Salmon in the Sacramento River system typically hold in pools below 69.8 to 77°F (21 to 25°C).

In general, adult Chinook Salmon appear capable of migrating upstream under a wide range of temperatures. Bell (1986) reported that salmon and steelhead migrate upstream in water temperatures that range from 3 to 20ºC (37 to 68°F). Bell (1986) reports that temperatures ranging from 3 to 13ºC (37 to 55°F) are suitable for upstream migration of spring-run Chinook Salmon, and 10 to 19ºC (50 to 66°F) is suitable for upstream migration of fall-run Chinook Salmon. In a review of available literature, Marine (1992) reported a water temperature range of 6 to 14ºC (43 to 57°F) as optimal for pre-spawning broodstock survival, maturation, and spawning for adult Chinook Salmon.

9B.5.2.2 Spawning

Most Chinook Salmon spawn in larger rivers or tributaries, although spawning has been observed in streams as small as 7 to 10 ft (2 to 3 m) wide (Vronskiy 1972). Chinook Salmon typically spawn in low- to moderate-gradient reaches of streams, but can navigate shorter reaches with steeper gradients to access suitable spawning areas. Armantrout (ULEP 1998) concluded that Chinook Salmon seldom inhabit streams with gradients greater than 3 percent after examining extensive inventory data from Oregon. The upper extent of Chinook Salmon distribution in the Umpqua River basin in Oregon appears to occur where gradients are less than 3 percent (ULEP 1998).

Upon arrival at the spawning grounds, adult females dig shallow depressions or pits (redds) in suitably sized gravels (discussed in further detail below), deposit eggs in the bottom during the act of spawning, and cover them with additional gravel. Over a period of one to several days, the female gradually enlarges the redd by digging additional pits in an upstream direction (Burner 1951). Redd areas vary considerably depending on female size, substrate size, and water velocities, and can range from 5.4 (Neilson and Banford 1983) to 482 ft^2 (0.5 to 44.8 m^2) (Chapman et al. 1986).

Chinook Salmon tend to seek spawning sites with high rates of intergravel flow. Upwelling, which is associated with a concave bed profile, may be an important feature selected by spawning Chinook Salmon (Vaux 1968).

Chinook Salmon are capable of spawning within a wide range of water depths and velocities, provided that intergravel flow is adequate for delivering sufficient oxygen to eggs and alevins (Healey 1991). Depths most often recorded for Chinook Salmon redds range from 4 to 80 inches (10 to 200 cm) (Burner 1951, Chambers et al. 1955, Vronskiy 1972), and velocities range from 0.5 to 3.3 ft/s (15 to 100 cm/s) (Burner 1951, Chambers et al. 1955, Thompson 1972, Vronskiy 1972, Smith 1973), although values may vary between races and stream basins.

Fall-run Chinook Salmon, for instance, are able to spawn in deeper water with higher velocities such as the mainstem Sacramento River because of their larger size (Hallock et al. 1957).

Substrate particle size composition has been shown to have a significant influence on intragravel flow dynamics (Platts et al. 1979). Chinook Salmon may therefore have evolved to select redd sites with specific particle size criteria that will ensure adequate delivery of dissolved oxygen to their incubating eggs and developing alevins. In addition, salmon are limited by the size of substrate that they can physically move during the redd building process. Substrates selected likely reflect a balance between water depth and velocity, substrate composition and angularity, and fish size. As depth, velocity, and fish size increase, Chinook Salmon are able to displace larger substrate particles. D50 values (the median diameter of substrate particles found within a redd) for spring-run Chinook have been found to range from 10.8 to 78.0 mm (0.43 to 3.12 inches) (Platts et al. 1979; Chambers et al. 1954, 1955).

In 1997, USFWS researchers collected data on substrate particle size, velocity, and depth at hundreds of Chinook Salmon redds in the Sacramento River between Keswick Dam and Battle Creek to develop habitat suitability criteria for use in models that can aid in determining instream flows beneficial for anadromous salmonids. Redds in both shallow and deep areas were sampled. Table 9B.1 summarizes habitat suitability criteria data collected in this study for three of the four runs (too few spring-run redds were found from which to collect data). Much more detail on the methods used and results can be found in USFWS (2003).

Table 9B.1 Range of Suitable Habitat Values for Chinook Salmon Spawning in the Sacramento River (USFWS 2003)

Run	Range of Suitable Values Velocity ft/s	Range of Suitable Values Velocity m/s	Range of Suitable Values Depth ft	Range of Suitable Values Depth m	Range of Suitable Values Substrate in	Range of Suitable Values Substrate cm
Fall	0.93 to 2.66	0.28 to 0.81	1–14	0.3–4	1–3 to 3–5	3–8 to 8–13
Late fall	0.90 to 2.82	0.27 to 0.86	1–14	0.3–4	1–3 to 4–5	3–8 to 10–13
Winter	1.54 to 4.10	0.47 to 1.25	3–16	0.9–5	1–3 to 3–5	3–8 to 8–13

9B.5.2.3 Egg Incubation and Alevin Development

Once redd construction is completed, a key determinant of survival from egg incubation through fry emergence is the amount of fine sediment in the gravel (McCuddin 1977; Reiser and White 1988). High concentrations of fine sediment in (or on) a streambed can reduce permeability and intergravel flow within the redd. This can result in reduced delivery rate of oxygen and increasingly elevated metabolic waste levels around incubating eggs, larvae, and sac-fry as they develop within egg pockets (Kondolf 2000), which can in turn lead to high mortality. Several studies have correlated reduced dissolved oxygen levels with mortality, impaired or abnormal development, delayed hatching and emergence, and reduced fry size at emergence in anadromous salmonids (Wickett 1954, Alderdice et al. 1958, Coble 1961, Silver et al. 1963, McNeil 1964a, Cooper 1965, Shumway et al. 1964, Koski 1981). Silver et al. (1963) found that low dissolved oxygen concentrations are related to mortality and reduced size in Chinook Salmon and steelhead embryos. Fine sediments in the gravel interstices can also physically impede fry emergence, trapping (or entombing) them within the redd (Phillips et al. 1975, Hausle and Coble 1976).

The effects of high fine sediment concentrations may be counteracted to a certain extent by the redd construction process itself. As adult salmon build redds, they displace fine material downstream and coarsen the substrate locally (Kondolf et al. 1993, Peterson and Foote 2000, Moore et al. 2004). However, the effects of sediment reduction during redd construction may be rapidly reversed by infiltration of fine sediment into the redds during the incubation period (Kondolf et al. 1993).

Suitable water temperatures are required for proper embryo development and emergence. Incubating Chinook Salmon eggs can withstand constant temperatures between 35.1 (Combs and Burrows 1957) and 62.1°F (1.7 and 16.7°C) (USFWS 1999); however, substantial mortality may occur at the extremes. Myrick and Cech (2004) conclude that temperatures between 43 and 54°F (6 and 12°C) are best for ensuring egg and alevin survival. Sublethal stress and/or mortality of incubating eggs resulting from elevated temperatures would be expected to begin at temperatures of about 58°F (14.4°C) for constant exposures (Combs and Burrows 1957, Combs 1965, Healey 1979).

Some have suggested that the eggs and fry of winter-run Chinook Salmon may be slightly more tolerant of warm water temperatures than those of fall-run Chinook Salmon. One study by USFWS (1999) showed fall-run Chinook Salmon egg mortality increasing at lower temperatures (53.6°F [12°C]) than winter-run (56.0°F [13.3°C]). Greater tolerance to temperature was also observed in the post-hatching period, as was also found by Healey (1979). According to Myrick and Cech (2001), however, temperature tolerances of winter-run eggs and fry generally agree with those found for populations in more northern regions, and there does not appear to be much variation, if any, with regard to egg thermal tolerances between runs of Chinook Salmon (Healey 1979, Myrick and Cech 2001).

9B.5.2.4 Fry Rearing

Following emergence, fry occupy low-velocity, shallow areas near stream margins, including backwater eddies and areas associated with bank cover such as large woody debris (Lister and Genoe 1970, Everest and Chapman 1972, McCain 1992). As the fry grow, they tend to move into deeper and faster water further from banks (Hillman et al. 1987, Everest and Chapman 1972, Lister and Genoe 1970). Everest and Chapman (1972) suggests that habitat with water velocities less than 0.5 ft/s (15 cm/s) and depths less than 24 inches (60 cm) are suitable for newly emerged fry.

Although fry typically drift downstream following emergence (Healey 1991), movement upstream or into cooler tributaries following emergence has also been observed in some systems (Lindsay et al. 1986, Taylor and Larkin 1986). On the Sacramento River, juvenile Chinook Salmon are more commonly found in association with natural banks and shaded riparian cover than banks stabilized with riprap (DFG 1983; Michny and Hampton 1984; Michny and Deibel 1986; Michny 1987, 1988, 1989; Fris and DeHaven 1993). DeHaven (1989) found this association to be weaker at lower water temperatures than at temperatures over 70°F (21°C).

9B.5.2.5 Juvenile Rearing

Little is known regarding habitat selection of juvenile Chinook Salmon in the Sacramento River system specifically. Habitat preferences of Chinook Salmon may vary depending on channel confinement, substrate and bank characteristics, abundance of small and large wood, presence of other salmonids (particularly Coho Salmon), and whether the Chinook display an ocean- or stream-type life history. Juvenile habitat use may also change seasonally, diurnally, or as a function of growth, with larger juveniles tending to occupy habitats with higher water velocities.

Several researchers have shown relationships between velocity and juvenile Chinook Salmon habitat use, with juveniles generally occupying areas with water velocities less than 15 to 30 cm/s (Thompson 1972, Hillman et al. 1987, Steward and Bjornn 1987, Murphy et al. 1989, Beechie et al. 2005), as well as a preference for areas with cover provided by brush, large wood, or undercut banks (Hillman et al. 1987, Johnson et al. 1992, Beechie et al. 2005). Lister and Genoe (1970) found that juvenile Chinook Salmon preferred “slow water adjacent to faster water (40 cm/s),” and Shirvell (1994) suggested that preferred habitat locations vary by activity. For feeding, they are likely to select positions with optimal velocity conditions, whereas for predator avoidance, optimal light conditions are more likely to be important (Shirvell 1994). At night, juvenile Chinook Salmon appear to move to quiet water or pools and settle to the bottom, returning the next day to the riffle and glide habitats they had occupied the previous day (Edmundson et al. 1968, Chelan County Public Utility District 1989).

Although some researchers have found juvenile Chinook Salmon to reside primarily in pools, they may also use glides and runs as well as riffles. Chinook Salmon may prefer deeper pools with low water velocities during spring and summer as well as during winter (Lister and Genoe 1970, Everest and Chapman 1972, Swales et al. 1986, Hillman et al. 1987). In the Elk River in Oregon, Burnett and Reeves (2001) found most juvenile ocean-type Chinook Salmon (in sympatry with Coho Salmon and steelhead) in valley segments with deeper pools, larger volume pools, and pools with greater densities of large wood. In Elk River tributaries, the juveniles were observed almost exclusively in pools. Roper et al. (1994) also found age-0+ Chinook to be strongly associated with pools in the South Umpqua River basin in Oregon. In the Sacramento and American rivers, CDFG (1997) found juvenile Chinook Salmon densities to be highest in runs, closely followed by pools, with fish also occupying riffles and glides.

9B.5.2.6 Summer Rearing

Juvenile growth rates are an important influence on survival because juvenile salmon are gape-limited predators that are themselves subject to gape-limited predation by larger fish. Thus, faster growth both increases the range of food items available to them and decreases their vulnerability to predation (Myrick and Cech 2004). Temperatures have a significant effect on juvenile Chinook Salmon growth rates. On maximum daily rations, growth rate increases with temperature to a certain point and then declines with further increases. Reduced rations can also result in reduced growth rates; therefore, declines in juvenile salmonid growth rates are a function of both temperature and food availability. Laboratory studies indicate that juvenile Chinook Salmon growth rates are highest at rearing temperatures from 65 to 70°F (18.3 to 21.1°C) in the presence of unlimited food (Clarke and Shelbourn 1985, Banks et al. 1971, Brett et al. 1982, Rich 1987), but decrease at higher temperatures. Myrick and Cech (2004) note that two studies have been published on the relationship between temperature and growth of Central Valley Chinook Salmon—one by Marine and Cech (2004) on Sacramento River fall-run Chinook Salmon, and one by Myrick and Cech (2002) on American River fall-run Chinook Salmon. Provided that food is not limited, these studies showed that optimum temperatures for growth were between 63 and 68°F (17 and 20°C). Under natural conditions, it is unlikely that Chinook Salmon will feed at 100 percent rations, and disease, competition, and predation are also factors that may affect survival. To determine temperatures that might be optimal for growth of juvenile Chinook under natural conditions, Brett et al. (1982) used a value of 60 percent rations, based on field studies that suggested fish in the wild fed at roughly 60 percent of their physiological maximum. When used in a model developed for sockeye salmon, Brett determined that juvenile Chinook Salmon would reach their optimal growth at a temperature of about 59°F (15°C) (Brett et al. 1982). Nicholas and Hankin (1989) suggest that the duration of freshwater rearing is tied to water temperatures, with juveniles remaining longer in rivers with cool water temperatures.

Temperatures of greater than 74°F (23.3°C) are considered potentially lethal to juvenile Chinook Salmon (State Water Contractors 1990). Myrick and Cech (2004) summarized available information on juvenile Chinook Salmon temperature tolerances. Incipient upper lethal temperature (IULT) studies, which may be the most biologically relevant for studying juvenile temperature tolerances, are lacking for Central Valley Chinook Salmon. Sacramento River fall-run Chinook Salmon were reared at temperatures between 70 and 75°F (21 and 24°C) by Marine and Cech (2004) without significant mortality; however, Rich (1987) observed significant mortality after only 8 days of rearing at 75°F (24°C) (Myrick and Cech 2004). Myrick and Cech (2004) suggests that, until IULT studies are conducted on Central Valley Chinook Salmon, managers use Brett's (1952) and Brett et al.'s (1982) data on more northern Chinook Salmon, which determined that the IULT is in the range of 24 to 25°C (75 to 77°F). More detail on temperature tolerances of various Chinook life stages can be found in Myrick and Cech (2001, 2004).

Chronic exposure to high temperatures may result in greater vulnerability to predation. Marine (1997) found that Sacramento River fall-run Chinook Salmon reared at the highest temperatures (21 to 24°C [70 to 75°F]) were preyed upon by Striped Bass more often than those reared at low or moderate temperatures. Consumption rates of piscivorous fish such as Sacramento pikeminnow, Striped Bass, and largemouth bass increase with temperature, which may compound the effects of high temperature on juvenile and smolt predation mortality.

9B.5.2.7 Winter Rearing

Juvenile Chinook Salmon rearing in tributaries may disperse downstream into mainstem reaches in the fall and take up residence in deep pools with LWD, in interstitial habitat provided by boulder and rubble substrates, or along river margins (Swales et al. 1986, Healey 1991, Levings and Lauzier 1991). During high flow events, juveniles have been observed to move to deeper areas in pools, and they may also move laterally in search of slow water (Shirvell 1994, Steward and Bjornn 1987). Hillman et al. (1987) found that individuals remaining in tributaries to overwinter chose areas with cover and low water velocities, such as areas along well-vegetated, undercut banks. There is very little information available on Chinook Salmon use of floodplains and off-channel habitats such as sloughs and oxbows compared to Coho Salmon. However, studies in the Sacramento and Cosumnes rivers have shown that shallow, seasonally inundated floodplains can provide suitable rearing habitat for Chinook Salmon.

In winter, juvenile Chinook Salmon may make use of the interstitial spaces between coarse substrates as cover (Bjornn 1971, Hillman et al. 1987). Hillman et al. (1987) found that the addition of cobble substrate to heavily sedimented glides in the fall substantially increased winter rearing densities, with juvenile Chinook Salmon using the interstitial spaces between the cobbles as cover. Fine sediment can act to reduce the value of gravel and cobble substrate as winter cover by filling interstitial spaces between substrate particles. This may cause juveniles to avoid these embedded areas and move elsewhere in search of suitable winter cover (Stuehrenberg 1975, Hillman et al. 1987).

Over much of the Chinook Salmon's range, winter temperatures are too cold to allow for much growth in the winter. The low-temperature threshold for positive growth in juvenile Chinook Salmon is believed to be about 40.1°F (4.5°C), with 39.4°F (4.1°C) being the lower limit for zero net growth in a juvenile Chinook Salmon population (Armour 1990). In the Sacramento River, water temperatures rarely fall below 43°F (6°C), however, allowing for growth throughout the winter.

Within the action area, where juvenile Chinook Salmon are rearing in mainstem channels downstream of reservoirs, water temperatures rarely fall below 43°F (6°C), allowing for growth throughout the winter months. Under these conditions, habitat shifts are less related to seasonal temperature changes and more strongly affected by growth (i.e., as individuals grow, they can take advantage of habitats with stronger flow and are better able to escape predation).

In the Sacramento/San Joaquin system, some juvenile Chinook Salmon rear on seasonally inundated floodplains in the winter. Sommer et al. (2001) found higher growth and survival rates of juveniles that reared on the Yolo Bypass floodplain than in the mainstem Sacramento River, and Moyle (2000) observed similar results on the Cosumnes River floodplain. On the Yolo Bypass, bioenergetic modeling suggested that increased prey availability on the floodplain was sufficient to offset increased metabolic demands from higher water temperatures (9°F [5°C] higher than mainstem). The Yolo Bypass has a relatively smooth topography with few pits and depressions, which possibly enhances its value as floodplain rearing habitat by reducing stranding mortality as floodwaters recede and juvenile salmon return to the main stem (Sommer et al. 2001).

9B.5.2.8 Smoltification and Outmigration

Juveniles of all four runs of Chinook Salmon in the Central Valley must pass through the Sacramento-San Joaquin Delta and San Francisco Bay Estuary on their way to the ocean, and many rear there for varying periods prior to ocean entry. Williams (2012) found evidence that many naturally produced fall-run Chinook Salmon that survived to return as adults had left freshwater at lengths greater than 55 mm, while juvenile Chinook Salmon from other Central Valley runs were older and larger upon entering the estuary and likely passed through it more quickly (Williams 2012).

In many systems within the species' distribution, juvenile Chinook Salmon spend up to several months in estuaries feeding and growing before entering the ocean (Healey 1991); in productive estuaries, this strategy can result in ocean entry at a larger size with a higher chance of survival, presumably by reducing predation at this critical juncture. Although wetlands and floodplains may have been extensive enough in the Delta under historical conditions (Atwater et al. 1979) to support high juvenile production in an environment where there were fewer predators, Delta marsh habitats and native fish communities have undergone such extreme changes from historical conditions (Kimmerer et al. 2008) that few locations in the eastern and central Delta currently provide suitable habitat for rearing Chinook Salmon. For example, substantial numbers of fry may be found in the Delta from January through March, but relatively few were found in the remaining months of the year during sampling from 1977 to 1997 (Brandes and McLain 2001). The annual abundance of fry (defined as less than 2.8 inches [70 mm] fork length) in the Delta during this period appears related to flow, with the highest numbers observed in wet years (Brandes and McLain 2001).

Although growth rates of juvenile Chinook Salmon may be high at temperatures approaching 66°F (19°C), cooler temperatures may be required for Chinook Salmon to successfully complete the physiological transformation from parr to smolt. Smoltification in juvenile Sacramento River fall-run Chinook Salmon was studied by Marine (1997), who found that juveniles reared under a high temperature regime of 70 to 75°F (21 to 24°C) exhibited altered and impaired smoltification patterns relative to those reared at low 55 to 61°F (13 to 16°C) and moderate 63 to 68°F (17 to 20°C) temperatures. Some alteration and impairment of smoltification was also seen in the juveniles reared at moderate temperatures.

9B.5.3 Winter-Run Chinook Salmon

9B.5.3.1 Legal Status

Federal: Endangered, Designated Critical Habitat
State: Endangered

Although Chinook Salmon range from California's Central Valley to Alaska and the Kamchatka Peninsula in Asia, winter-run Chinook Salmon are only found in the Sacramento River. Chinook Salmon of this race are unique because they spawn during the summer months when air temperatures usually approach their yearly maximum. As a consequence, winter-run Chinook Salmon require stream reaches with cold water sources that will protect embryos and juveniles from the warm ambient conditions in the summer. Historically, high-elevation reaches of tributaries to the upper Sacramento River (e.g., McCloud River) provided the cold water reaches that supported summer spawning by winter-run Chinook Salmon. Currently, hypolimnetic releases from Shasta Lake provide the cold water temperatures that allow winter-run Chinook Salmon to persist downstream of the dam, despite the complete loss of historical spawning habitat, access to which was cut off upon completion of Shasta Dam (1963).

The California-Nevada chapter of the American Fisheries Society petitioned NMFS to list the run as a threatened species in 1985 (AFS 1985) and, following a dangerously low year-class in 1989, NMFS issued an emergency listing for Sacramento River winter-run Chinook Salmon as a threatened species (NMFS 1989); the California Fish and Game Commission listed the winter run as endangered in the same year. After several years of low escapements in the early 1990s, the status of winter-run was changed from threatened to endangered by NMFS in 1994, which was reaffirmed in 2005 and 2011 (NMFS 1994, 2005, 2011).

The ESU includes fish that are propagated as part of a conservation hatchery program managed by the USFWS at Livingston Stone National Fish Hatchery (LSNFH). Since 2000, the proportion of the ESU spawning in the Sacramento River that are of hatchery origin has generally ranged from 5 to 10 percent of the total population, but reached a high of 20 percent in 2005 (NMFS 2011). USFWS's goal is to manage the LSNFH program such that hatchery origin fish are less than 20 percent of total in-river escapement. Hatchery fish were estimated to be 12 percent of the total in-river spawners in 2010, based on carcass surveys (DFG 2010). Over the last 10 years, hatchery returns have averaged 8 percent of total escapement (NMFS 2011).

Critical habitat was designated as the Sacramento River from Keswick Dam at river mile (RM) 302 to Chipps Island (RM 0) at the westward margin of the Delta; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco-Oakland Bay Bridge) to the Golden Gate Bridge (NMFS 1993).

9B.5.3.1.1 Distribution

Winter-run Chinook Salmon are found only in the Sacramento River basin. The distribution of winter-run Chinook Salmon spawning has shifted over time in response to changes in upstream passage caused by water supply development and operations. Prior to construction of Shasta Dam in the 1940s, winter-run Chinook Salmon spawned in the upper Sacramento River system (in the Little Sacramento, McCloud, and possibly Pit and Fall rivers) and in nearby Battle Creek (Yoshiyama et al. 1998). Since the construction of Shasta Dam, winter-run Chinook Salmon have been limited to the mainstem Sacramento River below Keswick Dam (RM 302), although a few adults occasionally stray into tributaries (e.g., Battle and Mill creeks) to spawn (Harvey-Arrison 2001). The distribution of spawning likely shifted again in 1966, when the construction and operation of RBDD (RM 243.5) impeded access to upstream reaches, forcing more winter-run adults to spawn downstream of the diversion dam. A radio-tag survey of winter-run adults between 1979 and 1981 indicated that adults were delayed at RBDD between 1 and 40 days, with an average delay of 18 days (Hallock and Fisher 1985). The dam also forced winter-run adults to spawn downstream of Red Bluff, where summer water temperatures were frequently too high to support successful egg incubation and emergence. Beginning in 1986, the Bureau of Reclamation (Reclamation) began raising RBDD gates during the winter to facilitate upstream passage of winter-run Chinook (Reclamation 2004), which precipitated an upstream shift in the distribution of winter-run spawning. In 2012, the RBDD gates were opened to allow year-round passage.

Until 2001, most winter-run spawning occurred downstream of ACID Dam (RM 298.4); however, an improvement of this dam's fish passage facilities in 2001 allowed another upstream shift in the distribution of spawning (DFG 2002a, 2004).

9B.5.3.1.2 Life History and Habitat Requirements

General habitat requirements for Chinook Salmon are described above; the following describes life history strategies and habitat requirements unique to the winter-run or of primary importance to its life history. The winter-run Chinook Salmon's life history is unique to the Sacramento River because it provides the thermal conditions that allow for the success of this strategy. Because winter-run Chinook Salmon spawn in late spring and early summer, they require access to stream reaches with summer water temperatures cool enough to allow egg incubation. The spawning reaches and reaches downstream have sufficiently warm water temperatures to support growth throughout the winter, allowing juveniles to grow large enough to smolt and outmigrate before water temperatures become too high the following spring and summer. This life-history strategy reduces competition for spawning habitat with other runs. However, it also makes the run reliant on year-round coldwater sources, which limits the potential for expanding the range of the run in the Sacramento River basin.

Table 9B.2 illustrates life history timing for winter-run Chinook Salmon in the Sacramento River basin. Winter-run Chinook Salmon display a life history that is intermediate between ocean-type and stream-type. They spend between 5 and 10 months rearing in fresh water before migrating to sea, which is longer than for typical ocean-type Chinook Salmon, but shorter than for other stream-type Chinook Salmon (Healey 1991).

Table 9B.2 Life History Timing of Winter-run Chinook Salmon in the Sacramento River Basin

Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept		Oct		Nov		Dec	
Adult entry into San Francisco Bay[a]	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate									Moderate	Moderate	Moderate	Moderate
Migration past RBDD[b]	Moderate	Moderate	Moderate	Moderate	Peak	Peak	Moderate	Moderate	Moderate	Moderate	Low	Low	Low	Low									Low	Low
Spawning[c]								Moderate	Peak	Peak	Peak	Peak	Moderate	Moderate	Moderate									
Incubation[c]								Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate					
Fry emergence[c]												Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate					
Rearing (age 0+)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate				Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Presence at CVP/SWP salvage facilities[c]	Peak	Peak	Moderate	Moderate	Moderate	Moderate	Low	Low															Low	Low
Outmigration toward and through the Delta[c]	Moderate	Moderate	Peak	Peak	Peak	Peak	Peak	Peak	Moderate	Moderate									Moderate	Moderate	Moderate	Moderate	Peak	Peak

Notes:
a. Van Woert 1958; Hallock et al. 1957
b. Hallock and Fisher 1985
c. NMFS 2012 (unpubl. data)

Period of Low Activity
Period of Moderate Activity
Period of Peak Activity

9B.5.3.1.3 Adult Upstream Migration and Spawning

Adult winter-run Chinook Salmon enter San Francisco Bay from November through June (Van Woert 1958, Hallock et al. 1957). Migration past RBDD begins in mid-December and can continue into early August, but the majority of winter-run adults migrate past RBDD between January and May, with a peak in mid-March (Hallock and Fisher 1985). In recent years, upstream passage of winter-run adults at RBDD was addressed by raising the gates between September 15 and May 15, which encompasses the vast majority of the upstream migration period for winter-run Chinook Salmon. As of 2012, the gates at RBDD are open year-round to allow for upstream passage.

Like spring-run Chinook Salmon, winter-run Chinook Salmon enter spawning streams while still reproductively immature. Adults hold for a few months in deep pools near spawning areas, which provides time for gonadal development. Spawning occurs from mid-April to mid-August, peaking in May and June, in the Sacramento River reach between Keswick Dam and RBDD (Reclamation 1991). With the changes in RBDD gate operations, volitional spawning below RBDD is negligible in most years. Since fish passage improvements were completed at the ACID Dam in 2001, winter-run Chinook Salmon spawning has shifted upstream. The majority of winter-run Chinook Salmon in recent years (i.e., more than 50 percent since 2007) spawn in the area from Keswick Dam to the ACID Dam (approximately 5 miles) (NMFS 2009).

9B.5.3.1.4 Juvenile Rearing and Outmigration

Winter-run fry emerge from the spawning gravels from mid-June through mid-October (NMFS 1997). Because spawning is concentrated upstream in the reaches below Keswick Dam, the entire Sacramento River can serve as a nursery area for juveniles as they migrate downstream. Emigrating juvenile Sacramento River winter-run Chinook Salmon pass the RBDD beginning as early as mid-July, typically peaking in September, and can continue through March in dry years (Reclamation 1991, NMFS 1997). Many juveniles apparently rear in the Sacramento River below RBDD for several months before they reach the Delta (Williams 2006). From 1995 to 1999, all Sacramento River winter-run Chinook Salmon outmigrating as fry passed the RBDD by October, and all outmigrating presmolts and smolts passed the RBDD by March (Martin et al. 2001).

Juvenile Sacramento River winter-run Chinook Salmon occur in the Delta primarily from November through early May based on data collected from trawls in the Sacramento River at West Sacramento, although the overall timing may extend from September to early May (NMFS 2012). The timing of migration varies somewhat because of changes in river flows, dam operations, seasonal water temperatures, and hydrologic conditions (water year type). Winter-run Chinook Salmon juveniles remain in the Delta until they are between 5 and 10 months of age, after reaching a fork length of approximately 118 mm. Distinct emigration pulses from the Delta appear to coincide with periods of high precipitation and increased turbidity (Del Rosario et al. 2013).

The entire population of the Sacramento River winter-run Chinook Salmon passes through the Delta as migrating adults and emigrating juveniles. Because winter-run Chinook Salmon use only the Sacramento River system for spawning, adults are likely to migrate upstream primarily along the western edge of the Delta through the Sacramento River corridor. Juveniles likely use a wider area within the Delta for migration and rearing than adults; juvenile winter-run salmon have been collected at various locations in the Delta, including the SWP and CVP south Delta export facilities. Studies using acoustically tagged juvenile and adult Chinook Salmon are ongoing to further investigate the migration routes, migration rates, reach-specific mortality rates, and the effects of hydrologic conditions (including the effects of SWP/CVP export operations) on salmon migration through the Delta. Tagging studies have indicated that juvenile salmon entering the interior Delta via the Delta Cross Channel and Georgiana Slough survive at a lower rate than fish migrating within the Sacramento River (Newman and Brandes 2010; Perry et al. 2010, 2012). Juvenile winter-run Chinook Salmon likely inhabit Suisun Marsh for rearing and may inhabit the Yolo Bypass when flooded, although use of these two areas is not well understood.

9B.5.3.1.5 Population Trends

There is little historical data available to characterize winter-run Chinook Salmon escapements prior to the construction of Shasta Dam; indeed, the agencies did not recognize winter-run Chinook Salmon as a distinct run until the 1940s (Needham et al. 1943). In the late 1930s, the pending construction of Shasta Dam prompted the agencies to commission a study of potential salmon salvage options. As part of this investigation, researchers placed a counting weir at ACID Dam between 1937 and 1939 to estimate the size of the salmon run in the Sacramento River (Hatton 1940). The counting weir enabled scientists to estimate the run size of the fall-run Chinook Salmon populations; however, the removal of flashboards from the ACID Dam during winter prevented observations of winter-run Chinook Salmon during their period of upstream migration (December–May).

There were no direct observations of winter-run Chinook Salmon spawning in the mainstem Sacramento River between 1943 and 1946—the first years when the construction of Shasta Dam blocked upstream passage. Nevertheless, incidental observations of winter-run salmon during trap-and-haul operations for spring-run salmon, coupled with poor environmental conditions in the Sacramento River and Deer Creek, led Slater to conclude that “the winter-run populations were small” in the years when Shasta Dam was being constructed (1963).

Slater (1963) hypothesized that the winter-run salmon population began to rebound in 1947, and that “this initial recovery seems to have been both substantial and rapid” from the “low point of 1943–1946.” He cites an angling survey conducted by Smith (1950), which evaluated the 1947–1948 and 1949–1950 sport fishery in the upper Sacramento River. “Increased catches of winter-run Chinook Salmon in January and February 1949” (Slater 1963) led Smith (1950) to conclude that a “sizable” winter-run population existed. Similarly, Slater cited an increase in the number of winter-run salmon that were harvested by Coleman National Fish Hatchery between 1949 and 1956 (as part of the fall-run salmon propagation program) (Azevedo and Parkhurst 1958) as evidence that winter-run salmon escapements increased in the late 1940s and early 1950s. Although these qualitative assessments do not permit a detailed tracking of winter-run salmon abundance, they do suggest a positive trend in the population in the years after Shasta Dam was completed.

This positive trend seems to have continued through the 1950s, because Hallock estimated that 11,000 winter-run adults were harvested from the Sacramento River by anglers in the winter of the 1961–1962 fishing season (Slater 1963). Hallock’s estimate of the percentage of winter-run Chinook Salmon caught in the in-river recreational harvest suggests that total winter-run escapements in the winter of 1961–1962 numbered in the tens of thousands. In June 1963, Slater personally observed winter-run Chinook Salmon spawning in the vicinity of Redding in numbers that approached the fall-run population that spawned in the same sites (Slater 1963). For context, the four years before Slater's observation of winter-run spawning in 1963 (1959–1962) had fall-run salmon escapement estimates ranging from 115,500 to 250,000 salmon. Although Slater observed spawning in only a small portion of the habitat available to both winter-run and fall-run salmon in the Sacramento River, his observation suggests that the winter-run salmon population had increased substantially from the few hundred fish captured during the trap-and-haul salvage operation in 1943 and 1945. His observation also suggests that the winter-run salmon population had recovered from a probable year-class failure in 1943 and a partial year-class failure in 1944.

Beginning in 1967, agency biologists began estimating annual winter-run escapements by monitoring adults migrating through the fish passage facilities of RBDD. Although the dam facilitated a more accurate account of the winter-run population, gate operations interfered with upstream passage. Gate operations were modified beginning in winter 1986 to facilitate the upstream passage of winter-run Chinook Salmon. However, raising the dam gates rendered winter-run escapement estimates less reliable, because migrating salmon could bypass the dam's fish counting facilities.

The RBDD counts permitted agency biologists to track the decline in winter-run Chinook abundance beginning in the 1970s. The drought of 1976–1977 caused a precipitous decline in abundance between 1978 and 1979, when escapements fell below 2,500 fish. Population abundance remained very low through the mid-1990s, with adult abundance in some years less than 500 fish (DFW 2014).

Beginning in the mid-1990s and continuing through 2006, adult escapement showed a trend of increasing abundance, approaching 20,000 fish in 2005 and 2006. However, recent population estimates of winter-run Chinook Salmon spawning upstream of the RBDD have declined since the 2006 peak. The escapement estimate for 2007 through 2014 has ranged from a low of 738 adults in 2011 to a high of 5,959 adults in 2013. The escapement estimate of 738 adults in 2011 was the lowest total escapement estimate since the all-time low escapement estimate of 144 adults in 1994. Poor ocean productivity (Lindley et al. 2009), drought conditions from 2007 to 2009, and low in-river survival (National Marine Fisheries Service 2011) are suspected to have contributed to the recent decline in escapement of adult winter-run Chinook Salmon. Table 9B.3 shows winter-run Chinook Salmon natural and hatchery escapement subsequent to 2004.

1 **Table 9B.3 Recent Winter-run Chinook Salmon Natural and Hatchery Escapement**

Year	Sacramento River above RBDD	Sacramento River below RBDD	Subtotal	CNFH Transfers	LSNFH Transfers	Battle Creek	Total
Dec 1990-Aug 1991	177	0	177	33	–	–	211
Dec 1991-Aug 1992	1,159	44	1,203	34	–	–	–
Dec 1992-Aug 1993	369	9	378	–	–	–	–
Dec 1993-Aug 1994	144	0	144	42	–	–	–
Dec 1994-Aug 1995	1,159	7	1,166	43	–	88	–
Dec 1995-Aug 1996	1,012	0	1,012	–	–	325	–
Dec 1996-Aug 1997	836	0	836	–	–	44	–
Dec 1997-Aug 1998	2,831	62	2,893	–	99	–	–
Dec 1998-Aug 1999	3,264	0	3,264	–	24	–	–
Dec 1999-Aug 2000	1,261	0	1,261	–	89	2	–
Dec 2000-Aug 2001	8,085	35	8,120	–	104	–	–
Dec 2001-Aug 2002	7,325	12	7,337	–	104	–	–
Dec 2002-Aug 2003	8,105	28	8,133	–	85	–	–
Dec 2003-Aug 2004	7,784	0	7,784	–	85	–	–
Dec 2004-Aug 2005	15,730	0	15,730	36	109	0	15,875
Dec 2005-Aug 2006	17,157	48	17,205	5	93	6	17,304
Dec 2006-Aug 2007	2,487	0	2,487	1	54	0	2,542
Dec 2007-Aug 2008	2,725	0	2,725	0	105	0	2,830

Year	Sacramento River above RBDD	Sacramento River below RBDD	Subtotal	CNFH Transfers	LSNFH Transfers	Battle Creek	Total
Dec 2008-Aug 2009	4,537	0	4,537	0	121	0	4,658
Dec 2009-Aug 2010	1,533	0	1,533	0	63	0	1,596
Dec 2010-Aug 2011	738	0	738	2	86	1	827
Dec 2011-Aug 2012	2,578	0	2,578	0	93	–	2,671
Dec 2012-Aug 2013	5,920	0	5,920	0	164	–	6,084
Dec 2013-Aug 2014	2,627	0	2,627	0	388	–	3,015

Source: DFW 2014

Note:
CNFH = Coleman National Fish Hatchery

Winter-run Chinook Salmon escapement to the Sacramento River in 2011 was 827 fish, which is the smallest number since 1994 and only 10 percent of the 40-year-average of approximately 8,000 fish (Azat 2012). Unusual ocean conditions appear to have been affecting the ESU in the past 5 years, along with other Central Valley Chinook Salmon stocks (NMFS 2011). Climate change and future variations in ocean conditions, along with the many factors affecting survival during freshwater life stages, may pose a serious risk to the ESU (NMFS 2011).

9B.5.4 Central Valley Spring-Run Chinook Salmon

9B.5.4.1 Legal Status

Federal: Threatened, Designated Critical Habitat
State: Threatened

Spring-run Chinook Salmon were probably the most abundant salmonid in the Central Valley under historical conditions (Mills and Fisher 1994); however, large dams eliminated access to vast amounts of historical habitat, and the spring run has exhibited the severest declines of any of the four Chinook Salmon runs in the Sacramento River basin (Fisher 1994).

The Central Valley spring-run Chinook Salmon ESU was federally listed as threatened in 1999, and the listing was reaffirmed in 2005 when critical habitat was also designated (NMFS 1999a, 2005). Spring-run Chinook Salmon was listed as a threatened species under the California Endangered Species Act (CESA) in February 1999. The ESU includes all naturally spawned populations of spring-run Chinook Salmon in the Sacramento River and its tributaries in California, including the Feather River. Feather River Hatchery spring-run Chinook Salmon are also included in the ESU. This ESU largely consists of three self-sustaining wild populations (i.e., Mill, Deer, and Butte creeks). Fish in these streams spawn outside of the action area but pass through it on their upstream and downstream migrations. Spring-run Chinook Salmon in the Feather River and Clear Creek spawn within the action area.

Designated critical habitat for Central Valley spring-run Chinook Salmon includes stream reaches of the American, Feather, Yuba, and Bear rivers; tributaries of the Sacramento River, including Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks; and the main stem of the Sacramento River from Keswick Dam through the Delta. Designated critical habitat in the Delta includes portions of the Delta Cross Channel, Yolo Bypass, and portions of the network of channels in the northern Delta. Critical habitat for spring-run Chinook Salmon was not designated for the Stanislaus or San Joaquin rivers.

9B.5.4.2 Distribution

Prior to the construction of dams in the Sacramento and San Joaquin basins, spring-run Chinook Salmon migrated during the spring snowmelt flows to access coldwater holding and spawning habitat higher up in the basins. These steeper, higher-elevation reaches are often characterized by falls and cascades that may be obstacles to upstream movement of salmonids at lower flows. By migrating during the high spring snowmelt flows, spring-run Chinook Salmon can also access areas above reaches that become too warm for salmon in the summer and fall, isolating them from the fall run. Thus, under historical conditions, the spring- and fall-run Chinook Salmon were geographically isolated in terms of where they spawned in the basin, which maintained their genetic integrity.

Spring-run Chinook Salmon once occupied all major river systems in California where there was access to cool reaches that would support oversummering adults. Historically, they were widely distributed in streams of the Sacramento-San Joaquin basin, spawning and rearing over extensive areas in the upper and middle reaches (elevations ranging from 1,400 to 5,200 ft [450 to 1,600 m]) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit rivers (Myers et al. 1998). Spring Chinook Salmon runs in the San Joaquin River were extirpated in the mid- to late 1940s following the closure of Friant Dam and diversion of water for agricultural purposes to the San Joaquin Valley.

In the Sacramento River, the closure of Shasta Dam in 1945 cut off access to the spring run's major historical spawning grounds in the McCloud, Pit, and upper Sacramento rivers. This represented a loss of 70 percent of spring-run spawning habitat in the Sacramento River basin (Yoshiyama et al. 2001). Populations of spawning spring-run Chinook Salmon in the Sacramento River basin are more common in east-side tributaries to the Sacramento River upstream of the mouth of the American River. The most important spawning populations are in Deer, Mill, and Butte creeks because of their relative lack of past hatchery influence, as well as relatively stable numbers. Some spawning also takes place in Big Chico, Antelope, Cottonwood, Beegum, Clear, and Battle Creeks, and in the mainstem Sacramento River downstream of Keswick Dam and upstream of RBDD (Association of California Water Agencies and California Urban Water Agencies 1997; DFG 1998, 2002b, 2012 [GrandTab data]). A spring run in the Feather River basin is maintained by hatchery production; however, the stock is believed to have been hybridized with the fall run to a great extent (Lindley et al. 2004).

9B.5.4.2.1 Changes in Distribution and Hybridization with Fall Chinook Salmon

Dams have reduced or eliminated spatial segregation between spawning spring- and fall-run Chinook Salmon in some areas, particularly in the mainstem Sacramento River, leading to increased potential for hybridization on the spawning grounds. The completion of Keswick and Shasta dams in the mid-1940s blocked spring-run Chinook Salmon access to habitat in the McCloud, Pit, and Little Sacramento rivers. After construction of the dams, spring-run Chinook Salmon were forced to spawn in the mainstem Sacramento River below Keswick Dam. Historically, water temperatures would have been too high in the mainstem Sacramento River for spring-run Chinook Salmon to hold in this area during the summer. But because of hypolimnetic releases from Shasta Lake, this reach provides temperatures during the summer that are now suitable for spring-run Chinook Salmon holding and spawning, where before they were only suitable for fall-run spawning once temperatures cooled in the fall. However, coldwater releases from Shasta Dam can warm relatively rapidly during the very hot days typical of the Sacramento Valley in summer and early fall. As a result, both the fall and spring runs must spawn in close enough proximity to Keswick Dam to benefit from these releases. The elimination of the spatial segregation that had existed between the fall and spring runs results in competition between the runs for the limited spawning habitat. Since fall-run Chinook Salmon spawn slightly later than spring-run, spring-run redds may also be superimposed by spawning fall-run fish. This may have contributed to the loss of the spring-run population, along with hybridization between the two runs, as described below.

The majority of spring-run Chinook Salmon used to spawn upstream in tributaries rather than in the mainstem Sacramento River; however, the completion and operation of Shasta Dam reduced water temperatures in the main stem downstream of Keswick Dam, which permitted spring-run Chinook Salmon to spawn there, resulting in hybridization with fall-run stocks. Although spring-run Chinook Salmon spawn earlier than fall-run, the timing of spawning of the two runs overlaps enough that hybridization can occur where they share the same spawning areas. Where the spring run is now forced to share spawning grounds in the mainstem Sacramento River with the fall run, fall-run Chinook Salmon may dominate because of their longer growth period in the ocean, slightly larger size, and less time spent holding in the stream prior to spawning. Hybridization between the two runs has tended to be to the detriment of the spring run life history.

Because of this hybridization with fall-run Chinook Salmon in the mainstem channel, there are considered to be only three “pure” self-sustaining populations of wild spring-run Chinook Salmon remaining in Deer, Mill, and Butte creeks.

Similar patterns have been observed in the Feather River, where the spring run historically spawned upstream of the location of Oroville Dam, and where they are now forced to spawn in the same area as the fall run, as well as in the Yuba and American rivers, where forced sympatry on the spawning grounds and subsequent hybridization following dam construction led to DFW concluding that the spring run was “extinct” in those rivers.

9B.5.4.3 Life History and Habitat Requirements

General habitat requirements for Chinook Salmon are described above; the following describes life history strategies and habitat requirements unique to the spring run or of primary importance to its life history. Spring-run Chinook Salmon display a stream-type life history strategy—adults migrate upstream while sexually immature, hold in deep cold pools over the summer, and spawn in late summer and early fall. Juvenile outmigration is highly variable, with some juveniles outmigrating in winter and spring, and others oversummering and then emigrating as yearlings. Table 9B.4 illustrates life-history timing for spring-run Chinook Salmon in the Sacramento River basin. The table illustrates some of the changes in timing that have been observed for the run over the years, particularly with regard to upstream migration and spawning.

Table 9B.4 Life History Timing of Spring-run Chinook Salmon in the Sacramento River Basin

Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Adult entry into Sacramento-San Joaquin Delta Estuary												
“Historical” adult migration past Red Bluff Diversion Dam[a]												
“Recent” adult migration past Red Bluff Diversion Dam[b]												
Entry into spawning tributaries (current)[c]												
Adult holding												
Historical spawning in Sacramento River basin[d]												
Spawning (Deer, Mill, Butte creeks[e])												
Spawning (mainstem Sacramento River[f])												
Incubation												
Fry emergence												
Fry/juvenile outmigration from tributaries[g]												
Subyearling/Yearling outmigration from tributaries[g, h]												
Presence at CVP/SWP salvage facilities[i]												
Outmigration toward and through the Delta[i]												
Ocean entry (yearlings)												

Sources*:* Fisher 1994; Myers et al. 1998; Hill and Weber 1999; Ward and McReynolds 2001; USFWS 2005

Notes:

a. As observed in the 1970s (Association of California Water Agencies and California Urban Water Agencies 1997)

b. As observed in the 1980s (Association of California Water Agencies and California Urban Water Agencies 1997)

c. Association of California Water Agencies and California Urban Water Agencies (1997), Hill and Webber (1999)

d. Rutter (1908), Parker and Hanson (1944)

e. Harvey (1995), Moyle et al. (1995)

f. Association of California Water Agencies and California Urban Water Agencies (1997)

g. Some spring run disperse downstream soon after emergence as fry in March and April, with others smolting after several months of rearing, and still others remaining to oversummer and emigrate as yearlings (USFWS 1995).

h. Based on outmigrant trapping in Butte Creek in 1999 and 2000, up to 69% of age 0+ juveniles outmigrate through the lower Sacramento River and Sacramento-San Joaquin Delta between mid-November and mid-February, with a peak in December and January (DFG 1998, Hill and Weber 1999, Ward and McReynolds 2001). A smaller number remain in Butte Creek and outmigrate in late spring or early summer; and in both Butte and Mill creeks, some of these oversummer and outmigrate as yearlings from October to March, with a peak in November (Association of California Water Agencies and California Urban Water Agencies 1997, Hill and Webber 1999)

i. NMFS 2012 (unpublished data)

Period of activity

Period of peak activity

9B.5.4.3.1 Adult Upstream Migration and Spawning

Adult spring-run Chinook Salmon may return between the ages of 2 to 5 years. Historically, adults of this run are believed to have returned predominantly at ages 4 and 5 years at a large size. Most spring-run Chinook Salmon now return at age 3, although some portion returns at age 4 (Fisher 1994, McReynolds et al. 2005) probably because of intense ocean harvest (which removes the largest fish from the population and selects for fish that spend fewer years at sea). In 2003, an estimated 69 percent of the spring run in Butte Creek returned at age 4 (Ward et al. 2004); however, in most years, the proportion of age 4 adults is much smaller.

Adult Central Valley spring-run Chinook Salmon begin their upstream migration in late January and early February (DFG 1998) and enter the Sacramento River between February and September, primarily in May and June (DFG 1998, Myers et al. 1998). Lindley et al. (2006) reported that adult Central Valley spring-run Chinook Salmon enter native tributaries from the Sacramento River primarily between mid-April and mid-June. Adults enter Deer and Mill creeks beginning in March, peaking in May, and concluding in June (Vogel 1987a, 1987b; Association of California Water Agencies and California Urban Water Agencies 1997). Their upstream migration is timed to take advantage of spring snowmelt flows, which allow them access to upstream holding areas where temperatures are cool enough to hold over the summer prior to the spawning season (NMFS 1999a). In the Sacramento River, upstream migration of spring-run Chinook Salmon overlaps to a certain extent with that of winter-run Chinook Salmon; and adults from particular runs are not generally distinguishable from one another by physical appearance alone, making it difficult to pinpoint migration timing with precision (Healey 1991).

Adults require large, deep pools with moderate flows for holding over the summer prior to spawning in the fall. Marcotte (1984) reported that suitability of pools declines at depths less than 7.9 ft (2.4 m) and that optimal water velocities range from 0.5 to 1.2 ft/s (15 to 37 cm/s). In the John Day River in Oregon, spring-run adults usually hold in pools deeper than 4.9 ft (1.5 m) that contain cover from undercut banks, overhanging vegetation, boulders, or woody debris (Lindsay et al. 1986).

In Sacramento River tributaries, adults will pack densely in the limited holding pool habitat that is available. Some fish remain to spawn at the tails of the holding pools, while most move upstream to the upper watersheds to spawn, and still others move back downstream to spawn. Although there are several deep pools in the upper Sacramento River that may provide holding habitat for adult spring-run Chinook Salmon, it is not clear which pools are heavily used. As a result of cold water releases from Shasta Reservoir and natural channel characteristics, numerous deep pools with suitable holding habitat are located between Keswick Dam and Red Bluff (Northern California Water Association and Sacramento Valley Water Users 2011).

Water temperatures for adult spring-run Chinook Salmon holding and spawning are reportedly best when less than 60.8°F (16°C), and are lethal when greater than 80.6°F (27°C) (Hinze 1959, Boles et al. 1988, DFG 1998). Spring Chinook Salmon in the Sacramento River typically hold in pools below 69.8 to 77°F (21 to 25°C). Adults may be particularly sensitive to temperatures during July and August, when energy reserves are low and adults are preparing to spawn. There is evidence that spring-run Chinook Salmon in the San Joaquin River were exposed to high temperatures during migration and holding under historical conditions (Clark 1943, Yoshiyama et al. 2001). It is possible that Central Valley spring-run Chinook Salmon are adapted to tolerate warmer temperatures than other Chinook Salmon stocks; however, there is no experimental evidence to confirm this hypothesis, and short-term exposure to temperatures as high as 25 to 27°C (77 to 80.6°F) is known to be tolerated by adult Chinook Salmon (Boles et al. 1988).

Habitat suitability studies conducted by USFWS (2004) indicate that suitable spawning velocities for spring-run Chinook Salmon in Butte Creek range from 0.80 to 3.22 ft/s (24.4 to 98 cm/s), and suitable substrate size ranges from 1 to 5 inches (2.5 to 12.7 cm) in diameter. Adult Chinook have been observed spawning in water greater than 0.8 foot deep and in water velocities of 1.2 to 3.5 ft/s (DFG 1998).

The timing of spring run spawning in the mainstem Sacramento River has shifted later in the year, which is believed to be a result of genetic introgression with the fall run (Association of California Water Agencies and California Urban Water Agencies 1997). Populations in Deer and Mill creeks, which do not appear to have significantly hybridized with the fall run, generally spawn earlier than those in the main stem (Lindley et al. 2004). Rutter (1908) noted that most spawning in the late 1800s/early 1900s in the Sacramento River basin occurred in August. Parker and Hanson (1944) observed intensive spawning of spring-run Chinook Salmon from the first week of September through the end of October in 1941. Redd counts have indicated that spring-run Chinook Salmon spawning typically begins in late August, peaks in September, and concludes in October in both Deer and Mill creeks (Harvey 1995, Moyle et al. 1995, NMFS 2004a).

In the Feather River, the time of river entry for spring-run Chinook Salmon has apparently shifted to later in the season, and is now intermediate between timing of entry of spring run into other tributaries and timing of entry of the fall run. Whereas wild-type spring-run Chinook Salmon enter Deer and Mill creeks primarily in mid-April to mid-June, coded-wire tag data and anecdotal information from anglers indicate that Feather River fish do not enter fresh water until June or July (Association of California Water Agencies and California Urban Water Agencies 1997).

9B.5.4.3.2 Egg Incubation and Alevin Development

In the Sacramento River and its tributaries, egg incubation for spring-run Chinook Salmon extends from August to March (Fisher 1994, Ward and McReynolds 2001). Egg incubation generally lasts between 40 and 90 days at water temperatures of 42.8 to 53.6°F (6 to 12°C) (Vernier 1969, Bams 1970, Heming

1982). At temperatures of 37°F (2.7°C), time to 50 percent hatching can take up to 159 days (Alderdice and Velsen 1978). Alevins remain in the gravel for 2 to 3 weeks after hatching while absorbing their yolk sacs. Emergence from the gravels occurs from November to March in the Sacramento River basin (Fisher 1994, Ward and McReynolds 2001). Once fry emerge from the gravel, they initially seek areas of shallow water and low velocities while they finish absorbing the yolk sac (Moyle 2002). As juvenile Chinook Salmon grow, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures (Healey 1991). USFWS catches of juvenile salmon in the Sacramento River near West Sacramento showed that larger juvenile salmon were captured in the main channel and smaller fry were typically captured along the channel margins (USFWS 1997).

9B.5.4.3.3 Juvenile Rearing and Outmigration

Fry and juvenile rearing takes place in the natal streams, the mainstem of the Sacramento River, inundated floodplains (including the Sutter and Yolo bypasses), and the Delta. During the winter, some spring-run juveniles have been found rearing in the lower portions of non-natal tributaries and intermittent streams (Maslin et al. 1997, Snider et al. 2001).

The rearing and outmigration patterns exhibited by spring-run Chinook Salmon are highly variable, with fish rearing anywhere from 3 to 15 months before outmigrating to the ocean (Fisher 1994). Variation in length of juvenile residence may be observed both within and among streams (e.g., Butte versus Mill creeks, [USFWS 1996]). Some may disperse downstream soon after emergence as fry in March and April, with others smolting after several months of rearing, and still others remaining to oversummer and emigrate as yearlings (USFWS 1996). Scale analysis indicates that most returning adults have emigrated as subyearlings (Myers et al. 1998). Calkins et al. (1940) conducted an analysis of scales of returning adults, and estimated that more than 90 percent had emigrated as subyearlings, at about 3.5 inches (88 mm).

The term “yearling” is generally applied to any juveniles that remain to oversummer in their natal stream. Yearling outmigrants are common in Deer and Mill creeks, but rare in Butte Creek (Association of California Water Agencies and California Urban Water Agencies 1997). Extensive outmigrant trapping in Butte Creek has shown that spring-run Chinook Salmon outmigrate primarily as juvenile (age 0+) fish from November through June, with a small proportion remaining to emigrate as yearlings beginning in mid-September and extending through March, with a peak in November (Association of California Water Agencies and California Urban Water Agencies 1997, Hill and Webber 1999, Ward et al. 2004). Peak movement of juvenile spring-run Chinook Salmon in the Sacramento River at Knights Landing generally occurs in December, and again in March. However, juveniles also have been observed migrating between November and the end of May (Snider and Titus 1998, 2000b, c, d; Vincik et al. 2006; Roberts 2007).

Coded-wire-tag studies conducted on Butte Creek spring-run Chinook Salmon have shown that juveniles use the Sutter Bypass as a rearing area until it begins to drain in the late winter or spring (Hill and Webber 1999). Few juvenile Chinook Salmon are observed in the bypass after mid-May. Five recaptures indicate that juveniles leaving the Sutter Bypass migrate downstream rapidly and do not use the mainstem Sacramento River as rearing habitat (Hill and Webber 1999).

Within the Delta, juvenile Chinook Salmon forage in shallow areas with protective cover, such as tidally influenced sandy beaches and shallow water areas with emergent aquatic vegetation (Meyer 1979, Healey 1980). Very little information is available on the estuarine rearing of spring-run Chinook Salmon (NMFS 2004a). NMFS (2004a) postulates that, because spring-run Chinook Salmon yearling outmigrants are larger than fall-run Chinook Salmon smolts, and are ready to smolt upon entering the Delta, they may spend little time rearing in the estuary. Most have presumably left the estuary by mid-May (DFG 1995). Once in the ocean, spring-run Chinook Salmon perform extensive offshore migrations before returning to their natal streams to spawn.

9B.5.4.4 Population Trends

At one time, spring-run Chinook Salmon may have been the most abundant race in the Central Valley, with escapement in the hundreds of thousands (Mills and Fisher 1994). Spring-run Chinook Salmon have since declined to remnant populations totaling a few thousand fish, sometimes approaching 30,000 to 40,000 in good years (Mills and Fisher 1994, NMFS 1999a). Loss of access to upstream spawning and rearing areas due to the construction of dams in the Sacramento and San Joaquin rivers is believed to have been a major cause of the decline of the spring run.

Under historical conditions, it is doubtful that spring-run Chinook Salmon spawned in the mainstem Sacramento in significant numbers (Lindley et al. 2004). After the closure of Shasta and Keswick dams, spring-run Chinook Salmon began to spawn in the mainstem Sacramento River when changes in temperatures made this a viable life-history strategy. Throughout the 1970s and 1980s, thousands of spring-run Chinook Salmon passed RBDD en route to spawning grounds farther upstream. By the 1990s, escapements had declined; however, changes in the RBDD gate operations beginning in 1986 complicated the process of estimating spring-run Chinook Salmon abundance. Identification of the spring run at RBDD is also complicated by their low escapements and the difficulty of distinguishing fish of this run from those of the fall run. The two runs cannot be distinguished reliably by physical characteristics or run timing (Healey 1991) because of the naturally protracted run timing of the abundant fall run, and the apparent shift to later upstream migration timing by the spring run, which results in the runs being more temporally overlapped than they were historically.

Populations of spring-run Chinook Salmon in Butte Creek increased after the 1990s, and Butte Creek currently has the largest naturally spawning spring-run population (DFW 2014, GrandTab data). A few naturally spawning fish are also present in Battle, Clear, Cottonwood, Antelope, Mill, Deer, and Big Chico creeks (DFW 2014, GrandTab data). In general, spring-run Chinook Salmon that are most genetically similar to the runs that occurred historically in the Sacramento basin are currently confined to spawning primarily in Deer, Mill, and Butte creeks, with perhaps a few spawning in the mainstem Sacramento River.

Restrictions on ocean harvest to protect winter-run Chinook Salmon, as well as improved ocean conditions, have likely had a positive impact on spring-run Chinook Salmon adult returns to the Central Valley. In 2008, abundance in key indicator streams (e.g., Mill, Deer, and Butte Creeks) was at historical levels; however, between 2008 and 2011, spring-run populations in these same streams dropped closer to historical lows (as based on preliminary DFW 2014, GrandTab data). Spring-run Chinook Salmon populations generally increased from 1990 through 2006, but then returned to very low levels by 2008 and remained low through 2011. The preliminary total spring-run Chinook Salmon escapement count for 2013 was 23,697 adults, which was the highest count since 2003 (30,697 adults) and over three times that of 2011 (7,408 adults) (DFW 2014) (Table 9B.5).

1 **Table 9B.5 Recent Spring-run Chinook Salmon Natural and Hatchery Escapement**

YEAR	Sacramento River Mainstem	Battle Ck[a]	Clear Ck	Cottonwood Ck	Antelope Ck	Mill Ck	Deer Ck	Big Chico Ck	Butte Ck Snorkel	Butte Ck Carcass	Feather River Hatchery[b]	TOTAL SPRING RUN
1990	4,198	2	–	–	–	844	496	–	250	–	1,893	7,683
1991	825	–	–	–	–	319	479	–	–	–	4,303	5,926
1992	371	–	–	–	0	237	209	–	730	–	1,497	3,044
1993	391	–	1	1	3	61	259	38	650	–	4,672	6,076
1994	862	–	0	–	0	723	485	2	474	–	3,641	6,187
1995	426	66	2	8	7	320	1,295	200	7,500	–	5,414	15,238
1996	378	35	–	6	1	253	614	2	1,413	–	6,381	9,083
1997	128	107	–	0	0	202	466	2	635	–	3,653	5,193
1998	1,115	178	47	477	154	424	1,879	369	20,259	–	6,746	31,649
1999	262	73	35	102	40	560	1,591	27	3,679	–	3,731	10,100
2000	43	78	9	122	9	544	637	27	4,118	–	3,657	9,244
2001	621	111	0	245	8	1,104	1,622	39	9,605	18,670	4,135	26,663
2002	195	222	66	125	46	1,594	2,195	0	8,785	16,409	4,189	25,043
2003	0	221	25	73	46	1,426	2,759	81	4,398	17,404	8,662	30,697
2004	370	90	98	17	3	998	804	0	7,390	10,558	4,212	17,150
2005	30	73	69	47	82	1,150	2,239	37	10,625	17,592	1,774	23,093
2006	0	221	77	55	102	1,002	2,432	299	4,579	6,537	2,181	12,906
2007	248	291	194	34	26	920	644	0	4,943	6,871	2,635	11,144

YEAR	Sacramento River Mainstem	Battle Ck[a]	Clear Ck	Cottonwood Ck	Antelope Ck	Mill Ck	Deer Ck	Big Chico Ck	Butte Ck Snorkel	Butte Ck Carcass	Feather River Hatchery[b]	TOTAL SPRING RUN
2008	52	105	200	0	3	381	140	0	3,935	11,046	1,460	13,387
[2009]	0	194	120	0	0	220	213	6	2,059	2,763	989	4,505
[2010]	0	172	21	15	17	482	262	2	1,160	1,991	1,661	4,623
[2011]	0	157	8	2	6	366	271	124	2,130	4,505	1,969	7,408
[2012]	0	799	68	1	1	768	734	0	8,615	16,140	3,738	22,249
[2013]	0	608	659	1	0	644	708	0	11,470	16,783	4,294	23,697
[2014]	0	429	95	2	7	679	830	0	3,616	5,083	2,776	9,901

Source: DFW 2014, GrandTab data.

Notes:
Data for years in brackets are preliminary.

a. In 2009, USFWS conducted a comprehensive analysis of Battle Creek coded wire tag data from 2000-2008 to estimate numbers of fall- and late fall-run Chinook Salmon returning to Battle Creek. Previously, a cutoff date of December 1 was used to assign run. This changed some Battle Creek estimates.

b. Feather River Hatchery implemented a methodology change in 2005 for distinguishing spring- from fall-run. Fish arriving prior to the spring-run spawning period were tagged and returned to the river. The spring-run escapement was the number of these tagged fish that subsequently returned to the hatchery during the spring-run spawning period.

9B.5.5 Central Valley Fall-run and Late Fall-run Chinook Salmon

9B.5.5.1 Legal Status

Federal: Species of Concern
State: Central Valley fall-run – None; Central Valley late fall-run – Species of Special Concern

Fall-run populations occur throughout the range of Chinook Salmon and are currently the most abundant and widespread of the salmon runs in California and the Central Valley, largely because the construction of dams was not as damaging in terms of loss of historical habitat compared to the runs that spawned at higher elevations. Fall-run abundance is also a function of hatchery supplementation, because fall-run Chinook Salmon have been the primary focus of hatchery production at Central Valley hatcheries for several decades. As the most abundant salmonid species in the Central Valley, fall-run Chinook Salmon constitute an important component of the commercial and recreational salmon fishery in California. NMFS designated the Central Valley Fall (and Late fall) Chinook Salmon ESU as a Species of Concern in 2004 (NMFS 2004b).

NMFS classifies late fall-run Chinook Salmon as part of the Central Valley fall-run and late fall-run Chinook Salmon ESU, reasoning that the late fall-run population represents a life-history variation of the fall-run salmon population rather than a distinct run (NMFS 2004b). However, agencies generally treat late fall-run salmon in the Sacramento River basin as a distinct run, conducting separate carcass and redd surveys for them, and publishing separate reports to address the fall-run and late fall-run populations. Agencies also manage the hatchery propagation of late fall-run separately from fall-run Chinook Salmon. Except for hatchery propagation, there are relatively few restoration and management activities that focus specifically on late fall-run Chinook Salmon in the Sacramento River, as compared to the other runs of Chinook Salmon in the basin (USFWS 1996).

9B.5.5.2 Distribution

9B.5.5.2.1 Fall-run Chinook Salmon

Within the range of the Central Valley ESU, large populations of fall-run Chinook Salmon are found in the Sacramento River and its major tributaries. Fall-run Chinook Salmon are the most widely distributed salmonid in the Sacramento River basin, with significant spawning populations documented as far north as the upstream limit of anadromy in the upper Sacramento River (Keswick Dam at RM 302) and as far south as the American River near Sacramento. Sizeable spawning populations occur in other tributaries to the Sacramento River—Clear Creek, Battle Creek, Butte Creek, and Feather River—with more modest spawning populations in numerous smaller tributaries (e.g., Deer, Mill, Cow, and Antelope creeks). The San Joaquin River system once supported large runs of both spring-run and fall-run Chinook Salmon. Fall-run Chinook Salmon historically spawned in the mainstem San Joaquin River upstream of the Merced

River confluence and in the mainstem channels of the major tributaries—the Merced, Tuolumne, and Stanislaus rivers. Dam construction and water diversion dewatered much of the mainstem San Joaquin River, limiting fall-run Chinook to the three major tributaries where they currently spawn and rear downstream of mainstem dams.

9B.5.5.2.2 Late Fall-run Chinook Salmon

Little is known about the historical distribution of late fall-run salmon in the Sacramento River valley. Late fall-run Chinook Salmon currently spawn primarily in the mainstem Sacramento River between Red Bluff (RM 243.5) and Keswick Dam (RM 302). DFW conducts aerial redd surveys that target the late fall-run spawning period, and an analysis of the surveys suggests that adults generally spawn upstream of RBDD (RM 243.5). Yoshiyama et al. (1996) gleaned incidental references to late fall-run fish from historical documents to suggest that late fall-run Chinook Salmon historically spawned in the mainstem reaches of the upper Sacramento River and tributaries such as the Little Sacramento, Pit, and McCloud rivers. Because a significant fraction of juvenile late fall-run Chinook Salmon oversummer in natal streams before emigrating, mainstem reaches close to coldwater sources were likely the most important historical spawning areas for late fall-run Chinook Salmon. Unfortunately, there is little historical data on water temperatures in the upper Sacramento River basin to analyze the stream reaches that may have been important spawning and rearing areas for the late fall-run. Yoshiyama et al. (1996) also suggested the presence of historical spawning populations of late fall-run Chinook Salmon in the American and San Joaquin rivers prior to the era of large dam construction.

9B.5.5.3 Life History and Habitat Requirements

General habitat requirements for Chinook Salmon were described previously. Only habitat requirements specific to fall-run and late fall-run Chinook Salmon are described here.

Historically, the summer water temperature regime in the Sacramento River was a key variable that influenced the life history timing and strategy of the different salmonids that occur in the basin. Fall-run Chinook Salmon avoid stressful summer conditions by migrating upstream in the fall (September–November) when both air and water temperatures begin to cool. Because they arrive at spawning grounds with fully developed gonads, adult fall-run can spawn immediately (October–November), which allows their progeny to emerge in time to emigrate from the Sacramento River as fry in the subsequent spring (February–May) before water temperatures become too high.

Because fall-run Chinook Salmon adults migrate upstream during periods of low fall baseflows, spawning is generally limited to the alluvial reaches of mainstem rivers below flow-related obstacles. There is relatively little oversummering habitat in these lower mainstem reaches to support a yearling life history strategy, so the majority of fall-run juveniles emigrate as fry before spring water temperatures become lethal. Historically, warming spring water temperatures may have imposed a lethal penalty on the progeny of any late-arriving fall-run adults.

Yoshiyama et al. (1996) suggested that spawning populations of late fall-run salmon occurred in the Sacramento River prior to the construction of Shasta Dam, citing what are mostly incidental references to late fall-run salmon in several historical documents. Although these historical accounts indicate the occurrence of salmon migrating upstream and spawning in December or later on several different Central Valley tributaries, it is not clear whether such migration and spawning activity occurred consistently or in substantial numbers. These historical references to late fall-run fish may document fall-run stragglers whose progeny perished the subsequent spring and contributed little to the population, or they may indicate passage barriers that delayed the upstream migration and spawning of fall-run fish en masse.

Late fall-run salmon in the Sacramento River have been a collateral beneficiary of the operation of the Shasta and Trinity divisions of the CVP, which maintain suitable water conditions for endangered winter-run Chinook Salmon. Since 1994, coldwater releases designed to protect winter-run eggs incubating through the summer months have likely expanded suitable oversummering habitat for late fall-run juveniles downstream. Fall-run juveniles could continue to emigrate as fry or spend a summer growing in the river before emigrating as subyearlings.

The late fall-run Chinook Salmon strategy is successful because a substantial fraction of juveniles oversummer in the Sacramento River before emigrating, which allows them to avoid predation through both their larger size and greater swimming ability (larger juvenile salmon can evade a certain amount of predation through size alone). One implication of this life history strategy is that rearing habitat is most likely the limiting factor for late fall-run Chinook Salmon, especially if availability of cool water determines the downstream extent of spawning habitat for late fall-run salmon.

Tables 9B.6 and 9B.7 display the life-history timing of fall-run and late fall-run Chinook Salmon in the action area.

Table 9B.6 Life History Timing of Central Valley Fall-run Chinook Salmon

Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept		Oct		Nov		Dec	
Adult migration past Red Bluff Diversion Dam													Light	Light	Light	Light	Moderate	Peak	Peak	Peak	Moderate	Light	Light	Light
Spawning																		Light	Moderate	Peak	Peak	Moderate	Light	Light
Incubation	Moderate	Moderate	Moderate	Moderate	Light	Light													Light	Light	Moderate	Moderate	Moderate	Moderate
Fry emergence[a]	Peak	Peak	Peak	Peak	Moderate	Moderate	Light	Light															Moderate	Moderate
Rearing in mainstem Sacramento River[b]	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate												
Outmigration past Red Bluff Diversion Dam	Light	Moderate	Moderate	Moderate	Moderate	Peak	Peak	Peak	Peak	Moderate	Moderate	Light												
Presence at CVP/SWP salvage facilities	Light	Light	Moderate	Moderate	Light	Light	Moderate	Moderate	Peak	Peak	Moderate	Moderate												
Emigration toward and through the Delta[c]	Moderate	Moderate	Moderate	Moderate	Peak	Peak	Peak	Peak	Peak	Peak	Moderate	Moderate	Light	Light	Light	Light							Light	Light

Notes:

a. Northern California Water Association and Sacramento Valley Water Users (2011) shows emergence ending in February; Williams (2006) shows emergence ending in April.

b. A few fall-run Chinook Salmon remain upstream of RBDD location to rear to a yearling life stage.

c. NMFS (2012, unpublished data)

Period of light activity
Period of moderate activity
Period of peak activity

Table 9B.7 Life History Timing of Central Valley Late Fall-run Chinook Salmon

Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Adult entry into mainstem Sacramento River[a, b]												
Migration past Red Bluff Diversion Dam[a, b, c]												
Adult holding[d]												
Spawning[a, b, c, e, f, g]												
Incubation												
Fry emergence[a, c]												
Stream residency[a, c]												
Fry outmigration past Red Bluff Diversion Dam[b]												
Smolt outmigration past Red Bluff Diversion Dam[b]												
Presence at CVP/SWP salvage facilities												
Emigration toward and through the Delta[c]												
Smolt outmigration[a]												
Ocean entry[c]												

Sources:
a. Yoshiyama et al. 1998
b. Association of California Water Agencies and California Urban Water Agencies
c. Fisher 1994
d. Moyle 2002
e. Snider et al. 1998, 1999, 2000
f. Northern California Water Association and Sacramento Valley Water Users 2011
g. Williams 2006

Period of light activity
Period of moderate activity
Period of peak activity

9B.5.5.3.1 Adult Upstream Migration and Spawning

Adult fall-run Chinook Salmon migrate into the Sacramento River and its tributaries from June through December in mature condition, with upstream migration peaking in September and October. Fall-run Chinook Salmon in the San Joaquin system typically enter spawning streams from September through November. Adults spawn soon after arriving at their spawning grounds between late September and December, with peak spawning activity in late October and early November.

Adult late fall-run Chinook Salmon migrate up the Sacramento River between mid-October and mid-April, with peak migration occurring in December (Reclamation 1991) (Table 9B.7). Adults spawn soon after reaching spawning areas between January and April. Fisher reports that peak spawning in the Sacramento River occurs in early February (1994), but carcass surveys conducted in the late 1990s suggest that peak spawning may occur in January (Snider et al 1998, 1999, 2000).

Fall-run and late fall-run Chinook Salmon are generally able to spawn in deeper water with higher velocities than Chinook Salmon in other runs because of their larger size (Healey 1991). Late fall-run salmon tend to be the largest individuals of the Chinook Salmon species that occur in the Sacramento River basin (USFWS 1996).

Fry emergence occurs from December through March, and fry rear in freshwater for only a few months before migrating downstream to the ocean as smolts between March and July (Yoshiyama et al. 1998). Late fall-run fry emerge from redds between April and June (Vogel and Marine 1991).

9B.5.5.3.2 Juvenile Rearing and Outmigration

Fall-run Chinook Salmon in the Sacramento River generally exhibit two rearing strategies: migrating to the lower reaches of the river or Delta as fry, or remaining to rear in the gravel-bedded reach for about 3 months and then smolting and outmigrating. The highest abundances of fry in the Delta are observed in wet years (Brandes and McLain 2001). Fall-run Chinook Salmon fry rear during a time and in a location where floodplain inundation is most likely to occur, thereby expanding the amount of rearing habitat available. Relative survival of fry appears to be higher in the upper Sacramento River than in the Delta or bay, especially in wet years (Brandes and McClain 2001).

One potential disadvantage of early emergence and emigration and rearing in mainstem channels and the estuary is the possibility of higher predation mortality because of the relatively small size of emigrants. However, fall-run Chinook Salmon fry exhibit several characteristics to combat predation mortality. Predators often occupy deep pools in mainstem channels, so fry generally use shallow water habitat found along channel margins or in runs and riffles to avoid predators. Because rearing habitat is not limiting for fall-run Chinook Salmon fry, they do not exhibit territorial behavior, which allows them to rear, smolt, and outmigrate in higher densities. By emigrating synchronously in schools rather than as individuals, fall-run Chinook Salmon fry and smolts can swamp potential predators to avoid significant losses to predation; and by emigrating in late spring, they have the advantage of higher discharge fueled by early snowmelt, which can reduce their exposure to predation.

Fall-run Chinook Salmon juvenile smolt during early spring, prior to increases in water temperatures. Juvenile Chinook Salmon feed and grow as they move downstream in spring and summer; larger individuals are more likely to move downstream earlier than smaller juveniles (Nicholas and Hankin 1989, Beckman et al. 1998), and it appears that in some systems juveniles that do not reach a critical size threshold will not outmigrate, but will remain to oversummer (Bradford et al. 2001). Bell (1958) suggests that the timing of yearling smolt outmigration corresponds to increasing spring discharges and temperatures. Kjelson et al. (1981) observed that peak seine catches of Chinook Salmon fry in the Sacramento-San Joaquin Delta correlated with increases in flow associated with storm runoff. Flow accounted for approximately 30 percent of the variability in the fry catch.

As fall-run Chinook Salmon fry and parr migrate downstream, they also use the lower reaches of non-natal tributaries as rearing habitat (Maslin et al. 1997). During periods of high winter and spring runoff, fall-run Chinook Salmon juveniles are also diverted into the bypasses that border the Sacramento River, where growing conditions are generally better than mainstem rearing habitats, which can facilitate higher rates of juvenile survival (Sommer et al. 2001). Natural floodplain or riparian areas that become inundated during high flows may also provide good habitat for juvenile Chinook Salmon and prevent them from being displaced downstream (The Nature Conservancy 2003).

Research conducted in the Central Valley suggests that seasonally inundated, shallow water habitats may provide superior rearing habitat for juvenile salmonids than mainstem channels (Sommer et al. 2001). Juvenile fall-run salmon migrate downstream between January and June when floodplains and bypasses are periodically flooded during wet water years. By promoting faster growth, prolonged floodplain inundation likely helps the fall-run population by increasing juvenile salmon survival.

As described above, the timing of late fall-run spawning in January through March means that fry emerge between April and June. Water temperatures in the lower Sacramento River are often too high in May and June to support fry survival, so later-emerging fry that migrate downstream likely suffer high rates of mortality and contribute little to the population. This suggests that a significant fraction of late fall-run juveniles rear in the upper Sacramento River throughout the summer before emigrating in the following fall and early winter as large subyearlings (Fisher 1994). Summer rearing is made possible by the cold water releases from the Shasta-Trinity divisions of the CVP. Late fall-run juveniles generally leave the Sacramento River by December (Vogel and Marine 1991), with peak emigration of smolts in October.

Although growth rates of juvenile Chinook Salmon may be high at temperatures approaching 19°C (66°F), cooler temperatures may be required to successfully complete the physiological transformation from parr to smolt. Smoltification in juvenile Sacramento River fall-run Chinook Salmon was studied by Marine (1997), who found that juveniles reared under a high temperature regime of 21 to 24°C (70 to 75°F) exhibited altered and impaired smoltification patterns relative to those reared at low 55 to 61°F (13 to 16°C) and moderate 17 to 20°C (63 to 68°F) temperatures. Some alteration and impairment of smoltification was also seen in the juveniles reared at the moderate temperatures.

Chronic exposure to high temperatures may also result in greater vulnerability to predation. In this same study by Marine (1997), Sacramento River fall-run Chinook Salmon reared at the highest temperatures (21 to 24°C [70 to 75°F]) were preyed upon by Striped Bass more often than those reared at low or moderate temperatures. Consumption rates of piscivorous fish such as Sacramento pikeminnow, Striped Bass, and largemouth bass increase with temperature, which may compound the effects of high temperature on juvenile and smolt predation mortality. Juvenile growth rates are an important influence on survival; faster growth thus both increases the range of food items available to them and decreases their vulnerability to predation (Myrick and Cech 2004).

9B.5.5.3.3 Ocean Residence

When fall-run Chinook Salmon produced from the Sacramento-San Joaquin system enter the ocean, they appear to head north to inhabit the northern California-southern Oregon coast (Oregon Department of Fish and Wildlife 1987). They typically have a greater tendency to remain along the continental shelf than do stream-type Chinook Salmon (Healey 1983). The age of returning Chinook Salmon adults in California ranges from 2 to 5 years.

9B.5.5.4 Population Trends

Although NMFS considers fall-run and late fall-run Chinook Salmon as part of the same ESU in the Central Valley, most resource agencies have tracked the two runs separately. For example, DFW has conducted aerial redd surveys specifically targeting late fall-run salmon, and the Anadromous Fish Restoration Program (AFRP) has tracked late fall-run salmon escapements as a separate population. However, reports on fall-run escapement estimates vary because some include late fall-run in the estimates, while others do not. Because the older reports often fail to clarify which runs are being enumerated in the escapement estimate, care must be exercised when using fall-run escapement estimates, especially from different sources.

9B.5.5.4.1 Fall-run Chinook Salmon

Fall-run Chinook Salmon estimates are available from 1940; however, systematic counts of Chinook Salmon in the San Joaquin Basin began in 1953, long after construction of large dams on the major San Joaquin basin rivers. Comparable estimates of population size before 1940 are not available. Since population estimates began, the number of fall-run Chinook returning to the San Joaquin

Basin annually has fluctuated widely. Escapement in the Tuolumne River dropped from a high of 40,300 in 1985 to a low of about 100 resulting from the 1987 to 1992 dry period (TID/MID 1997). With increased precipitation and improved flow conditions, escapement increased to 3,300 in 1996 (TID/MID 1997). From 1971 to 2007, hatchery production is estimated to have composed about 29 percent of the returning adult fall-run Chinook Salmon in the San Joaquin basin (PFMC 2008). Table 9B.8 provides a summary of estimated escapement from 1990 to 2013 in the Sacramento and San Joaquin River systems.

Table 9B.8 Recent Fall-run Chinook Salmon Natural and Hatchery Escapement

Year	Sacramento River System				San Joaquin River System			Sacramento and San Joaquin Combined		
	Hatch.	Main.	Trib.	Total	Hatch.	Trib.	Total	Hatch.	In-River	Total
1990	25,611	48,284	12,803	86,698	114	1,041	1,155	25,725	62,128	87,853
1991	28,528	30,631	72,296	131,455	83	917	1,000	28,611	103,844	132,455
1992	30,171	32,229	44,995	107,395	1,078	1,940	3,018	31,249	79,164	110,413
1993	30,234	46,231	82,975	159,440	2,573	3,410	5,983	32,807	132,616	165,423
1994	42,760	58,546	111,078	212,384	2,862	5,421	8,283	45,622	175,045	220,667
1995	45,324	63,934	211,025	320,283	3,925	5,960	9,885	49,249	280,919	330,168
1996	36,936	84,086	213,646	334,668	5,024	11,859	16,883	41,960	309,591	351,551
1997	71,448	119,296	185,484	376,228	7,440	19,129	26,569	78,888	323,909	402,797
1998	75,028	6,318	141,079	222,425	3,890	19,711	23,601	78,918	167,108	246,026
1999	49,657	161,192	180,501	391,350	4,787	18,122	22,909	54,444	359,815	414,259
2000	50,965	96,688	290,698	438,351	7,396	39,934	47,330	58,361	427,320	485,681
2001	61,318	75,296	453,323	589,937	7,391	27,303	34,694	68,709	555,922	624,631
2002	96,248	65,690	672,962	834,900	9,753	28,016	37,769	106,001	766,668	872,669
2003	118,097	89,229	362,161	569,487	8,666	12,839	21,505	126,763	464,229	590,992
2004	116,869	43,604	202,904	363,377	11,406	12,065	23,471	128,275	258,573	386,848
2005	187,427	57,012	172,457	416,896	5,984	14,813	20,797	193,411	244,282	437,693
2006	80,594	55,468	146,427	282,489	4,289	6,176	10,465	84,883	208,071	292,954
2007	22,511	17,061	54,767	94,339	1,130	1,699	2,829	23,641	73,527	97,168
2008	18,785	24,743	25,618	69,146	315	1,830	2,145	19,100	52,191	71,291
[2009]	20,904	5,827	22,842	49,573	1,799	1,757	3,556	22,703	30,426	53,129

Year	Sacramento River System				San Joaquin River System			Sacramento and San Joaquin Combined		
	Hatch.	Main.	Trib.	Total	Hatch.	Trib.	Total	Hatch.	In-River	Total
[2010]	46,306	16,372	90,154	152,832	5,421	4,937	10,358	51,727	111,463	163,190
[2011]	87,679	11,957	105,460	205,096	16,293	6,500	22,793	103,972	123,917	227,889
[2012]	136,710	28,701	155,450	320,861	7,620	13,342	20,962	144,330	197,493	341,823
[2013]	107,001	40,084	279,871	426,956	6,279	14,668	20,947	113,280	334,623	447,903
[2014]	50,713	34,876	152,587	238,176	9,627	8,094	17,721	60,340	195,557	255,897

Source: DFW 2014

Note:
Data for years in brackets are preliminary.

9B.5.5.4.2 Late Fall-run Chinook Salmon

There is little information to evaluate the historical abundance of late fall-run salmon in the Sacramento River basin. In fact, late fall-run salmon were first recognized by fishery agencies as a distinct run only after the construction of RBDD in 1966, which permitted more accurate counting of upstream migrants and the timing of upstream migration (USFWS 1996). Between 1967 and 1976, late fall-run salmon escapements averaged 22,000 adults (USFWS 1996); however, between 1977 and 1985, escapements averaged only about 9,900 adults (DFW 2014). Population estimates of late fall-run salmon after 1985 are complicated by changes in RBDD gate operations, when Reclamation began raising the dam gates during winter months to facilitate the upstream migration of winter-run Chinook Salmon. Because the upstream migration of late fall-run salmon overlaps with that of winter-run Chinook Salmon, late fall-run benefited from improved upstream access, but the accuracy of escapement estimates suffered (USFWS 1996). RBDD gate operations were revised again in 1994 so that gates were raised between September 15 and May 15, encompassing the entire upstream migration period of late fall-run salmon and further compromising the calculation of escapements. Post-1985 escapement estimates are cruder because of the change in RBDD gate operations. Table 9B.9 provides a summary of estimated escapement from 1970 to 2013 in the mainstem Sacramento River, Battle Creek, and Clear Creek.

1 **Table 9B.9 Recent Late Fall-run Chinook Salmon Natural and Hatchery Escapement**

Year	Sacramento River above RBDD	CNFH Transfers	Total above RBDD	Sacramento River below RBDD	Battle Creek	Battle Creek CNFH	Battle Creek Total	Clear Creek	Total
Nov 1990-Apr 1991	6,493	118	6,611	1,491	–	161	161	–	8,263
Nov 1991-Apr 1992	8,958	398	9,356	431	–	344	344	–	10,131
Nov 1992-Apr 1993	339	400	739	–	–	528	528	–	1,267
Nov 1993-Apr 1994	137	154	291	–	–	598	598	–	889
Nov 1994-Apr 1995	–	166	166	–	–	323	323	–	489
Nov 1995-Apr 1996	–	48	48	–	–	1,337	1,337	–	1,385
Nov 1996-Apr 1997	–	–	–	–	–	4,578	4,578	–	4,578
Nov 1997-Apr 1998	38,239	–	38,239	1,101	–	3,079	3,079	–	42,419
Nov 1998-Apr 1999	8,683	–	8,683		–	7,075	7,075	–	15,758
Nov 1999-Apr 2000	8,580	–	8,580	122	0	4,181	4,181	–	12,883
Nov 2000-Apr 2001	18,351	–	18,351	925	98	2,439	2,537	–	21,813
Nov 2001-Apr 2002	36,004	–	36,004	0	216	4,186	4,402	–	40,406
Nov 2002-Apr 2003	5,346	38	5,384	148	57	3,183	3,240	110	8,882
Nov 2003-Apr 2004	8,824	60	8,884	0	40	5,166	5,206	60	14,150
Nov 2004-Apr 2005	9,493	79	9,572	1,031	23	5,562	5,585	94	16,282
Nov 2005-Apr 2006	7,678	12	7,690	2,485	50	4,822	4,872	42	15,089
Nov 2006-Apr 2007	13,798	66	13,864	1,477	72	3,361	3,433	69	18,843
Nov 2007-Apr 2008	3,673	0	3,673	291	19	6,334	6,353	55	10,372

Year	Sacramento River above RBDD	CNFH Transfers	Total above RBDD	Sacramento River below RBDD	Battle Creek	Battle Creek CNFH	Battle Creek Total	Clear Creek	Total
Nov 2008-Apr 2009	3,271	58	3,329	63	32	6,436	6,468	336	10,196
[Nov 2009-Apr 2010]	3,843	81	3,924	439	27	5,505	5,532	91	9,986
[Nov 2010-Apr 2011]	3,686	39	3,725	0	28	4,635	4,663	58	8,446
[Nov 2011-Apr 2012]	2,811	47	2,858	11	19	3,031	3,050	50	5,969
[Nov 2012-Apr 2013]	4,918	43	4,961	309	42	3,577	3,619	77	8,966
[Nov 2013-Apr 2014]	7,227	39	7,266	723	120	4,869	4,989	72	13,050

Source: DFW 2014

Note:
Data for years in brackets are preliminary.

9B.5.5.4.3 Hybridization

Historically, spring-run Chinook Salmon and fall-run Chinook Salmon both spawned during the fall, but they were separated spatially because spring-run Chinook Salmon spawned in upper tributaries that the fall-run Chinook Salmon could not access. Under current conditions, the Keswick and Shasta dams have prevented spring-run Chinook Salmon from accessing upper tributaries, and instead they spawn in the mainstem Sacramento River where the fall run spawns. The elimination of spatial segregation of fall-run Chinook Salmon and spring-run Chinook Salmon spawning contributed to hybridization on the spawning grounds (Yoshiyama et al. 1998). Also, hatchery practices have likely mixed fall-run and spring-run Chinook Salmon stocks, causing even greater hybridization. By hybridizing with spring-run Chinook Salmon, the peak spawning activity of fall-run Chinook Salmon has likely shifted to occur earlier than it did historically.

9B.5.5.5 Hatchery Influence

Fall-run Chinook Salmon have long been a focus of hatchery production in the Central Valley, and the artificial propagation of the fall run supports the commercial and recreational harvest of salmon in California. Within the Sacramento River basin, Coleman National Fish Hatchery on Battle Creek produces substantial numbers of fall-run salmon for release in the Sacramento River and Bay-Delta estuary. Using a mixed-stock model to estimate the contribution of wild fish from the Central Valley to the fall-run Chinook Salmon ocean fishery, Barnett-Johnson et al. (2007) found that the contribution of wild fish was about 10 percent, which suggests that hatchery supplementation is a substantial contributor to the population.

Late fall-run salmon have been artificially propagated at the Coleman National Fish Hatchery on Battle Creek for more than two decades. USFWS releases between 200,000 and 2.5 million late fall-run juveniles in the Sacramento basin each year, primarily in Battle Creek. Although hatchery strays likely compose a portion of the spawning population of late fall-run salmon in the Sacramento River, it is unclear what proportion of escapements that hatchery-origin fish constitutes. It is also unclear whether hatchery juveniles that are released in Battle Creek compete with naturally spawned juveniles for oversummering habitat in the mainstem Sacramento River.

9B.5.6 Upper Klamath and Trinity Rivers Spring-Run Chinook Salmon

9B.5.6.1 Legal Status

Federal: Not warranted
State: Species of Special Concern

Two Chinook Salmon ESUs are found in the Klamath basin, the Southern Oregon and Coastal (SOCC) ESU and the Upper Klamath and Trinity Rivers ESU. The former are fall-run fish that spawn in the mainstem of the lower Klamath River. The Upper Klamath and Trinity Rivers ESU contains fall-run, late fall-run, and spring-run fish that spawn in the Klamath and Trinity rivers upstream of the Trinity River's confluence with the Klamath. Although wild spring-run Chinook Salmon in the Klamath River system differ from fall-run Chinook Salmon genetically, as well as in terms of life history and habitat requirements (NRC 2004), all are included within this ESU (Myers et al. 1998). The following profile pertains only to the spring-run, and focuses on the South Fork Trinity River (SFTR), which is within the action area and supports one of the few remaining stocks of wild spring-run Chinook Salmon within the greater Klamath Basin (Van Kirk and Naman 2008). The SFTR is the largest undammed river remaining in California.

A status review in 1999 concluded that neither ESU warranted listing (NMFS 1999b). A petition to list the Upper Klamath and Trinity Rivers ESU was submitted to NMFS in January 2011 (CBD et al. 2011); in April 2011, NMFS announced that listing was not warranted. Of primary importance in their decision was their conclusion that the spring-run and fall-run Chinook Salmon in the basin constitute a single ESU (NMFS 2012). The genetic structure of Chinook Salmon populations in coastal basins (as opposed to the Central Valley) indicates that the spring- and fall-run life histories have evolved multiple times in different watersheds (Myers et al. 1998, Waples et al. 2004). Three hatchery stocks from the Iron Gate and Trinity River hatcheries are considered part of the ESU because they were founded using native, local stock in the watershed where fish are released (NMFS 2012).

9B.5.6.2 Distribution

The Upper Klamath and Trinity Rivers ESU includes all naturally spawned and hatchery populations of spring, fall, and late-fall runs of Chinook Salmon in the Klamath and Trinity rivers upstream of the confluence of the Klamath and Trinity rivers. Iron Gate Dam currently blocks upstream migration to historical spawning habitat on the Klamath River, and Lewiston Dam is likewise a barrier to upstream migration on the Trinity River.

9B.5.6.3 Life History and Habitat Requirements

General habitat requirements for Chinook Salmon are described earlier; the following describes life-history strategies and habitat requirements unique to the spring-run Chinook or of primary importance to its life history. Spring-run Chinook Salmon display a stream-type life-history strategy—adults migrate upstream while sexually immature, hold in deep cold pools over the summer, and spawn in late summer and early fall. Juvenile outmigration is highly variable, with some age 0+ juveniles outmigrating in their first spring, but others oversummering and then emigrating as yearlings the following spring.

Table 9B.10 illustrates life-history timing for spring-run Chinook Salmon in the South Fork Trinity River basin.

Table 9B.10 Life History Timing of Spring-run Chinook Salmon in the South Fork Trinity River

Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept		Oct		Nov		Dec	
Adult upstream migration in Klamath River[a]																								
Spawning in SFTR[b]																								
Incubation and alevin development																								
Fry emergence[c]																								
Age 0+ outmigration in SFTR[d, e]																								
Age 1+ outmigration in SFTR[d, f]						?	?	?	?	?	?													
Ocean entry (yearlings)																								

Sources:
a. Snyder 1931; Strange 2008
b. State Coastal Conservancy 2009
c. West et al. 1990
d. Dean 1994, 1995
e. It is not possible to differentiate between fall-run and spring-run juveniles; therefore, exact timing for the spring run is unknown and may differ from the fall run.
f. Occurs in the spring after spawning; exact timing unknown.

Period of activity
Period of peak activity

9B.5.6.3.1 Adult Upstream Migration, Holding, and Spawning

Adults spawn from September through early November in the South Fork Trinity River (State Coastal Conservancy 2009).

Within the SFTR watershed, spring-run Chinook Salmon spawning takes place primarily between Hitchcock Creek and the East Fork of the SFTR on the mainstem SFTR, in Plummer Creek, in the mainstem of Hayfork Creek and the lower reaches of Salt and Tule creeks (USFS 2001a, Reclamation 1994), and possibly Big Creek (Chilcote et al. 2012). The East Fork of Hayfork Creek is used as summer holding habitat by adults, according to USFS (2001b), and adults have been observed during August in the lower SFTR below Surprise Creek and below Mule Bridge (USFS 2011).

9B.5.6.3.2 Egg Incubation and Alevin Development

Emergence takes place from March until early June (West et al. 1990).

9B.5.6.3.3 Juvenile Rearing and Outmigration

Rearing in the SFTR basin takes place in the mainstem SFTR between Hitchcock Creek and the East Fork of the SFTR (USFS 2001a). This area was noted to be an oversummering area by USFS (2001a). Rearing also takes place in Plummer Creek (USFS 2001a).

Juvenile spring-run Chinook Salmon of the Upper Klamath and Trinity Rivers ESU generally remain in fresh water for a year or more. On the South Fork Trinity River, outmigration occurs in late April and May with a peak in May (Dean 1994, 1995); however, it is not possible to differentiate between spring and fall juveniles, so spring-run outmigration timing may differ somewhat from the fall run. Age-1 juveniles (Type III) have been found to outmigrate from the South Fork Trinity River during the following spring (Dean 1994, 1995).

9B.5.6.4 Population Trends

A review by Williams et al. (2011) of Myers et al. (1998) and DFG (1965) estimates historical abundance of the entire ESU (both spring and fall runs) at approximately 130,000 adults for 1912, evenly split between the Klamath and Trinity rivers (NMFS 2012). Since the review by Myers et al. (1998) was published, there apparently has been little change in abundance, population trends, or population growth rates (Williams et al. 2011), except for two of the three spring-run populations that were evaluated, one of which was the South Fork Trinity River, where abundance is low relative to historical estimates (NMFS 2012). The spring run likely dominated numbers of Chinook Salmon in the South Fork Trinity River historically (Reclamation 1994). Declines in the SFTR basin have been attributed to increased sediment delivery and destruction of riparian vegetation from a history of logging and road-building in the characteristically unstable soils found there (USFS 1996; Trinity County Resource Conservation District 2003), effects of the 1964 flood (Reclamation 1994), major wildfire events (e.g., 1987, 2008), mining, and livestock grazing (Chilcote et al. 2012), as well as water withdrawals and clearing of large woody debris from stream channels (USFS 1994). Water withdrawals for domestic and agricultural uses appear to be a major factor influencing fish production in Hayfork Creek (Reclamation 1994), a major tributary to the SFTR that is located in more stable soils. Temperatures in the SFTR and Hayfork Creek are believed to be limiting spring-run populations in the SFTR and Hayfork Creek (Chilcote et al. 2012), thus climate change could result in future declines (Van Kirk and Naman 2008). NMFS suspects that dams on the mainstem Klamath and Trinity rivers caused as much as 90 percent of the spring-run Chinook Salmon decline (USFS 2001b). These dams may affect Chinook Salmon populations by altering natural seasonal flow patterns and temperatures, which affects habitat as well as behavioral cues for life-history transitions (USFS 1999). Escapement of spring-run Chinook Salmon to the Trinity River is shown in Figure 9B.1.

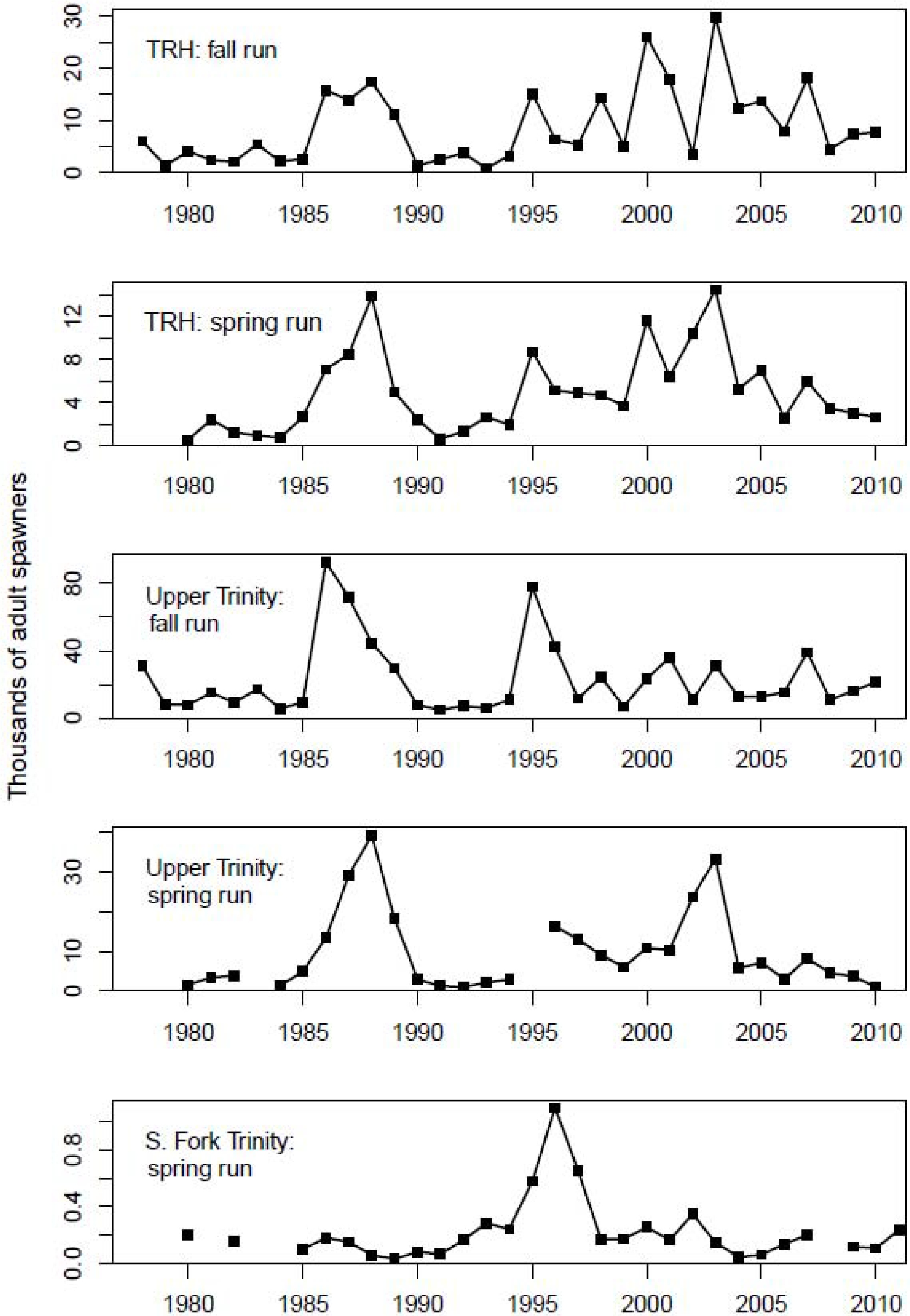

Figure 9B.1 Spring-run Chinook Salmon Escapement in the Trinity River, 1980–2010 (from Williams et al. 2011)

9B.5.6.5 Hatchery Influences

Hatchery stocking using native Chinook Salmon began in 1917 and includes both fall- and spring-run fish. There are two hatcheries in the basin: Iron Gate Hatchery on the Klamath River and Trinity River Hatchery on the Trinity River. Chinook Salmon released from Iron Gate Hatchery are all fall-run fish (NRC 2004), while the Trinity River Hatchery produces both spring- and fall-run Chinook Salmon. Approximately 10.3 million fingerling and yearling Chinook Salmon are released annually from these two hatcheries (NMFS 2012). The stocks from these hatcheries were founded from local, native fish and are genetically similar to local, natural populations; they are considered part of the same ESU by NMFS (NMFS 2012).

9B.5.7 References

AFS (American Fisheries Society). 1985. *Petition to List the Winter-run of Chinook Salmon on the Sacramento River of California as a Threatened Species.* Submitted by Cay Goude of the California-Nevada Chapter of the American Fisheries Society to Dr. William Gordon, Director, National Marine Fisheries Service as cited by National Marine Fisheries Service in 51 FR 5391-5392.. October 31, 1985**.**

Alderdice, D. F., and F. P. J. Velsen. 1978. Relation between temperature and incubation time for eggs of Chinook salmon (*Oncorhynchus tshawytscha*). *Journal of the Fisheries Research Board of Canada* 35: 69-75.

Alderdice, D. F., W. P. Wickett, and J. R. Brett. 1958. Some effects of temporary exposure to low dissolved oxygen levels on Pacific salmon eggs. *Journal of the Fisheries Research Board of Canada* 15: 229-250.

Armour, C. L. 1990. *Guidance for evaluating and recommending temperature regimes to protect fish.* Instream Flow Information Paper 28, Biological Report 90 (22). U.S. Fish and Wildlife Service, National Ecology Research C1enter, Fort Collins, Colorado.

Association of California Water Agencies and California Urban Water Agencies. 1996. *The Status of Late-fall and Spring-run Chinook Salmon in the Sacramento River Basin Regarding the Endangered Species Act.* Special Report. Submitted to National Marine Fisheries Service. Prepared by S. P. Cramer and D. B. Demko, S.P. Cramer and Associates, Inc., Gresham, Oregon.

Atwater, B. F., S. G. Conard, J. N. Dowden, C. W. Hedel, R. L MacDonald, and W. Savage. 1979. History, landforms, and vegetation of the estuary's tidal marshes. In *San Francisco Bay: the Urbanized Estuary*, pp. 347-385. Edited by T. J. Conomos. Pacific Division of the American Association for the Advancement of Science, San Francisco, California.

Azat, J. 2012. Central Valley Chinook salmon harvest and escapement. *Interagency Ecological Program for the San Francisco Estuary* 25:13-15.

Azevedo, R. L., and Z. E. Parkhurst. 1958. *The upper Sacramento River salmon and steelhead maintenance program, 1949-1956*. United States Fish and Wildlife Service. As cited in Slater 1963.

Bams, R. A. 1970. Evaluation of a revised hatchery method tested on pink and chum salmon fry. *Journal of the Fisheries Research Board of Canada* 27: 1429-1452.

Banks, J. L., L. G. Fowler, and J. W. Elliott. 1971. Effects of rearing temperature on growth, body form, and hematology of fall Chinook fingerlings. *The Progressive Fish-Culturist* 33: 20-26.

Barnett-Johnson, R., C. B. Grimes, C. F. Royer, and C. J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (*Oncorhynchus tshawytscha*) to the ocean fishery using otolith microstructure as natural tags. *Canadian Journal of Fisheries and Aquatic Sciences* 64:1683-1692.

Beckman, B. R., D. A. Larsen, B. Lee-Pawlak, and W. W. Dickhoff. 1998. Relation of fish size and growth rate to migration of spring Chinook salmon smolts. *North American Journal of Fisheries Management* 18: 537-546.

Beechie, T. J., M. Liermann, E. M. Beamer, and R. Henderson. 2005. A classification of habitat types in a large river and their use by juvenile salmonids. *Canadian Journal of Fisheries and Aquatic Sciences* 134:717-729.

Bell, M. C. 1986. *Fisheries Handbook of Engineering Requirements and Biological Criteria*. Report No. NTIS AD/A167-877. Fish Passage Development and Evaluation Program, U.S. Army Corps of Engineers, North Pacific Division, Portland, Oregon.

Bell, R. 1958. Time, Size, and Estimated Numbers of Seaward Migrants of Chinook Salmon and Steelhead Trout in the Brownlee-Oxbow Section of the Middle Snake River. State of Idaho Department of Fish and Game, Boise.

Bjornn, T. C. 1971. Trout and salmon movements in two Idaho streams as related to temperature, food, stream flow, cover, and population density. *Transactions of the American Fisheries Society* 100: 423-438.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. In *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats,* pp. 83-138. Edited by W. R. Meehan. Special Publication No. 19. American Fisheries Society, Bethesda, Maryland.

Boles, G. L., S. M. Turek, C. D. Maxwell, and D. M. McGill. 1988. *Water Temperature Effects on Chinook Salmon (*Oncorhynchus tshawytscha*) with Emphasis on the Sacramento River: a Literature Review*. California Department of Water Resources, Northern District, Red Bluff.

Bradford, M. J., J. A. Grout, and S. Moodie. 2001. Ecology of juvenile Chinook salmon in a small non-natal stream of the Yukon River drainage and the role of ice conditions on their distribution and survival. *Canadian Journal of Zoology* 79: 2043-2054.

Brandes, P. L., and J. S. McLain. 2001. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin estuary. *Contributions to the Biology of Central Valley Salmonids*, pp. 39-138. Edited by R. L. Brown. Fish Bulletin 179: Volume 2. California Department of Fish and Game, Sacramento.

Brett, J. R. 1952. Temperature tolerance in young Pacific salmon, genus *Oncorhynchus. Journal of the Fisheries Research Board of Canada* 9: 265-323.

Brett, J. R., W. C. Clarke, and J. E. Shelbourn. 1982. Experiments on thermal requirements for growth and food conversion efficiency of juvenile Chinook salmon *Oncorhynchus tshawytscha. Canadian Technical Report of Fisheries and Aquatic Sciences* 1127. Department of Fisheries and Oceans, Fisheries Research Branch, Pacific Biological Station, Nanaimo, British Columbia.

Burner, C. J. 1951. Characteristics of spawning nests of Columbia River salmon. *U.S. Fish and Wildlife Service Fishery Bulletin* 52: 97-110.

Burnett, K. M., and G. H Reeves. 2001. Valley segment use by juvenile ocean-type Chinook salmon *(Oncorhynchus tshawytscha)* in tributaries of the Elk River, Oregon (1988–1994). Chapter 3 in *Relationships among Juvenile Anadromous Salmonids, their Freshwater Habitat, and Landscape Characteristics over Multiple Years and Spatial Scales in the Elk River, Oregon*. Doctoral dissertation. Oregon State University, Corvallis.

CALFED Bay-Delta Program. n.d. *Ecosystem Restoration: Winter-run Chinook Salmon in the Sacramento River.* www.calwater.ca.gov/science/pdf/eco_restor_winter_chinook.pdf.

Calkins, R. D., W. F. Durand, and W. H. Rich. 1940. *Report of the Board of Consultants on the Fish Problem of the Upper Sacramento River*. Stanford University, Stanford, California. As cited in Myer et al. 1998.

CBD et al. (Center for Biological Diversity, Oregon Wild, Environmental Protection Information Center, and The Larch Company). 2011. *Petition to List Upper Klamath Chinook Salmon (*Oncorhynchus tshawytscha*) as a Threatened or Endangered Species.*

CDFW (California Department of Fish and Wildlife). 2014. GrandTab 2014.04.22. California Central Valley Chinook Population Report. Compiled April 22, 2014. Fisheries Branch.

Chambers, J. S., R. T. Pressey, J. R. Donaldson, and W. R. McKinley. 1954. *Research Relating to Study of Spawning Grounds in Natural Areas*. Annual Report, Contract No. DA 35026-Eng-20572. Prepared by Washington State Department of Fisheries, Olympia, Washington, for U.S. Army Corps of Engineers, Fisheries-Engineering Research Program, North Pacific Division, Portland, Oregon.

Chambers, J. S., G. H. Allen, and R. T. Pressey. 1955. *Research Relating to Study of Spawning Grounds in Natural Areas.* Annual Report, Contract No. DA 35026-Eng-20572. Prepared by Washington State Department of Fisheries, Olympia, Washington, for U.S. Army Corps of Engineers, Fisheries-Engineering Research Program, North Pacific Division, Portland, Oregon.

Chapman, D. W., D. E. Weitkamp, T. L. Welsh, M. B. Dell, and T. H. Schadt. 1986. Effects of river flow on the distribution of Chinook salmon redds. *Transactions of the American Fisheries Society* 115: 537-547.

Chelan County Public Utility District. 1989. *Summer and Winter Ecology of Juvenile Chinook Salmon and Steelhead Trout in the Wenatchee River, Washington*. Prepared by Don Chapman Consultants for Chelan County Public Utility District, Wenatchee, Washington.

Chilcote, S., A. Collins, A. Cousins, N. Hemphill, A. Hill, and J. Smith. 2013. *Spring Chinook in the SFTR Rivers: Recommended Management Actions and the Status of their Implementation*. Trinity River Restoration Program, South Fork Trinity River Spring Chinook Subgroup.

Clark, G. H. 1943. Salmon at Friant Dam - 1942. *California Fish and Game* 29: 89-91

Clarke, W. C., and J. E. Shelbourn. 1985. Growth and development of seawater adaptability by juvenile fall Chinook salmon (*Oncorhynchus tshawytscha*) in relation to temperature. *Aquaculture* 45: 21-31.

Coble, D. W. 1961. Influence of water exchange and dissolved oxygen in redds on survival of steelhead trout embryos. *Transactions of the American Fisheries Society* 90: 469-474.

Combs, B. D. 1965. Effect of temperature on the development of salmon eggs. *The Progressive Fish-Culturist* 27: 134-137.

Combs, B. D., and R. E. Burrows. 1957. Threshold temperatures for the normal development of Chinook salmon eggs. *The Progressive Fish-Culturist* 19: 3-6.

Cooper, A. C. 1965. *The Effect of Transported Stream Sediments on the Survival of Sockeye and Pink Salmon Eggs and Alevin*. Bulletin 18. International Pacific Salmon Fisheries Commission, New Westminster, British Columbia, Canada.

Dean, M. 1994. Life history, distribution, run size, and harvest of spring-run Chinook salmon in the South Fork Trinity River Basin. Chapter VII - job VII in *Trinity River Basin Monitoring Project 1991-1992*.

_____. 1995. Life history, distribution, run size, and harvest of spring-run Chinook salmon in the South Fork Trinity River Basin. Chapter VII - job VII in *Trinity River Basin Monitoring Project 1992-1993*.

DeHaven, R. W. 1989. Distribution, Extent, Replaceability and Relative Values to Fish and Wildlife of Shaded Riverine Aquatic Cover of the Lower Sacramento River, California. Part I: 1987-88 Study Results and Recommendations. Prepared by U.S. Fish and Wildlife Service, Sacramento, California, for U.S. Army Corps of Engineers, Sacramento District, Sacramento, California. As cited by Fris and Dehaven 1993.

Del Rosario, R., Y. J. Redler, K. Newman, P. L. Brandes, T. Sommer, K. Reece, and R. Vincik. 2013. Migration patterns of juvenile winter-run-sized Chinook salmon (*Oncorhynchus tshawytscha*) through the Sacramento–San Joaquin Delta. *San Francisco Estuary and Watershed Science* 11(1). http://www.escholarship.org/uc/item/36d88128.

DFG (California Department of Fish and Game). 1965. *California Fish and Wildlife Plan.* DFG, Inland Fisheries Division, Sacramento, California.

_____. 1982. Sacramento River and Tributaries Bank Protection and Erosion Control Investigation--Evaluation of Impacts on Fisheries. Final Report. CDFG, Bay-Delta Fishery Project, Sacramento, California.

_____. 1995. Fish Species of Special Concern in California, Spring-run Chinook Salmon. Habitat Conservation Planning Branch.

_____. 1997. Central Valley Anadromous Fish-Habitat Evaluations: Sacramento and American River Investigations, October 1995 through September 1996. Stream Evaluation Program, Technical Report No. 97-1. Prepared by CDFG, Environmental Services Divsion, Stream Flow and Habitat Evaluation Program for U.S. Fish and Wildlife Service, Central Valley Anadromous Fish Restoration Program.

_____. 1998. *A Status Review of the Spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) in the Sacramento River Drainage.* Report to the Fish and Game Commission, Candidate Species Status Report 98-01. CDFG, Sacramento.

_____. 2002a. *Sacramento River Winter-run Chinook Salmon.* Biennial Report 2000-2001. Prepared by CDFG, Habitat Conservation Division, Native Anadromous Fish and Watershed Branch for California Fish and Game Commission.

_____. 2002b. *Sacramento River Spring-run Chinook Salmon.* Annual report. Prepared by CDFG, Habitat Conservation Division, Native Anadromous Fish and Watershed Branch for Fish and Game Commission.

_____. 2004. *Sacramento River Winter-run Chinook Salmon.* Biennial Report 2002-2003. Prepared by CDFG, Habitat Conservation Division, Native Anadromous Fish and Watershed Branch for California Fish and Game Commission.

_____. 2010. Letter from Terry Foreman, Chief Fisheries Branch to Rod McInnis, Regional Administrator, NMFS concerning the Sacramento River winter-run Chinook escapement estimate for 2010, dated December 8, 2010 As cited in NMFS 2011.

DFW (California Department of Fish and Wildlife). 2014. *GrandTab.* California Central Valley Sacramento and San Joaquin River systems Chinook salmon escapement, hatcheries and natural areas. Fisheries Branch, Anadromous Resources Assessment. Sacramento.

Edmundson, E., F. E., Everest, and D. W. Chapman. 1968. Permanence of station in juvenile Chinook salmon and steelhead trout. *Journal of the Fisheries Research Board of Canada* 25: 1453–1464.

Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. *Journal of the Fisheries Research Board of Canada* 29: 91-100.

Fisher, F. W. 1994. Past and present status of Central Valley Chinook salmon. *Conservation Biology* 8: 870-873.

Fris, M. B., and R. W. DeHaven. 1993. A Community-Based Habitat Suitability Index Model for Shaded Riverine Aquatic Cover, Selected Reaches of the Sacramento River System. U.S. Fish and Wildlife Service, Sacramento Field Office, Sacramento, California.

Hallock, R. J., D. H. Fry, Jr., and D. A. LaFaunce. 1957. The use of fyke traps to estimate the runs of adult salmon and steelhead in the Sacramento River. *California Fish and Game* 43: 271-296.

Hallock, R. J., and F. W. Fisher. 1985. *Status of the Winter-run Chinook Salmon,* Oncorhynchus tshawytscha*, in the Sacramento River*. Anadromous Fisheries Branch Office Report. California Department of Fish and Game.

Harvey, C. D. 1995. *Juvenile Spring-run Chinook Salmon Emergence, Rearing and Outmigration Patterns in Deer Creek and Mill Creek, Tehama County for the 1994 Broodyear.* California Department of Fish and Game, Redding.

Harvey-Arrison, C. 2001. Re: Accounts of winter-run Chinook salmon in Battle and Mill creeks. Internal memorandum to D. Hallock, California Department of Fish and Game, Sacramento. 19 June.

Hatton, S. R. 1940. Progress report on the Central Valley fisheries investigations, 1939. *California Fish and Game* 26:334-369.

Hausle, D. A., and D. W. Coble. 1976. Influence of sand in redds on survival and emergence of brook trout (*Salvelinus fontinalis*). *Transactions of the American Fisheries Society* 105: 57-63.

Healey, M. C. 1980. *Utilization of the Nanaimo River Estuary by Juvenile Chinook Salmon*, Oncorhynchus tshawytscha. U.S. Fisheries Bulletin 77: 653–668.

_____. 1983. Coastwide distribution and ocean migration patterns of stream- and ocean-type Chinook salmon (*Oncorhynchus tshawytscha*). *Canadian Field Naturalist* 97: 427-433.

_____. 1991. Life history of Chinook salmon *(Oncorhynchus tshawytscha)*. In *Pacific Salmon Life Histories*, pp. 311-393. Edited by C. Groot and L. Margolis. University of British Columbia Press, Vancouver, British Columbia.

Healey, T. P. 1979. *The Effect of High Temperature on the Survival of Sacramento River Chinook (King) Salmon,* Oncorhynchus tshawytscha*, Eggs and Fry.* Administrative Report 79-10. California Department of Fish and Game, Anadromous Fisheries Branch.

Heming, T. A. 1982. Effects of temperature on utilization of yolk by Chinook salmon (*Oncorhynchus tshawytscha*) eggs and alevins. *Canadian Journal of Fisheries and Aquatic Sciences* 39: 184-190.

Hill, K. A., and J. D. Webber. 1999. *Butte Creek Spring-run Chinook Salmon,* Oncorhynchus tshawytscha*, Juvenile Outmigration and Life History 1995-1998*. Inland Fisheries Administrative Report No. 99-5. California Department of Fish and Game, Sacramento Valley and Central Sierra Region, Rancho Cordova, California.

Hillman, T. W., J. S. Griffith, and W. S. Platts. 1987. Summer and winter habitat selection by juvenile Chinook salmon in a highly sedimented Idaho stream. *Transactions of the American Fisheries Society* 116: 185-195.

Hinze, J. A. 1959. *Annual Report, Nimbus Salmon and Steelhead Hatchery, Fiscal Year of 1957-58.* Inland Fisheries Administrative Report 59-4. California Department of Fish and Game.

Johnson, R., D. C. Weigand, and F. W. Fisher. 1992. *Use of Growth Data to Determine the Spatial and Temporal Distribution of Four Runs of Juvenile Chinook Salmon in the Sacramento River, California.* Report No. AFF1-FRO-92-15. U.S. Fish and Wildlife Service. As cited by The Nature Conservancy *Sacramento River Ecological Flows Study: State of System Report*, November 2006.

Kano, B. 2006. *GrandTab; Central Valley Streams Chinook Salmon Escapement Database.* California Department of Fish and Game. Native Anadromous Fish and Watershed Branch. Red Bluff, California. As cited by Department of Fish and Wildlife *Annual Report Chinook Salmon Spawner Stocks in California's Central Valley*, 2004.

Kimmerer, W., L. Brown, S. Culberson, P. Moyle, M. Nobriga, and J. Thompson. 2008. Aquatic ecosystems. In *The State of Bay-Delta Science 2008*, pp. 55-72. Edited by M. Healey, M. Dettinger, and R. Norgaard. CALFED Science Program, Sacramento, California.

Kjelson, M. A., P. F. Raquel, and F. W. Fisher. 1981. Influences of freshwater inflow on Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento-San Joaquin Estuary. In *Proceedings of the National Symposium on Freshwater Inflow to Estuaries*, pp. 88-108. Edited by R. D. Cross and D. L. Williams. FWS/OBS-81/04. U.S. Fish and Wildlife Service, Washington, D. C.

Kondolf, G. M. 2000. Assessing salmonid spawning gravel quality. *Transactions of the American Fisheries Society* 129: 262-281.

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

Koski, K. V. 1981. The survival and quality of two stocks of chum salmon (*Oncorhynchus keta*) from egg deposition to emergence. *Rapports et Proces-Verbaux des Reunions, Conseil International pour L'Exploration de la Mer* 178: 330-333.

Levings, C. D., and R. B. Lauzier. 1991. Extensive use of the Fraser River basin as winter habitat by juvenile Chinook salmon (*Oncorhynchus tshawytscha*). *Canadian Journal of Zoology* 69: 1759-1767.

Lindley, S. T., R. Schick, B. P. May, J. J. Anderson, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2004. *Population Structure of Threatened and Endangered Chinook Salmon ESUs in California's Central Valley Basin*. Technical Memorandum NOAA-TM-NMFS-SWFSC-360. National Marine Fisheries Service, Southwest Fisheries Science Center.

Lindley, S. T., R. Schick, A. Agrawal, M. Goslin, T. E. Pearson, E. Mora, J. J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2006. Historical population structure of Central Valley steelhead and its alteration by dams. *San Francisco Estuary and Watershed Science* [online serial] 4(2).

Lindsay, R. B., W. J. Knox, M. W. Flesher, B. J. Smith, E. A. Olsen, and L. S. Lutz. 1986. *Study of Wild Spring-run Chinook Salmon in the John Day River System*. 1985 Final Report. Contract DE-AI79-83BP39796, Project 79-4. Prepared by Oregon Department of Fish and Wildlife, Portland for Bonneville Power Administration, Portland, Oregon.

Lister, D. B., and H. S. Genoe. 1970. Stream habitat utilization of cohabiting underyearlings of Chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon in the Big Qualicum River, British Columbia. *Journal of the Fisheries Research Board of Canada* 27: 1215-1224.

Marcotte, B. D. 1984. *Life History, Status, and Habitat Requirements of Spring-run Chinook Salmon in California.* U.S. Forest Service, Lassen National Forest, Chester, California.

Marine, K. R. 1992. *A Background Investigation and Review of the Effects of Elevated Water Temperature on Reproductive Performance of Adult Chinook Salmon (*Oncorhynchus tshawytscha*)*. Department of Wildlife and Fisheries Biology, University of California, Davis. As cited by Department of Water Resources *Matrix of Life History and Habitat Requirements for Feather River Fish Species*, SP-F15 Task 1 and SP-F21 Task 1 Oroville Facilities Relicensing FERC Project No. 2100, April 2004.

_____. 1997. *Effects of Elevated Water Temperature on Some Aspects of the Physiological and Ecological Performance of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*): Implications for Management of California's Central Valley Salmon Stocks.* Master's thesis. University of California, Davis.

Marine, K. R., and J. J. Cech, Jr. 2004. Effects of high water temperature on growth, smoltification, and predator avoidance in juvenile Sacramento River Chinook salmon. *North American Journal of Fisheries Management* 24: 198-210.

Martin, C. D., P. D. Gaines, and R. R. Johnson. 2001. *Estimating the Abundance of Sacramento River Juvenile Winter Chinook Salmon with Comparisons to Adult Escapement.* Final Report, Report Series: Volume 5. July. Prepared by U.S. Fish and Wildlife Service, Red Bluff, CA. Prepared for U.S. Bureau of Reclamation, Red Bluff, CA.

Maslin, P., M. Lennox, J. Kindopp, and W. McKinney. 1997. *Intermittent Streams as Rearing Habitat for Sacramento River Chinook Salmon* (Oncorhynchus tshawytscha). Department of Biological Sciences, California State University, Chico.

McCain, M. E. 1992. Comparison of habitat use and availability for juvenile fall Chinook salmon in a tributary of the Smith River, California. *FHR Currents* No. 7. U.S. Forest Service, Region 5.

McCuddin, M. E. 1977. *Survival of Salmon and Trout Embryos and Fry in Gravel-sand Mixtures.* Master's thesis. University of Idaho, Moscow. As cited in Kondolf 2000.

McNeil, W. J. 1964a. Effect of the spawning bed environment on reproduction of pink and chum salmon. *U.S. Fish and Wildlife Service Fishery Bulletin* 65: 495-523.

_____. 1964b. Redd superimposition and egg capacity of pink salmon spawning beds. *Journal of the Fisheries Research Board of Canada* 21: 1385-1396.

McReynolds, T. R., C. E. Garman, P. D. Ward, and M. C. Schommer. 2005. *Butte and Big Chico Creeks Spring-run Chinook Salmon,* Oncorhynchus tshawytscha*, Life History Investigation 2003-2004*. Inland Fisheries Administrative Report No. 2005-1. California Department of Fish and Game, Sacramento Valley and Central Sierra Region, Rancho Cordova, California.

Meyer, J. H. 1979. *A Review of the Literature on the Value of Estuarine and Shoreline Areas to Juvenile Salmonids in Puget Sound, Washington.* U.S. Fish and Wildlife Service, Fisheries Assistance Office, Olympia, Washington.

Michny, F. 1987. *Sacramento River, Chico Landing to Red Bluff Project, 1986 Juvenile Salmon Study.* Prepared by U.S. Fish and Wildlife Service, Sacramento for U.S. Army Corps of Engineers, Sacramento, California. As cited by U.S. Fish and Wildlife Service *Shaded Riverine Aquatic Cover of the Sacramento River System: Classification as Resources Category 1 Under the Fish and Wildlife Mitigation Policy*, October 1992.

_____. 1988. *Sacramento River Butte Basin Reach Pre-project Juvenile Salmon Study.* Prepared by U.S. Fish and Wildlife Service, Sacramento for U.S. Army Corps of Engineers, Sacramento, California. As cited by U.S. Fish and Wildlife Service *Shaded Riverine Aquatic Cover of the Sacramento River System: Classification as Resources Category 1 Under the Fish and Wildlife Mitigation Policy*, October 1992.

_____. 1989. *Sacramento River, Chico Landing to Red Bluff Project, 1987 Juvenile Salmon Study*. Prepared by U.S. Fish and Wildlife Service, Sacramento for U.S. Army Corps of Engineers, Sacramento, California. As cited by U.S. Fish and Wildlife Service *Shaded Riverine Aquatic Cover of the Sacramento River System: Classification as Resources Category 1 Under the Fish and Wildlife Mitigation Policy*, October 1992.

Michny, F., and R. Deibel. 1986. *Sacramento River, Chico Landing to Red Bluff Project, 1985 Juvenile Salmon Study*. Draft report. Prepared by U.S. Fish and Wildlife Service, Sacramento, California for U.S. Army Corps of Engineers, Sacramento, California.

Michny, F., and M. Hampton. 1984. *Sacramento River, Chico Landing to Red Bluff Project, 1984 Juvenile Salmon Study*. Draft report. Prepared by U.S. Fish and Wildlife Service, Sacramento, California for U.S. Army Corps of Engineers, Sacramento, California.

Mills, T. J., and F. Fisher. 1994. *Central Valley Anadromous Sport Fish Annual Run-size, Harvest, and Population Estimates, 1967 through 1991*. Inland Fisheries Technical Report. California Department of Fish and Game.

Moore, J. W., D. E. Schindler, and M. D. Scheuerell. 2004. Disturbance of freshwater habitats by anadromous salmon in Alaska. *Oecologia* 139: 298-308.

Moyle, P. B. 2000. Abstract 89. *CALFED Bay-Delta Program Science Conference 2000*. Edited by R. L. Brown, F. H. Nichols and L. H. Smith. CALFED Bay-Delta Program, Sacramento, California. As cited by CALFED Bay-Delta Program Science Conference 2000.

_____. 2002. *Inland Fishes of California*. Revised edition. University of California Press, Berkeley.

Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. *Fish Species of Special Concern in California*. Final Report. Prepared by Department of Wildlife and Fisheries Biology, University of California, Davis for California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova.

Murphy, M. L., J. Heifetz, J. F. Thedinga, S. W. Johnson, and K. V. Koski. 1989. Habitat utilization by juvenile Pacific salmon (*Oncorhynchus*) in the glacial Taku River, southeast Alaska. *Canadian Journal of Fisheries and Aquatic Sciences* 46: 1677-1685.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. *Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California*. NOAA Technical Memorandum NMFS-NWFSC-35. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.

Myrick, C. A., and J. J. Cech, Jr. 2001. *Temperature Effects on Chinook Salmon and Steelhead: a Review Focusing on California's Central Valley Populations*. Prepared by Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins and Department of Wildlife, Fish, and Conservation Biology, University of California, Davis for the Bay-Delta Modeling Forum.

_____. 2002. Growth of American River fall-run Chinook salmon in California's Central Valley: temperature and ration effects. *California Fish and Game* 88:35-44.

_____. 2004. Temperature effects on juvenile anadromous salmonids in California's Central Valley: what don't we know? *Reviews in Fish Biology and Fisheries* 14: 113–123.

Needham, P. R., H. A. Hanson, and L. P. Parker. 1943. *Supplementary Report on Investigations of Fish-salvage Problems in Relation to Shasta Dam.* Special Scientific Report No. 26. U.S. Fish and Wildlife Service.

Neilson, J. D., and C. E. Banford. 1983. Chinook salmon (*Oncorhynchus tshawytscha*) spawner characteristics in relation to redd physical features. *Canadian Journal of Zoology* 61:1524-1531.

Newman, K. B., and P. L. Brandes. 2010. Hierarchical modeling of juvenile Chinook Salmon survival as a function of Sacramento–San Joaquin Delta water exports. North American Journal of Fisheries Management 30:157–169.

Nicholas, J. W., and D. G. Hankin. 1989. *Chinook Salmon Populations in Oregon Coastal River Basins: Descriptions of Life Histories and Assessment of Recent Trends in Run Strengths.* Report EM 8402. Oregon Department of Fish and Wildlife, Research and Development Section, Corvallis.

NMFS (National Marine Fisheries Service). 1989. Endangered and threatened species; critical habitat; winter-run Chinook salmon. *Federal Register* 54: 32085-32088

______.1993. Designated critical habitat; Sacramento River winter-run Chinook salmon. *Federal Register* 58: 33212-33219.

______. 1994. Endangered and threatened species; status of Sacramento River winter-run Chinook salmon. *Federal Register* 59: 440-450.

______. 1997. *NMFS Proposed recovery plan for the Sacramento River winter-run Chinook salmon.* NMFS, Southwest Region, Long Beach, California.

______. 1999a. Endangered and threatened species; threatened status for two Chinook salmon evolutionarily significant units (ESUs) in California. *Federal Register* 64: 50394-50415.

______. 1999b. *Status Review Update for Deferred ESUs of West Coast Chinook Salmon (*Oncorhynchus tshawytscha*) from Washington, Oregon, California, and Idaho.* Report of West Coast Biological Review Team to NMFS, Seattle, Washington. http://www.nwr.noaa.gov/Publications/Biological-Status-Reviews/loader.cfm?csModule=security/getfile&pageid=21676.

______. 2004a. Endangered and threatened species: proposed listing determinations for 27 ESUs of west coast salmonids. *Federal Register* 69: 33102-33179.

______. 2004a. *Biological Opinion on the Long-term Central Valley Project and State Water Project Operations Criteria and Plan*. Endangered Species Act Section 7 Consultation. NMFS, Southwest Region, Long Beach, California.

______. 2004b. Endangered and threatened species: establishment of Species of Concern list, addition of species to Species of Concern list, description of factors for identifying Species of Concern, and revision of Candidate Species list Under the Endangered Species Act: notice. *Federal Register* 69: 19975-19979.

______. 2005. Endangered and threatened species; final listing determinations for 16 ESUs of West Coast salmon, and final 4(d) protective regulations for threatened salmonid ESUs. *Federal Register* 70: 37160-37204.

_____. 2009. *Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead.* October. Sacramento Protected Resources Division, Sacramento, CA.

_____. 2011. *Central Valley Recovery Domain 5-Year Review: Summary and Evaluation of Sacramento River Winter-run Chinook Salmon ESU.* NMFS, Southwest Region, Long Beach, California.

_____. 2012. Listing Endangered and Threatened species; 12-month finding on a petition to list Chinook salmon in the Upper Klamath and Trinity rivers basin as Threatened or Endangered under the Endangered Species Act. *Federal Register* 77: 19597-19605. http://www.gpo.gov/fdsys/pkg/FR-2012-04-02/pdf/2012-7879.pdf.

Northern California Water Association and Sacramento Valley Water Users. 2011. *Insights into the Problems, Progress, and Potential Solutions for Sacramento River Basin Native Anadromous Fish Restoration*. Prepared by D. Vogel for Northern California Water Association and Sacramento Valley Water Users. Red Bluff, California.

NRC (National Research Council). 2004. *Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery*. The National Academies Press, Washington, D.C. http://www.nap.edu/openbook.php?isbn=0309090970.

Oregon Department of Fish and Wildlife. 1987. *Abundance of Rogue River Fall Chinook Salmon.* Annual Progress Report, Fish Research Project Contract AFS-78-1. Prepared by S.P. Cramer for Oregon Department of Fish and Wildlife, Portland.

Parker, L. P., and H. A. Hanson. 1944. Experiments on transfer of adult salmon into Deer Creek, California. *Journal of Wildlife Management* 8: 192-198.

Perry, R. W., J. G. Romine, N. S. Adams, A. R. Blake, J. R. Burau, S. V. Johnston, and T. L. Liedtke. 2012. Using a non-physical behavioural barrier to alter migration routing of juvenile Chinook salmon in the Sacramento–San Joaquin River delta. *River Research and Applications*, n/a-n/a. doi: 10.1002/rra.2628

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

Peterson, D. P., and C. J. Foote. 2000. Disturbance of small-stream habitat by spawning sockeye salmon in Alaska. *Transactions of the American Fisheries Society* 129: 924-934.

PFMC (Pacific Fishery Management Council). 2008. *Review of 2007 Ocean Salmon Fisheries*. Portland, Oregon. www.pcouncil.org.

Phillips, R. W., R. L. Lantz, E. W. Claire, and J. R. Moring. 1975. Some effects of gravel mixtures on emergence of coho salmon and steelhead trout fry. *Transactions of the American Fisheries Society* 104: 461-466.

Platts, W. S., M. A. Shirazi, and D. H. Lewis. 1979. *Sediment Particle Sizes Used by Salmon for Spawning with Methods for Evaluation*. Ecological Research Series EPA-600/3-79-043. U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, Oregon.

Reclamation (U.S. Bureau of Reclamation). 1991. *Guide to Upper Sacramento River Chinook Salmon Life History*. Prepared by D. A. Vogel and K. R. Marine, CH2M HILL, Redding, California, for U.S. Bureau of Reclamation, Central Valley Project.

_____. 1994. *Action Plan for the Restoration of the SFTR Watershed and its Fishes*. Prepared by Pacific Watershed Associates for U.S. Bureau of Reclamation and Trinity River Task Force, Arcata, California. As cited by Trinity River Restoration Program *Spring Chinook in the South Fork Trinity River: Recommended Management Actions and the Status of their Implementation,* January 29, 2013.

_____. 2004. *Long-term Central Valley Project and State Water Project Operations Criteria and Plan Biological Assessment.* USDI Bureau of Reclamation, Mid-Pacific Region, Sacramento, California.

Reiser, D. W., and R. T. Peacock. 1985. *A technique for assessing upstream fish passage problems at small-scale hydropower developments*. Edited by F. W. Olson, R. G. White, and R. H. Hamre. Pp. 423-432. Symposium on Small Hydropower and Fisheries. American Fisheries Society, Bethesda, Maryland.

Reiser, D. W., and R. G. White. 1988. Effects of two sediment size-classes on survival of steelhead and Chinook salmon eggs. *North American Journal of Fisheries Management* 8: 432-437.

Rich, A. A. 1987. Report on studies conducted by Sacramento County to determine the temperatures which optimize growth and survival in juvenile Chinook salmon (Oncorhynchus tshawytscha). Prepared for McDonough, Holland and Allen, Sacramento, California, by A. A. Rich and Associates, San Rafael, California.

Roper, B. R., D. L. Scarnecchia, and T. J. La Marr. 1994. Summer distribution of and habitat use by Chinook salmon and steelhead within a major basin of the South Umpqua River, Oregon. *Transactions of the American Fisheries Society* 123: 298-308.

Rutter, C. 1908. The fishes of the Sacramento-San Joaquin basin, with a study of their distribution and variation. *Bulletin of the U.S. Bureau of Fisheries* 27: 103-152.

Shirvell, C. S. 1994. Effect of changes in streamflow on the microhabitat use and movements of sympatric juvenile coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*O. tshawytscha*) in a natural stream. *Canadian Journal of Fisheries and Aquatic Sciences* 51: 1644-1652.

Shumway, D. L., C. E. Warren, and P. Doudoroff. 1964. Influence of oxygen concentration and water movement on the growth of steelhead trout and coho salmon embryos. *Transactions of the American Fisheries Society* 93: 342-356.

Silver, S. J., C. E. Warren, and P. Doudoroff. 1963. Dissolved oxygen requirements of developing steelhead trout and Chinook salmon embryos at different velocities. *Transactions of the American Fisheries Society* 92: 327-343.

Slater, D. W. 1963. *Winter-run Chinook salmon in the Sacramento River, California with Notes on Water Temperature Requirements at Spawning.* Special Scientific Report—Fisheries 461. U.S. Fish and Wildlife Service.

Smith, A. K. 1973. Development and application of spawning velocity and depth criteria for Oregon salmonids. *Transactions of the American Fisheries Society* 102: 312-316.

Smith, S. H. 1950. *Upper Sacramento River Sport Fishery*. Special Scientific Report – Fisheries. U.S. Fish and Wildlife Service.

Snider, B., B. Reavis, and S. Hill. 1998. *Upper Sacramento River Late-fall-run Chinook Salmon Escapement Survey, December 1997-May 1998.* Stream Evaluation Program Technical Report No. 98-4. California Department of Fish and Game, Environmental Services Division.

_____. 1999. *Upper Sacramento River Late-fall-run Chinook Salmon Escapement Survey, December 1998 April 1999*. Stream Evaluation Program Technical Report No. 99-3. California Department of Fish and Game, Habitat Conservation Division, Native Anadromous Fish and Watershed Branch.

_____. 2000. *Upper Sacramento River Late-fall-run Chinook Salmon Escapement Survey, December 1999 April 2000*. Stream Evaluation Program Technical Report No. 00-9. California Department of Fish and Game, Habitat Conservation Division, Native Anadromous Fish and Watershed Branch.

_____. 2001. *Upper Sacramento River Winter-run Chinook Salmon Escapement Survey, May-August 2000*. Stream Evaluation Program Technical Report No. 01-1. California Department of Fish and Game, Habitat Conservation Division, Native Anadromous Fish and Watershed Branch.

Snider, B., and R. G. Titus. 2000. *Timing, Composition, and Abundance of Juvenile Anadromous Salmonid Emigration in the Sacramento River near Knights Landing, October 1996–September 1997.* California Department of Fish and Game, Habitat Conservation Division, Stream Evaluation Program Technical Report No. 00-04.

Snyder, J. O. 1931. Salmon of the Klamath River, California. *California Fish and Game Bulletin* 34:130.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 325-333.

State Coastal Conservancy. 2009. *Effects of Sediment Release following Dam Removal on the Aquatic Biota of the Klamath River*. Technical report. Prepared by Stillwater Sciences, Arcata, California, for State Coastal Conservancy, Oakland, California. http://www.usbr.gov/mp/kbao/kbra/docs/other/Klamath%20Dam%20Removal%20Biological%20Analysis_FINAL.pdf.

State Water Contractors. 1990. *Laboratory Information on the Effect of Water Temperature on Juvenile Chinook Salmon in the Sacramento and San Joaquin Rivers: a Literature Review.* San Francisco Bay/Sacramento-San Joaquin Delta, Water Quality Control Plan Hearings, WQCP-SWC Exhibit 605. Prepared by C. H. Hanson, Tenera Environmental, Berkeley, California, for State Water Contractors, Sacramento, California.

Steward, C. R., and T. C. Bjornn. 1987. The distribution of Chinook salmon juveniles in pools at three discharges. *Proceedings of the Annual Conference, Western Association of Fish and Wildlife Agencies* 67: 364-374.

Strange, J. 2008. *Adult Chinook Salmon Migration in the Klamath River Basin, 2007 Biotelemetry Monitoring Study Final Report*. Yurok Tribal Fisheries Program, Klamath, California, and University of Washington, School of Aquatic and Fishery Science, Seattle, Washington, in collaboration with Hoopa Valley Tribal Fisheries, Hoopa, California.

Stuehrenberg, L. C. 1975. *The Effects of Granitic Sand on the Distribution and Abundance of Salmonids in Idaho Streams.* Master's thesis. University of Idaho, Moscow.

Swales, S., R. B. Lauzier, and C. D. Levings. 1986. Winter habitat preferences of juvenile salmonids in two interior rivers in British Columbia. C*anadian Journal of Zoology* 64: 1506-1514.

Taylor, E. B., and P. A. Larkin. 1986. Current response and agonistic behavior in newly emerged fry of Chinook salmon, *Oncorhynchus tshawytscha*, from ocean- and stream-type populations. *Canadian Journal of Fisheries and Aquatic Sciences* 43: 565-573.

The Nature Conservancy. 2003. *Contrasting Patterns of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) Growth, Diet, and Prey Densities in Off-channel and Main Stem Habitats on the Sacramento River.* Prepared by M. P. Limm and M. P. Marchetti for The Nature Conservancy, Chico, California.

Thompson, K. 1972. Determining stream flows for fish life. *Proceedings of the Instream Flow Requirement Workshop*, pp. 31-50. Pacific Northwest River Basin Commission, Vancouver, Washington.

TID/MID (Turlock Irrigation District and Modesto Irrigation District). 1997. *Lower Tuolumne River Annual Report 97-1.*Trinity County Resource Conservation District. 2003. *South Fork Trinity River Water Quality Monitoring Project*. Prepared for California Department of Fish and Game, Redding, California.

ULEP (Umpqua Land Exchange Project). 1998. *Mapping Rules for Chinook Salmon (*Oncorhynchus tshawytscha*)*. Draft Report. ULEP, Roseburg, Oregon. As cited by The Nature Conservancy *Linking Biological Responses to River Processes: Implications for Conservation and Management of the Sacramento River—A Focal Species Approach*, November 2007.

USFS (U.S. Forest Service).1994. *Lower Hayfork Creek Watershed Analysis*. Hayfork Ranger District, Shasta-Trinity National Forest.

_____. 1996. *Lower Hayfork Creek Watershed Analysis*. Shasta-Trinity National Forest, Hayfork Ranger District.

_____. 1999. *Middle Hayfork Creek Watershed Analysis*. Hayfork Ranger District, Shasta-Trinity National Forest.

_____. 2001a. *Hidden Valley, Plummer Creek and Rattlesnake Creek Watershed Analysis*. Prepared by Foster Wheeler Environmental Corporation for U.S. Forest Service, Shasta-Trinity National Forest, Redding, California.

_____. 2001b. *Middle Hayfork-Salt Creek Watershed Analyses*. Prepared by URS Greiner Woodward Clyde for U.S. Forest Service, Shasta-Trinity National Forest, Redding, California.

_____. 2011. *Snorkel Survey Counts of Spring-run Chinook Salmon on the Salmon River, California*. Available from M. Meneks, U.S. Forest Service, Fort Jones, California.

USFWS (U.S. Fish and Wildlife Service). 1995. *Working Paper on Restoration Needs: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California.* Volume 2. Prepared for the USFWS under direction of the Anadromous Fish Restoration Program Core Group. Stockton, California.

_____. 1996. *Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes*. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon.

_____. 1999. *Effect of Temperature on Early-life Survival of Sacramento River Fall- and Winter-run Chinook Salmon.* Final report. USFWS, Northern Central Valley Fish and Wildlife Office, Red Bluff, California.

_____. 2003. *Flow-habitat Relationships for Steelhead and Fall, Late-fall and Winter-run Chinook Salmon Spawning in the Sacramento River between*

Keswick Dam and Battle Creek. Final report. USFWS, Sacramento Fish and Wildlife Office, Sacramento, California.

_____. 2004. *Flow-habitat Relationships for Spring-run Chinook Salmon Spawning in Butte Creek.* USFWS, Sacramento, California.

_____. 2005. *Flow-habitat Relationships for Chinook Salmon Rearing in the Sacramento River between Keswick Dam and Battle Creek.* USFWS, Sacramento Fish and Wildlife Office, Sacramento, California.

Van Kirk, R. W., and S. W. Naman. 2008. Relative effects of climate and water use on base-flow trends in the lower Klamath Basin. *Journal of the American Water Resources Association* 44: 1-18.

Van Woert, W. 1958. *Time Pattern of Migration of Salmon and Steelhead into the Upper Sacramento River during the 1957-1958 Season.* Inland Fisheries Administrative Report 58-7. California Department of Fish and Game. As cited by Natural Heritage Institute *Estimating Ecologically Based Flow Targets for the Sacramento and Feather Rivers*, April 2008.

Vaux, W. G. 1968. Intragravel flow and interchange of water in a streambed. *Fishery Bulletin* 66: 479-489.

Vernier, J. M. 1969. *Chronological Table of Embryonic Development of Rainbow Trout*. Canada Fisheries and Marine Service Translation Series 3913.

Vogel, D. A. 1987a. *Estimation of the 1986 Spring-run Chinook Salmon Run in Deer Creek, California*. Report No. FR1/FAO-87-3. U.S. Fish and Wildlife Service.

_____. 1987b. *Estimation of the 1986 Spring-run Chinook Salmon Run in Mill Creek, California.* Report No. FR1/FAO-87-12. U.S. Fish and Wildlife Service. As cited by Natural Heritage Institute *Estimating Ecologically Based Flow Targets for the Sacramento and Feather Rivers*, April 2008.

Vogel, D. A., and K. R. Marine. 1991. Guide to the Upper Sacramento River Chinook Salmon Life History. Bureau of Reclamation Central Valley Project.

Vronskiy, B. B. 1972. Reproductive biology of the Kamchatka River Chinook salmon (*Oncorhynchus tshawytscha* [Walbaum]). *Journal of Ichthyology* 12: 259-273.

Waples, R. S., D. J. Teel, J. M. Myers, and A. R. Marshall. 2004. Life-history divergence in Chinook salmon: historic contingency and parallel evolution. *Evolution* 58: 386-403.

Ward, P. D., and T. R. McReynolds. 2001. *Butte and Big Chico Creeks Spring-run Chinook Salmon,* Oncorhynchus tshawytscha*, Life History Investigation 1998-2000*. Inland Fisheries Administrative Report No. 2001-2. California Department of Fish and Game, Sacramento Valley and Central Sierra Region, Rancho Cordova, California.

Ward, P. D., T. R. McReynolds, and C. E. Garman. 2004. *Butte and Big Chico Creeks Spring-run Chinook Salmon,* Oncorhynchus tshawytscha*, Life History Investigation 2002–2003*. Inland Fisheries Administrative Report No. 2004-6. California Department of Fish and Game, Sacramento Valley and Central Sierra Region, Rancho Cordova, California.

West, J. R., O. J. Dix, A. D. Olson, M. V. Anderson, S. A. Fox, and J. H. Power. 1990. *Evaluation of Fish Habitat Conditions and Utilization in Salmon, Scott, Shasta, and Mid-Klamath Sub-basin Tributaries.* Annual report for Interagency Agreement 14-16-0001-89508. Prepared by U.S. Forest Service, Klamath National Forest, Yreka, California, and Shasta-Trinity National Forest, Weaverville, California.

Wickett, W. P. 1954. The oxygen supply to salmon eggs in spawning beds. J*ournal of the Fisheries Research Board of Canada* 11: 933-953.

Williams, J. G. 2006. Central Valley salmon: a perspective on Chinook and steelhead in the Central Valley of California. *San Francisco Estuary and Watershed Science* 4 (3).

_____. 2012. Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in and around the San Francisco Estuary. *San Francisco Estuary and Watershed Science* 10 (3).

Williams, T. H., J. C. Garza, N. Hetrick, S. T. Lindley, M. S. Mohr, J. M. Myers, M. R. O'Farrell, R. M. Quinones, and D. J. Teel. 2011. *Upper Klamath and Trinity River Chinook Salmon Biological Review Team Report*. National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley region of California. *North American Journal of Fisheries Management* 18: 487-521.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 1996. *Historical and Present Distribution of Chinook Salmon in the Central Valley Drainage of California*. In Volume III: *Assessments, Commissioned Reports, and Background Information,* pp. 309-362. *Sierra Nevada Ecosystem Project: Final Report to Congress.* University of California, Center for Water and Wildland Resources, Davis.

_____. 2001. Historical and present distribution of Chinook salmon in the Central Valley drainage of California. In *Contributions to the Biology of Central Valley Salmonids,* pp. 71-176. Edited by R. L. Brown. Fish Bulletin 179, Volume 1. California Department of Fish and Game, Sacramento.

9B.6 Central Valley Steelhead (*Oncorhynchus mykiss*)

9B.6.1 Legal Status

Federal: Threatened; Designated Critical Habitat
State: None

NMFS listed the Central Valley Steelhead ESU as threatened under the Federal ESA in 1998 (NMFS 1998). In 2004, NMFS proposed that all west coast steelhead ESUs be reclassified to DPSs and proposed to retain Central Valley Steelhead as threatened. In January 2006, after a status review (Good et al. 2005), NMFS issued its final decision to retain the status of Central Valley Steelhead as threatened (NMFS 2006).

Designated critical habitat for Central Valley Steelhead includes stream reaches of the American, Feather, Yuba, and Bear rivers and their tributaries and tributaries of the Sacramento River including Deer, Mill, Battle, Antelope, and Clear creeks in the Sacramento River basin; the Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers in the San Joaquin River basin; and portions of the Sacramento and San Joaquin rivers. Designated critical habitat in the Delta includes portions of the Delta Cross Channel Yolo Bypass, Ulatis Creek, and portions of the network of channels in the Sacramento River portion of the Delta as well as portions of the San Joaquin, Cosumnes, and Mokelumne rivers and portions of the network of channels in the San Joaquin portion of the Delta.

The DPS includes naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in the Sacramento and San Joaquin rivers and their tributaries, excluding steelhead from San Francisco and San Pablo bays and their tributaries and those from two artificial propagation programs: the Coleman Nimbus Fish Hatchery and Feather River Hatchery steelhead hatchery programs.

NMFS considered including resident *O. mykiss* in listed steelhead DPSs in certain instances, including (1) where resident *O. mykiss* have the opportunity to interbreed with anadromous fish below natural or artificial barriers, or (2) where resident fish of native lineage once had the ability to interbreed with anadromous fish but no longer do because they are above artificial barriers and are considered essential for the recovery of the DPS (NMFS 1998). However, USFWS, which under the ESA has authority over resident fish, concluded that behavioral forms of *O. mykiss* can be regarded as separate DPSs and that lacking evidence that resident Rainbow Trout need ESA protection, only anadromous forms should be included in the DPS and listed under the ESA (NMFS 1998). USFWS also did not believe that steelhead recovery would rely on the intermittent exchange of genetic material between resident and anadromous forms. In the final rule, the listing includes only the anadromous form of *O. mykiss*.

However, NMFS considers all *O. mykiss* that have access to the ocean (including resident Rainbow Trout) to potentially be steelhead and will treat these fish as steelhead because (1) resident fish can produce anadromous offspring, and (2) it is difficult or impossible to distinguish between juveniles of the different forms. Adult resident Rainbow Trout in Central Valley streams are often larger than Central Valley Steelhead. Several sources indicate that resident trout in the Central Valley commonly exceed 16 inches (406 mm) in length. Cramer et al. (1995) reported that resident Rainbow Trout in Central Valley rivers grow longer than 20 inches (508 mm). Hallock et al. (1961) observed resident trout in the upper Sacramento River upstream of the Feather River that were 14 to 20 inches (356 to 508 mm) in length. Also, at Coleman National Fish Hatchery, USFWS found about 15 percent overlap in size distribution between resident and anadromous *O. mykiss* at a length of 22.8 inches (579 mm) (Cramer et al. 1995). Steelhead, therefore, have significant size overlap with resident Rainbow Trout in Central Valley rivers, and many resident adult trout will be considered by NMFS to be steelhead.

The following profiles focus on the anadromous form of the species because these are the most likely to be affected by the proposed action, and several have special status under the ESA.

9B.6.2 Distribution

Central Valley Steelhead are widely distributed throughout their range but are low in abundance, particularly in the San Joaquin River basin, and they continue to decline (NMFS 2003). Microchemical analyses of otoliths taken from *O. mykiss* in the San Joaquin River basin have verified that the anadromous form of this species occurs in low numbers in the San Joaquin River basin (Zimmerman et al. 2009).

9B.6.2.1 Historical Distribution

O. mykiss once occurred throughout the Central Valley, spawning in the upper reaches of tributaries to the Sacramento and San Joaquin rivers. Lindley et al. (2006) conducted geographic information system (GIS) habitat modeling to estimate the amount of suitable habitat to support *O. mykiss* populations in the Central Valley, and their results suggest that steelhead were widely distributed throughout the Sacramento River basin, but relatively less abundant in the San Joaquin River basin due to natural barriers to migration. Yoshiyama et al. (1996) conducted a review of historical sources to document the historical distribution of Chinook Salmon in the Central Valley, which can be used to infer historical distribution of steelhead. The assumption that steelhead distribution in the Sacramento River basin overlapped with, and was likely more extensive than, spring-run Chinook distribution under historical conditions has been supported by studies conducted in the Klamath-Trinity River basin (Bureau of Indian Affairs 1985, Voight and Gale 1998). Yoshiyama et al. (1996) concluded that, because steelhead upstream migration occurs during high flows, their leaping abilities are superior to those of Chinook Salmon, and they have less restrictive spawning gravel criteria. Steelhead in the Sacramento River basin "could have used at least hundreds of miles of smaller tributaries not accessible to the earlier-spawning salmon." The model created by Lindley et al. (2006) estimates that 80 percent of historically accessible habitat for Central Valley Steelhead is now behind impassable dams; this estimate is supported by other research into steelhead and Chinook Salmon habitat loss in the Central Valley (Clark 1929; Yoshiyama et al. 1996, 2001).

9B.6.2.2 Current Distribution

Steelhead distribution in Central Valley drainages has been greatly reduced (McEwan and Jackson 1996). Steelhead are now primarily restricted to a few remaining free-flowing tributaries and to stream reaches below large dams, although a few steelhead may also spawn in intermittent streams during wet years. Naturally spawning steelhead populations have been found in the upper Sacramento River and tributaries below Keswick Dam; Mill, Deer, and Butte creeks; and the Feather, Yuba, American, and Mokelumne rivers (CMARP 1998). However, the records of naturally spawning populations depend on fish monitoring programs. Recent implementation of monitoring programs has found steelhead in additional streams, such as Auburn Ravine, Dry Creek, and the Stanislaus River. It is possible that naturally spawning populations exist in many other streams but are undetected because of the lack of monitoring or research programs. Although impassable dams prevent resident Rainbow Trout from emigrating, populations with steelhead ancestry may still exist above some dams (Reclamation 2008).

In the Sacramento River basin, populations of *O. mykiss* are known to spawn in the upper Sacramento, Yuba, Feather, and American rivers and in Deer, Mill, and Butte creeks. Saeltzer Dam was removed from Clear Creek in 2000, granting easier access to habitats in the higher-elevation canyon reaches. Though improved access may have opened up suitable spawning and rearing habitat for steelhead, it is not clear if steelhead have colonized Clear Creek since removal of the dam. A summary of recent distribution information for steelhead in Sacramento River tributaries in Good et al. (2005) shows that steelhead are widespread in accessible streams, if not abundant.

Research and monitoring on steelhead are limited in comparison with Chinook Salmon, so there is little specific information about the status and trend of the species and how adults and juveniles use habitats in the mainstem river and the Bay-Delta estuary. Though the upper reaches of the Sacramento River support a spawning population of resident Rainbow Trout, the mainstem river habitat used by the species is atypical for steelhead, which usually spawn in higher elevation, steeper, and narrower channels. Management of the species is also complicated by its polymorphism, with individuals being capable of exhibiting either a resident (Rainbow Trout) or an anadromous (steelhead) life history.

9B.6.3 Life History and Habitat Requirements

Steelhead generally exhibit a more flexible life history strategy than Chinook Salmon, and the habitat requirements of juvenile steelhead differ from those of juvenile Chinook Salmon. Unlike Chinook Salmon, steelhead can be iteroparous—that is, they can survive spawning, return to the ocean, and migrate into fresh water to spawn again. Post-spawning adults are known as kelts. In general, there are two types of steelhead: winter steelhead and summer steelhead.

Winter steelhead are of the ocean-maturing reproductive ecotype, becoming sexually mature during their ocean phase and spawning soon after their arrival at the spawning grounds. Adult summer steelhead are of the stream-maturing type, which enter their natal streams and spend several months holding and maturing in fresh water before spawning. Central Valley Steelhead are predominantly winter steelhead, and this section describes the life history and habitat requirements of winter steelhead.

Table 9B.11 illustrates aspects of the life-history timing of Central Valley Steelhead.

1 **Table 9B.11 Life-History Timing of Central Valley Steelhead**

Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept		Oct		Nov		Dec	
Adult Upstream Migration[a]	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Activity	Activity
Spawning in Mainstem Sacramento River Downstream of Keswick Dam[b]	Peak	Peak	Peak	Peak	Peak	Peak	?																?	?
Incubation and Alevin Development[c]	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity																
Fry Emergence[c]			Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity													
Age 0+ Outmigration from Upper Sacramento River[b]	Peak	Peak	Peak	Peak	Peak	Peak	Activity	Activity	Activity	Activity	Activity	Activity									Activity	Activity	Activity	Activity
Age 1+ Outmigration through the Delta[d]	Activity	Activity	Peak	Peak	Peak	Peak	Peak	Peak	Activity	Activity	Activity	Activity									Activity	Activity	Activity	Activity

2 Notes:
3 a. Bailey 1954, Hallock et al. 1961, McEwan 2001
4 b. Reclamation 2004
5 c. Based on timing of spawning
6 d. Based on fish facility salvage data (Reclamation 2004)

Period of activity
Period of peak activity

7

9B.6.3.1 Adult Migration and Spawning

Central Valley Steelhead generally leave the ocean and migrate upstream from August through March (Busby et al. 1996), In the Sacramento River, steelhead migrate upstream nearly every month of the year, with the bulk of migration from August through November and the peak in late September (Bailey 1954, Hallock et al. 1961, McEwan 2001). Spawning in the upper Sacramento River generally occurs from December through April (Newton and Stafford 2011).

The majority of steelhead in the mainstem Sacramento River spawn downstream of Keswick Dam (RM 302), with peak spawning from January through March when water temperatures throughout much of the Sacramento River are suitable to support egg incubation and emergence. The highest-density spawning within the mainstem is likely in the upstream portion of this area near Redding; however, the downstream extent of spawning is likely determined by the location of suitable water temperatures to support summer rearing of 0+ juveniles, which lack the swimming ability to move significant distances upstream to follow the upstream retreat of cold water in summer. Most Sacramento River steelhead are believed to spawn in the tributary streams. The progeny of adults that construct redds downstream of locations with suitable water temperatures in summer likely suffer high rates of mortality and contribute little to the population.

Steelhead migrate and spawn during high flows when observations and sampling are difficult (McEwan 2001). They may have a spawning distribution similar to late fall-run Chinook Salmon in that the juveniles of both species oversummer at least once before outmigration, so redds must be located where summer water temperatures can support summer rearing. The downstream extent of late fall-run Chinook Salmon spawning is generally near Ball’s Ferry Bridge (RM 276) in most years. Steelhead generally have higher thermal tolerances than Chinook Salmon (Moyle 2002), so steelhead spawning may extend slightly farther downstream.

Under historical conditions, steelhead likely spawned in much higher-gradient reaches in the Sacramento River and its tributaries, as do steelhead in other portions of their range. Steelhead are common in reaches with gradients of less than 6 percent (Burnett 2001, Harvey et al. 2002, Hicks and Hall 2003) and occur in some systems in reaches of up to 12 percent and more (Engle 2002). Though steelhead will spawn in mainstem river channels, it is unlikely that they spawned in the reach of the mainstem Sacramento River below Keswick Dam where they currently spawn because summer water temperatures in this reach were likely too high to support oversummering by juveniles.

As with Chinook Salmon, steelhead spawn in areas with suitable gravel and hydraulics. Work by Bovee (1978) found that steelhead prefer water depths of 14 inches (36 cm) for spawning, with a range between 6 and 24 inches (15 and 61 cm), and water velocities of 2 feet/second (61 cm/second), with a range of 1 to 3.6 feet/second (30 to 110 cm/second), which is similar to the hydraulic conditions preferred by Chinook Salmon in the Central Valley. Steelhead generally prefer to spawn in gravels, with optimal grain sizes ranging between

0.6 and 10 cm (6 and 102 mm) (Bjornn and Reiser 1991). For comparison, grain sizes used by spawning Chinook range from a D_{50} of 0.43 inch (10.8 mm) (Platts et al. 1979) to a D_{50} of 3.1 inches (78.0 mm) (Chambers et al. 1954, 1955).

Research in more northerly populations suggests that optimal spawning temperatures range from 39 to 52°F (4 to 11°C), with egg mortality at water temperatures above 56°F (13°C) (Hooper 1973, Bovee 1978, Reiser and Bjornn 1979, Bell 1986). More research is needed to understand the specific temperature tolerances of steelhead in the Central Valley and southern portions of their range. There is evidence that different strains of *O. mykiss* may have different thermal tolerances at the egg and embryo stage (Myrick and Cech 2001).

As stated above, steelhead can survive spawning, return to the ocean, and migrate into fresh water to spawn again. Although some kelts have been documented in the Sacramento River, there are probably few repeat spawners in the Sacramento River population (Reclamation 2004).

9B.6.3.2 Fry and Juvenile Rearing

Fry emergence is influenced by water temperature, but hatching generally requires 4 weeks, with another 4 to 6 weeks in the gravels before emergence. After emerging, steelhead fry typically disperse to shallow (<14 inches [36 cm]), low-velocity near-shore areas such as stream margins and low-gradient riffles and will forage in open areas lacking instream cover (Hartman 1965, Everest et al. 1986, Fontaine 1988). Everest and Chapman (1972) found that juvenile steelhead of all sizes most often chose territories over large-sized substrates. As they increase in size in late summer and fall, they increasingly use areas with cover and show a preference for higher-velocity, deeper mid-channel areas near the thalweg (Hartman 1965, Everest and Chapman 1972, Fontaine 1988). Bovee (1978) reports that fry prefer water depths ranging between 10 inches (25 cm) and 20 inches (51 cm) and water temperatures ranging between 45°F (7°C) and 60°F (16°C). Age 0+ steelhead have been relatively abundant in backwater pools and often live in the downstream ends of pools in late summer (Bisson et al. 1988, Fontaine 1988).

Steelhead fry may establish and defend territories soon after emerging (Shapovalov and Taft 1954). Fry and juvenile steelhead that are unsuccessful in establishing a territory may be displaced downstream where they may suffer higher rates of mortality from predation, entrainment, or elevated water temperatures (Dambacher 1991, Peven et al. 1994, Reedy 1995). Keeley (2001) found that increased competition between juvenile steelhead, caused by higher fish densities or lower food densities, caused increased mortality, lower or more variable growth rates, and emigration of smaller fish. Downstream dispersal due to overcrowding or high flows in rearing habitat does not necessarily increase mortality where there is suitable habitat downstream (Kahler et al. 2001). Downstream dispersal to larger stream reaches for further rearing prior to smolting appears common in many systems (Bjornn 1978, Loch et al. 1985, Leider et al. 1986, Dambacher 1991).

9B.6.3.3 Summer Rearing

Summer habitat can generally be assumed to be more limiting for age 1+ and 2+ juvenile steelhead than for age 0+ in many streams. Older age classes of juvenile steelhead (ages 1+ and 2+) prefer deeper water in summer than fry and show a stronger preference for pool habitats, especially deep pools near the thalweg with ample cover, as well as higher-velocity rapid and cascade habitats (Bisson et al. 1982, 1988; Dambacher 1991). Dambacher (1991) observed that most 1+ steelhead in the Steamboat Creek watershed of the North Umpqua River in Oregon were concentrated in mainstem reaches with relatively deep riffles and large substrates. Age 1+ fish typically feed in pools, especially scour and plunge pools (Fontaine 1988, Bisson et al. 1988). Age 1+ steelhead appear to avoid secondary channel and dammed pools, glides, and low-gradient riffles with mean depths less than 7.8 inches (20 cm) (Fontaine 1988, Bisson et al. 1988, Dambacher 1991). Beecher et al. (1993) reported that juvenile steelhead longer than 3 inches (75 mm) avoided areas less than 6 inches (15 cm) deep. Reedy (1995) indicates that age 1+ steelhead especially prefer high-velocity pool heads, where food resources are abundant, and pool tails, which provide optimal feeding conditions in summer due to lower energy expenditure requirements than the more turbulent pool heads. Fast, deep water, in addition to optimizing feeding versus energy expenditure, provides greater protection from avian and terrestrial predators (Everest and Chapman 1972).

9B.6.3.4 Winter Rearing

For juvenile steelhead to survive winter, they must avoid predation and high flows. The higher-gradient reaches typically used for spawning by steelhead (generally >3 percent) are often confined and characterized by coarse substrate that is immobile at all but the highest flows. Juvenile steelhead often use the interstitial spaces between cobbles and boulders as cover from high water velocity and presumably to avoid predation (Bjornn 1971, Hartman 1965, Bustard and Narver 1975, Swales et al. 1986, Everest et al. 1986, Grunbaum 1996). Age 0+ steelhead can use shallower habitats and can find interstitial cover in gravel-size substrates, while age 1+ or 2+ steelhead, because of their larger size, need coarser cobble/boulder substrate for cover (Bustard and Narver 1975; Bisson et al. 1982, 1988; Fontaine 1988; Dambacher 1991). Bustard and Narver (1975) reported that 1+ steelhead prefer water deeper than 17.5 inches (45 cm) in winter, while age 0+ steelhead often occupy water less than 5.8 inches (15 cm) deep and are rarely found at depths over about 23.4 inches (60 cm). In winter, age 1+ steelhead typically stay within the area of streambed that remains inundated at summer low flows, while age 0+ fish frequently overwinter beyond the summer low flow perimeter along the stream margins (Everest et al. 1986). Consequently, winter rearing habitat for age 1+ and 2+ juvenile steelhead is assumed to be more limiting than for age 0+ juveniles.

9B.6.3.5 Length of Stream Residence

Juvenile steelhead typically rear in fresh water from 1 to 3 years before outmigrating (McEwan and Jackson 1996). The majority of returning adult steelhead in the Central Valley have spent 2 years in fresh water before emigrating to the ocean (McEwan 2001). A scale analysis conducted by Hallock et al. (1961) indicated that 70 percent emigrated after 2 years, 29 percent after 1 year, and 1 percent after 3 years in fresh water. Juvenile emigration from the upper Sacramento River occurs between November and late June, with a peak between early January and late March (Reclamation 2004).

9B.6.3.6 Bay-Delta Residence

The Delta serves as an adult and juvenile migration corridor, connecting inland habitat to the ocean. The Delta may also serve as a nursery area for juvenile steelhead (McEwan and Jackson 1996); however, much is unknown regarding historical and current role of the Delta as steelhead nursery habitat. In coastal populations of winter steelhead, it is common for juvenile steelhead to migrate downstream at age 1+ and rear in the estuary for an additional year before smolting. Based on fish facility salvage data, most steelhead move through the Delta from November through June, with the peak salvage during February, March, and April. The majority of steelhead salvaged range from 175 to 325 mm, with the most common size ranging from 226 to 250 mm. Some of the age 1+ steelhead captured in rotary screw traps at RBDD, GCID, and Knights Landing may continue rearing for another year before entering the ocean. There may be some areas of the Bay-Delta estuary where summer water temperatures are moderated by tidal action so that steelhead 1+ migrants are able to rear throughout summer (Reclamation 2008).

9B.6.4 Population Trends

Construction of large dams in the Central Valley had great impact on *O. mykiss* populations because it eliminated access to nearly 80 percent of historical spawning and rearing habitat (Lindley et al. 2006). Construction of Shasta and Keswick dams eliminated access to many upstream tributaries (e.g., McCloud River, Pit River, and Sacramento River) that provided the cold water temperatures required for year-round rearing by steelhead. Dam construction also landlocked potentially anadromous *O. mykiss* populations in the upper watershed, forcing them to adopt a resident life history strategy (McEwan 2001).

In general, the majority of Central Valley Steelhead are confined to nonhistorical spawning and rearing habitat below impassable dams, but the existing spawning and rearing habitat can sustain steelhead at current population levels. In addition, monitoring data indicate that much of the anadromous form of the species is hatchery supported. Also, a strong resident component to the population (Rainbow Trout) interacts with and produces both resident and anadromous offspring.

In general, steelhead stocks throughout California have declined substantially. McEwan and Jackson (1996) reported that the adult population of steelhead in California was approximately 250,000, less than half the population that existed in the 1960s (McEwan and Jackson 1996). In the Central Valley, approximately 1 to 2 million adult steelhead may have returned annually prior to 1850, as based on historical Chinook Salmon abundance (McEwan 2001, NMFS 2006). In the Sacramento River basin, the average run size of steelhead in the 1950s was estimated to be approximately 20,540 adults (McEwan and Jackson 1996). In contrast, escapement estimates in 1991 and 1992 were less than 10,000 adults, less than half of the run size in the 1950s (McEwan and Jackson 1996). Similarly, counts of wild steelhead at RBDD declined from an average annual run size of 12,900 in the late 1960s to 1,100 adults in the 1993–94 season (McEwan and Jackson 1996). The most recent 5-year average for steelhead spawning upstream of RBDD is less than 2,000 adults (Good et al. 2005). NMFS (2006) notes that escapement estimates have not been made for the area upstream of RBDD since the mid-1990s and that estimates of abundance are derived from extrapolation of incidental catch of outmigrating juvenile steelhead captured as part of the midwater-trawl sampling for juvenile Chinook Salmon at Chipps Island, downstream of the confluence of the Sacramento and San Joaquin rivers.

Populations of naturally spawned Central Valley Steelhead have declined and are composed predominantly of hatchery fish. The California Fish and Wildlife Plan of 1965 estimated the combined annual run size for Central Valley and San Francisco Bay tributaries to be about 40,000 during the 1950s (DFG 1965). The spawning population during the mid-1960s for the Central Valley basin was estimated at about 27,000 (DFG 1965). These numbers likely consisted of both hatchery and wild steelhead. McEwan and Jackson (1996) estimated the annual run size for the Central Valley basin to be less than 10,000 adults by the early 1990s. Much of the abundance data since the mid-1960s were obtained by visual fish counts at the RBDD fish ladders when gates were closed during much of the steelhead migration season. Current abundance estimates are not available for naturally spawned fish since RBDD gate operations were changed, so the extent to which populations have changed following the 1987−94 drought is unknown. NMFS' (2003) status review estimated the Central Valley Steelhead population at less than 3,000 adults.

9B.6.5 Hatchery Influence

Reclamation funds the operation of Coleman Hatchery, Livingston Stone Hatchery, Nimbus Hatchery, and Trinity River Hatchery. DWR funds the operation of the Feather River Hatchery. USFWS operates Coleman and Livingston Stone hatcheries, and DFW operates Feather River, Nimbus, and Trinity hatcheries. These hatcheries are operated to mitigate for the anadromous salmonids that would be produced by the habitat if not for the dams on each respective river. Reclamation and DWR have discretion over how the hatcheries are operated, but generally leave operational decisions on how to meet mitigation goals to the operating agency (Reclamation 2008).

Hatchery production of steelhead is large compared to natural production, based on the Chipps Island trawl data (Good et al. 2005). The bulk of hatchery releases in the Central Valley occurs in the Sacramento River basin. An analysis of steelhead captures from trawl data by Nobriga and Cadrett (2001) indicated that hatchery steelhead composed 63 to 77 percent of the steelhead catch. Steelhead stocks at the Mokelumne River Hatchery and Nimbus Hatchery on the American River are not part of the Central Valley Steelhead DPS because of the source of broodstock used and genetic similarities to Eel River stocks (Good et al. 2005).

Genetic analysis indicated steelhead from the American River (collected from both the Nimbus Hatchery and the American River) are genetically more similar to Eel River steelhead (Northern California ESU) than other Central Valley Steelhead stocks. Eel River steelhead were used to found the Nimbus Hatchery stock. Mokelumne River Rainbow Trout (hatchery produced and naturally spawned) are genetically most similar to Mount Shasta Hatchery trout, but also show genetic similarity to the Northern California ESU (Nielsen 1997). Nielsen et al. (2005) found American River steelhead to be genetically different from other Central Valley stocks.

9B.6.6 References

Bailey, E .D. 1954. *Time pattern of 1953-54 migration of salmon and steelhead into the upper Sacramento River.* Unpublished report. California Department of Fish and Game. As cited in McEwan 2006.

Beecher, H. A., T. H. Johnson, and J. P. Carleton. 1993. Predicting microdistributions of steelhead (*Oncorhynchus mykiss*) parr from depth and velocity preference criteria: test of an assumption of the Instream Flow Incremental Methodology. *Canadian Journal of Fisheries and Aquatic Sciences* 50: 2380–2387.

Bell, M. C., editor. 1986. *Fisheries handbook of engineering requirements and biological criteria.* NTIS AD/A167-877. Fisheries-Engineering Research Program, U.S. Army Corps of Engineers, North Pacific Division. Portland, Oregon.

Bisson, P., J. L. Nielsen, R. A. Palmason, and L. E. Grove. 1982. *A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low streamflows*. Proceedings of the symposium on acquisition and utilization of aquatic habitat inventory information. Edited by N. B. Armantrout, 62–73. American Fisheries Society, Western Division. Bethesda, Maryland.

Bisson, P. A., K. Sullivan, and J. L. Nielsen. 1988. Channel hydraulics, habitat use, and body form of juvenile coho salmon, steelhead trout, and cutthroat trout in streams. *Transactions of the American Fisheries Society* 117: 262–273.

Bjornn, T. C. 1971. Trout and salmon movements in two Idaho streams as related to temperature, food, stream flow, cover, and population density. *Transactions of the American Fisheries Society* 100: 423–438.

_____. 1978. *Survival, production, and yield of trout and Chinook salmon in the Lemhi River, Idaho, Bulletin No. 27*. Prepared by Idaho Cooperative Fishery Research Unit, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, for Idaho Department of Fish and Game.

Bjornn, T. C., and D. W. Reiser. 1991. *Habitat requirements of salmonids in streams*. Influences of forest and rangeland management on salmonid fishes and their habitats. Edited W. R. Meehan, 83-138. American Fisheries Society Special Publication No. 19.

Bovee, K. D. 1978. *Probability-of-use-criteria for the family Salmonidae*. Instream Flow Information Paper 4. FWS/OBS-78/07. U.S. Fish and Wildlife Service.

Bureau of Indian Affairs. 1985. *Klamath River basin fisheries resource plan*. U.S. Department of the Interior. Prepared by CH2M HILL, Redding, California. As cited by Klamath River Basin Fisheries Task Force *Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program*, Jnauary 1991.

Burnett, K. M. 2001. *Relationships among juvenile anadromous salmonids, their freshwater habitat, and landscape characteristics over multiple years and spatial scales in the Elk River, Oregon.* Doctoral dissertation. Oregon State University, Corvallis.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status Review of West Coast steelhead from Washington, Idaho, Oregon and California. U.S. Department of Commerce. NOAA Technical Memo. NMFS-NWFSC-27.

Bustard, D. R., and D. W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). *Journal of the Fisheries Research Board of Canada* 32: 667–680.

Chambers, J. S., G. H. Allen, and R. T. Pressey. 1955. *Research relating to study of spawning grounds in natural areas*. Annual report, Contract DA 35026. Washington Department of Fisheries, Olympia.

Clark, G. H. 1929. Sacramento River salmon fishery. *California Fish and Game* 15: 1-11.

CMARP (Comprehensive Monitoring, Assessment and Research Program for the CALFED Bay-Delta Program). 1999. *Monitoring, assessment, and research on Central Valley steelhead: status of knowledge, review of existing programs, and assessment of needs.* Draft Report.

Cramer, S. P., D. W. Alley, J. E. Baldrige, K. Barnard, D. B. Demko, D. H. Dettman, B. Farrell, J. Hagar, T. P. Keegan, A. Laird, W. T. Mitchell, R. C. Nuzum, R. Orton, J. J. Smith, T. L. Taylor, P. A. Unger, and E. S. Van Dyke. 1995. *The status of steelhead populations in California in regards to the Endangered Species Act*. Special report. Submitted to National Marine Fisheries Service on behalf of Association of California Water Agencies, S.P. Cramer & Associates, Gresham, Oregon.

Dambacher, J. M. 1991. *Distribution, abundance, and emigration of juvenile steelhead (Oncorhynchus mykiss), and analysis of stream habitat in the Steamboat Creek basin, Oregon.* Master's thesis. Oregon State University, Corvallis.

DFG (California Department of Fish and Game). 1965. *California fish and wildlife plan*. California Department of Fish and Game, Sacramento.

Engle, R. O. 2002. *Distribution and summer survival of juvenile steelhead trout (*Oncorhynchus mykiss*) in two streams within King Range National Conservation Area, California.* Master's thesis, Humboldt State University, Arcata, California.

Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. *Journal of the Fisheries Research Board of Canada* 29: 91–100.

Everest, F. H., G. H. Reeves, J. R. Sedell, J. Wolfe, D. Hohler, and D. A. Heller. 1986. *Abundance, behavior, and habitat utilization by coho salmon and steelhead trout in Fish Creek, Oregon, as influenced by habitat enhancement.* Annual report, 1985 Project No. 84-11. Prepared by U.S. Forest Service for Bonneville Power Administration, Portland, Oregon.

Fontaine, B. L. 1988. *An evaluation of the effectiveness of instream structures for steelhead trout rearing habitat in the Steamboat Creek basin. Master's thesis.* Oregon State University, Corvallis.

Good, T. P., R. S. Waples, and P. Adams. 2005. *Updated status of federally listed ESUs of west coast salmon and steelhead*. NOAA Technical Memorandum NMFSNWFSC-66. National Marine Fisheries Service, Seattle, Washington.

Grunbaum, J. B. 1996. *Geographical and seasonal variation in diel habitat use by juvenile (age 1+) steelhead trout (*Oncorhynchus mykiss*) in Oregon coastal and inland streams.* Master's thesis. Oregon State University, Corvallis.

Hallock, R. J., W. F. Van Woert, and L. Shapovalov. 1961. An evaluation of stocking hatchery-reared steelhead rainbow trout (*Salmo gairdnerii gairdnerii*) in the Sacramento River system. California Department of Fish and Game. *Fish Bulletin* 114.

Hartman, G. F. 1965. The role of behavior in the ecology and interaction of underyearling coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri). Journal of the Fisheries Research Board of Canada* 22: 1035–1081.

Harvey, B. C., J. L. White, and R. J. Nakamoto. 2002. Habitat relationships and larval drift of native and nonindigenous fishes in neighboring tributaries of a coastal California river. *Transactions of the American Fisheries Society* 131:159–170.

Hicks, B. J., and J. D. Hall. 2003. Rock type and channel gradient structure salmonid populations in the Oregon Coast Range. *Transactions of the American Fisheries Society* 132: 468–482.

Hooper, D. R. 1973. *Evaluation of the effects of flows on trout stream ecology.* Pacific Gas and Electric Company, Emeryville, California.

Kahler, T. H., P. Roni, and T. P. Quinn. 2001. Summer movement and growth of juvenile anadromous salmonids in small western Washington streams. *Canadian Journal of Fisheries and Aquatic Sciences* 58: 1947-2637.

Keeley, E. R. 2001. Demographic responses to food and space competition by juvenile steelhead trout. *Ecology* 82: 1247-1259.

Leider, S. A., M. W. Chilcote, and J. J. Loch. 1986. Comparative life history characteristics of hatchery and wild steelhead trout (*Salmo gairdneri*) of summer and winter races in the Kalama River, Washington. *Canadian Journal of Fisheries and Aquatic Sciences* 43: 1398–1409.

Lindley, S. T., R. S. Schick, A. Agrawal, M. Goslin, T. E. Pearson, E. Mora, J. J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2006. Historical population structure of Central Valley steelhead and its alteration by dams. *S an Francisco Estuary and Watershed Science* 4: 1-19.

Loch, J. J., M. W. Chilcote, and S. A. Leider. 1985. *Kalama River studies final report: Part II. Juvenile downstream migrant studies*. Washington Department of Game, Fisheries Management Division, Olympia.

McEwan, D. 2001. *Central Valley steelhead*. Contributions to the biology of Central Valley salmonids. Edited by R. L. Brown, 1-44. *Fish Bulletin* 179. California Department of Fish and Game, Sacramento.

McEwan, D., and T. A. Jackson. 1996. *Steelhead restoration and management plan for California*. California Department of Fish and Game, Inland Fisheries Division, Sacramento.

Moyle, P .B. 2002. *Inland fishes of California*. Revised edition. University of California Press, Berkeley.

Myrick, C. A., and J. J. Cech, Jr. 2001. *Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations.* Technical Publication 01-1. Bay-Delta Modeling Forum.

Newton, J. M. and L. A. Stafford. 2011. Monitoring Adult Chinook Salmon, Rainbow Trout, and Steelhead in Battle Creek, California, from March through November 2009. Red Bluff, CA: U.S. Fish and Wildlife Service.

Nielsen, J. L. 1997. *Genetic variation in Mokelumne River trout (Oncorhynchus mykiss) using mitochondrial DNA and ten nuclear microsatellite loci.* Revised technical report. Prepared for East Bay Municipal Utility District, Oakland, California.

Nielsen, J. L., S. Paver, T. Wiacek, and I. Williams. 2005. *Genetics of Central Valley O. mykiss populations: drainage and watershed scale analyses*. San Francisco Estuary and Watershed Science. As cited by West Coast Steelhead Biological Review Team *Status Review Update for Deferred and Candidate ESU's of West Coast Steelhead*, December 19, 1997.

NMFS (National Marine Fisheries Service). 1998. Endangered and threatened species; threatened status for two ESUs of steelhead in Washington, Oregon, and California. *Federal Register* 63: 13347−13371.

_____. 2003. *Updated status of federally listed ESUs of West Coast salmon and steelhead*. National Marine Fisheries Service. Northwest and Southwest Fisheries Science Centers.

_____. 2006. Endangered and threatened species; final listing determinations for 10 Distinct Population Segments of West Coast steelhead. *Federal Register* 71: 834-862.

Nobriga, M. L. and P. Cadrett. 2001. Differences among hatchery and wild steelhead: evidence from delta fish monitoring programs. *Interagency Ecological Program Newsletter* 30-38.

Peven, C. M., R. R. Whitney, and K .R. Williams. 1994. Age and length of steelhead smolts from the mid-Columbia River basin, Washington. *North American Journal of Fisheries Management* 14: 77–86.

Platts, W. S., M. A. Shirazi, and D. H. Lewis. 1979. *Sediment particle sizes used by salmon for spawning with methods for evaluation*. Ecological Research Series EPA-600/3-79-043. U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, Corvallis, Oregon.

Reclamation (Bureau of Reclamation). 2004. *Long-term Central Valley Project and State Water Project operations criteria and plan.* Biological Assessment. Bureau of Reclamation, Sacramento, California.

_____. 2008. *Biological assessment on the continued long-term operations of the Central Valley Project and the State Water Project.* Bureau of Reclamation, Sacramento, California.

Reedy, G. D. 1995. *Summer abundance and distribution of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*) in the Middle Fork Smith River, California.* Master's thesis. Humboldt State University, Arcata, California.

Reiser, D. W., and T. C. Bjornn. 1979. *Habitat requirements of anadromous salmonids*. Influence of forest and rangeland management on anadromous fish habitat in western North America. Edited byW. R. Meehan, 1-54. General Technical Report PNW-96. U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station. Portland, Oregon.

Shapovalov, L., and A. C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. California Department of Fish and Game. *Fish Bulletin* 98.

Swales, S., R. B. Lauzier, and C. D. Levings. 1986. Winter habitat preferences of juvenile salmonids in two interior rivers in British Columbia. *Canadian Journal of Zoology* 64: 1506–1514.

Voight, H. N., and D. B. Gale. 1998. *Distribution of fish species in tributaries of the lower Klamath River: an interim report, FY 1996*. Technical report, No. 3. Yurok Tribal Fisheries Program, Habitat Assessment and Biological Monitoring Division.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 1996. Historical and present distribution of Chinook salmon in the Central Valley drainage of California, Sierra Nevada Ecosystem Project. Final report to congress. Volume III: assessments, commissioned reports, and background information, 309–362. University of California, Center for Water and Wildland Resources, Davis.

_____. 2001. Historical and present distribution of Chinook salmon in the Central Valley drainage of California. Contributions to the biology of Central Valley salmonids. Edited by R. L. Brown, 71-176. *Fish Bulletin* 179. California Department of Fish and Game, Sacramento.

Zimmerman, C. E., G. W. Edwards, and K. Perry. 2009. Maternal origin and migratory history of steelhead and rainbow trout captured in rivers of the Central Valley, California. *Transactions of the American Fisheries Society* 138: 280-291.

9B.7 Klamath Mountains Province Steelhead (*Oncorhynchus mykiss*)

9B.7.1 Legal Status

Federal: Not warranted
State: Species of Special Concern

A status review in 2001 (NMFS 2001) concluded that the Klamath Mountains Province Steelhead DPS was not in danger of extinction or likely to become so in the foreseeable future; therefore, it was not warranted for listing as threatened or endangered. This conclusion was based on population estimates and a finding that the genetic risk from naturally spawning hatchery fish was lower than estimated in previous reviews, as well as consideration of ongoing and proposed conservation efforts for anadromous salmonids in the basin (NMFS 2001).

The Klamath Mountains Province Steelhead DPS contains both summer and winter runs. Moyle (2002) describes steelhead in the Klamath Basin as having a summer run and a winter run. Some divide the winter run into fall and winter runs (Barnhart 1994, Hopelain 1998, USFWS 1998, Papa et al. 2007). In this section, winter steelhead refers to steelhead returning from fall through winter, except in cases when the distinction is pertinent to the discussion. The following summary focuses on steelhead in the Trinity River, which is within the area potentially affected by the proposed action, and on the mainstem Klamath in terms of potential effects on its role as a migration corridor for the steelhead runs.

9B.7.2 Distribution

Based on escapement data, approximately 55 percent of the summer run spawn in the Trinity River and other lower-elevation tributaries to the Klamath River. The Trinity, Scott, Shasta, and Salmon rivers are important spawning streams for the winter run.

Historically, steelhead probably ascended Clear Creek past the French Gulch area, but access to the upper basin was blocked by Whiskeytown Dam in 1964 (Yoshiyama et al. 1996). Operation of Whiskeytown Dam can produce suitable cold-water habitat downstream to Placer Road Bridge depending on flow releases (DFG 1998). McCormick-Saeltzer Dam, which limited steelhead migrations through ineffective fish ladders, was removed in 2000, allowing steelhead potential access to good habitat up to Whiskeytown Dam. USFWS has conducted snorkel surveys targeting spring-run Chinook (May through September) since 1999. Steelhead/rainbow are enumerated and separated into small, medium, and large (>22 inches) during these surveys, but because the majority of the steelhead run is unsurveyed, no spawner abundance estimates have been attempted (Reclamation 2008). Redd counts conducted during the 2001-02 run found that most spawning occurred upstream, near Whiskeytown Dam. Because of the large resident rainbow population, no steelhead population estimate could be made (Reclamation 2008). A remnant “landlocked” population of Rainbow Trout with steelhead ancestry may exist in Clear Creek above Whiskeytown Dam (Reclamation 2008).

9B.7.3 Life History and Habitat Requirements

General habitat requirements for steelhead are described in the Central Valley Steelhead profile; the following describes life history strategies and habitat requirements unique to steelhead of the Upper Klamath Mountains Province DPS or of primary importance to its life history. Both winter and summer runs of steelhead are included in the DPS. Winter steelhead become sexually mature during their ocean phase and spawn soon after arriving at their spawning grounds. Adult summer steelhead enter their natal streams and spend several months holding and maturing in fresh water before spawning. Throughout the entire year, at least one of the diverse life stages can be found present in the river (Israel 2003). As with the Central Valley DPS, this DPS is composed predominantly of winter steelhead.

9B.7.3.1 Winter Run

Winter steelhead adults generally enter the Klamath River from July through October (fall run) and from November through March (winter run) (USFWS 1998). Winter steelhead primarily spawn in tributaries from January through April (USFWS 1998), with peak spawn timing in February and March (ranging from January to April) (NRC 2004). Adults may repeat spawning in subsequent years after returning to the ocean. Half-pounders typically use the mainstem Klamath River until leaving the following March (NRC 2004), although they also use larger tributaries such as the Trinity River (Dean 1994, 1995).

Fry emerge in spring (NRC 2004), with fry observed in outmigrant traps in Bogus Creek and Shasta River from March through mid-June (Dean 1994). Age-0+ and 1+ juveniles have been captured in outmigrant traps in spring and summer in tributaries to the Klamath River above Seiad Creek (DFG 1990a, 1990b). These fish are likely rearing in the mainstem or non-natal tributaries before leaving as age-2+ outmigrants.

Juvenile outmigration primarily occurs between May and September with peaks between April and June, although smolts are captured in the estuary as early as March and as late as October (Wallace 2004). Most adult returns (86 percent) originate from fish that smolt at age 2+, in comparison with only 10 percent for age-1 juveniles and 4 percent for age 3+ juveniles (Hopelain 1998).

Similar limiting factors listed for summer steelhead also affect winter steelhead populations, including degraded habitats, decreased habitat access, fish passage, predation, and competition (for more species information see USFWS 1998, NRC 2004, and Wallace 2004).

9B.7.3.2 Summer Run

Summer steelhead adults enter and migrate up the Klamath River from March through June while sexually immature (Hopelain 1998), then hold in cooler tributary habitat until spawning begins in December (USFWS 1998).

Juvenile summer steelhead in the Klamath Basin may rear in fresh water for up to 3 years before outmigrating. Although many juveniles migrate downstream at age 1+ (Scheiff et al. 2001), those that outmigrate to the ocean at age 2+ appear to have the highest survival (Hopelain 1998). Juveniles outmigrating from tributaries at age 0+ and age 1+ may rear in the mainstem or in non-natal tributaries (particularly during periods of poor water quality) for 1 or more years before reaching an appropriate size for smolting. Age-0 juvenile steelhead have been observed migrating upstream into tributaries, off-channel ponds, and other winter refuge habitat in the lower Klamath River. Juvenile outmigration can occur from spring through fall. Smolts are captured in the mainstem and estuary throughout fall and winter (Wallace 2004), but peak smolt outmigration normally occurs from April through June, based on estuary captures (Wallace 2004). Temperatures in the mainstem are generally suitable for juvenile steelhead, except during summer, especially upstream of Seiad Valley.

9B.7.4 Population Trends

Long-term data are not available to evaluate Klamath River steelhead population trends. DFG (1965) estimated a basinwide annual run size of 283,000 adult steelhead (spawning escapement + harvest). Busby et al. (1994) reported winter steelhead runs in the basin to be 222,000 during the 1960s. Steelhead spawning surveys on tributaries to the mainstem Trinity River were conducted in 1964, 1971, 1972, and 1974 to monitor the effect of Lewiston Dam on steelhead populations. Hopelain (2001) used creel and gill net harvest data to estimate the winter-run steelhead population at 10,000 to 30,000 adults annually in the early 1980s. Spawning surveys were also conducted in South Fork Trinity River tributaries from 1989 to 1995 under DFW's Trinity River Project (Garrison 2000).

Population estimates of summer steelhead showed a steep decline during the 1990s (Reclamation 2008), but Koch (2001) reported increasing runs on the Klamath and Trinity rivers following the late 1990s.

9B.7.5 Hatchery Influence

Reclamation funds the operation of Coleman Hatchery, Livingston Stone Hatchery, Nimbus Hatchery, and Trinity River Hatchery. DWR funds the operation of the Feather River Hatchery. USFWS operates Coleman and Livingston Stone hatcheries, and DFW operates Feather River, Nimbus, and Trinity hatcheries. These hatcheries are operated to mitigate for the anadromous salmonids that would be produced by the habitat if not for the dams on each respective river. Reclamation and DWR have discretion over how the hatcheries are operated, but generally leave operational decisions on how to meet mitigation goals to the operating agency (Reclamation 2008).

NMFS (2001) reported that the Trinity River population is thought to contain a large percentage of hatchery origin spawners of mostly fall-run fish (20-70 percent).

9B.7.6 References

Barnhart, R. A. 1994. *Salmon and steelhead populations of the Klamath-Trinity Basin, California*. Klamath Basin fisheries symposium. Edited by T. J. Hassler, 73-97. California Cooperative Fishery Research Unit, Humboldt State University, Arcata. As cited by National Marine Fisheries Service *Biological Opinion for Klamath Project Operations*, May 31, 2002.

Busby P. J., T. C. Wainwright, and R. S. Waples. 1994. *Status review for Klamath Mountains Province steelhead.* NOAA Technical Memorandum NMFS-NWFSC-19. National Marine Fisheries Service, Seattle, Washington.

Dean, M. 1994. *Life history, distribution, run size, and harvest of spring-run Chinook salmon in the south fork Trinity River Basin.* Chapter VII - job VII in Trinity River Basin monitoring project 1991-1992.

_____. 1995. *Life history, distribution, run size, and harvest of spring-run Chinook salmon in the south fork Trinity River Basin*. Chapter VII - job VII in Trinity River Basin monitoring project 1992-1993.

DFG (California Department of Fish and Game). 1965. C*alifornia fish and wildlife plan*. California Department of Fish and Game, Sacramento. As cited by U.S. Fish and Wildlife Service *Klamath River (Iron Gate Dam to Seiad Creek) Life Stage Periodicities for Chinook, Coho, and Steelhead*, July 1997.

_____. 1990a. *Juvenile salmonid sampling within the Klamath-Trinity Basin, 1984*. Draft report. Inland Fisheries Division, Arcata, California. As cited by U.S. Fish and Wildlife Service *Klamath River (Iron Gate Dam to Seiad Creek) Life Stage Periodicities for Chinook, Coho, and Steelhead*, July 1997.

_____. 1990b. *Distribution, abundance, fork length and coded-wire tag recovery data for juvenile anadromous salmonids within the Klamath-Trinity Basin, 1985*. Draft report. Inland Fisheries Division, Arcata, California.

_____. 1998. *Strategic plan for management of Klamath Mountains Province steelhead trout*. Prepared for the National Marine Fisheries Service by the Resources Agency.

Garrison, P. 2000. *Study 2d1 – Steelhead spawner surveys in Trinity River tributaries*. California Department of Fish and Game [?], Steelhead Research and Monitoring Program, Weaverville Remote Office.

Hopelain J. S. 1998. *Age, growth, and life history of Klamath River basin steelhead trout (*Oncorhynchus mykiss irideus*) as determined from scale analysis.* Inland Fisheries Administration Report 98-3. California Department of Fish and Game, Sacramento.

_____. 2001. *Lower Klamath River angler creel census with emphasis on upstream migrating fall Chinook salmon, coho salmon, and steelhead trout during July through October, 1983 through 1987.* Inland Fisheries Administrative Report 01-1. California Department of Fish and Game, Sacramento.

Israel, J. 2003. *Life history, ecology, and status of Klamath River steelhead.* Report to University of California, Davis, Center for Watershed Sciences.

Koch, D. B. 2001. Letter from CDFG to J. Blum, National Marine Fisheries Service, 16 February.

Moyle P. B. 2002. *Inland fishes of California (second edition)*. University of California Press, Berkeley.

NMFS (National Marine Fisheries Service). 2001. Endangered and threatened species: final listing determination for Klamath Mountains Province steelhead. Federal Register 66:17845-17856.

NRC (National Research Council). 2004. *Endangered and threatened fishes in the Klamath River basin: causes of decline and strategies for recovery*. The National Academies Press, Washington, D.C. Available at: http://www.nap.edu/openbook.php?isbn=0309090970.

Papa R., J. A. Israel, F. Nonnis Marzano, and B. May. 2007. Assessment of genetic variation between reproductive ecotypes of Klamath River steelhead reveals differentiation associated with different run-timings. *Journal of Applied Ichthyology* 23: 142-146.

Reclamation (Bureau of Reclamation). 2008. *Biological assessment on the continued long-term operations of the Central Valley Project and the State Water Project.* U.S. Bureau of Reclamation, Sacramento, California.

Scheiff A. J., J. S. Lang, and W. D. Pinnix. 2001. *Juvenile salmonid monitoring on the mainstem Klamath River at Big Bar and mainstem Trinity River at Willow Creek 1997-2000.* Annual report of the Klamath River Fisheries Assessment Program. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, California. Juvenile salmonid monitoring annual report 2001

USFWS (U.S. Fish and Wildlife Service). 1997. *Klamath River (Iron Gate Dam to Seiad Creek) life state periodicities for Chinook, coho, and steelhead*. Prepared by USFWS, Coastal California Fish and Wildlife Office, Arcata.

Wallace, M. 2004. *Natural vs. hatchery proportions of juvenile salmonids migrating through the Klamath River estuary and monitor natural and hatchery juvenile salmonid emigration from the Klamath River Basin. July 1, 1998 through June 30, 2003.* Final performance report. Federal Aid in Sport Fish Restoration Act. Project no. F-51-R-6. Arcata, California.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 1996. *Historical and present distribution of Chinook salmon in the Central Valley drainage of California*. Volume III: assessments, commissioned reports, and background information. Sierra Nevada Ecosystem Project: final report to Congress, 309-361. University of California, Centers for Water and Wildlife Resources, Davis.

9B.8 Southern Oregon/Northern California Coast Coho Salmon ESU (*Oncorhynchus kisutch*)

9B.8.1 Legal Status

Federal: Threatened
State: Threatened

Coho Salmon (*Oncorhynchus kisutch*) in the Trinity River are in the Southern Oregon/Northern California Coast Coho Salmon ESU and were listed as threatened under the ESA in 1997 (NMFS 1997) and threatened under the California Endangered Species Act in 2002. This ESU includes naturally spawning populations between Punta Gorda, California, and Cape Blanco, Oregon, which encompasses the Trinity and Klamath basins (NMFS 1997). Three artificial propagation programs are considered to be part of the ESU: the Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery Coho Salmon programs. NMFS has determined that these artificially propagated stocks are no more than moderately diverged from the local natural populations. In addition, Coho Salmon in the Klamath Basin have been listed by the California Fish and Game Commission as threatened under the California Endangered Species Act (DFG 2002).

9B.8.2 Life History and Habitat Requirements

Coho Salmon exhibit a 3-year life cycle in the Trinity River and depend on freshwater habitat conditions year-round because they spend a full year residing in fresh water. Most Coho Salmon enter rivers between August and January, with some more northerly populations entering as early as June. Coho Salmon river entry timing is influenced by such factors as genetics, stage of maturity, river discharge, and access past the river mouth. Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools with suitable water depth, velocity, and substrate size. Spawning in the Trinity River occurs mostly in November and December. Coho eggs incubate from 35 to more than 100 days depending on water temperature and emerge from the gravel 2 to 7 weeks after hatching. Coho eggs hatch after an accumulation of 400 to 500 temperature units measured in degrees Celsius and emerge from the gravel after 700 to 800 temperature units. After emergence, fry move into areas out of the main current. As Coho grow, they spread out from the areas where they were spawned. During summer, juvenile Coho prefer pools and riffles with adequate cover such as large woody debris with smaller branches, undercut banks, and overhanging vegetation and roots.

Juvenile Coho Salmon overwinter in large mainstem pools, beaver ponds, backwater areas, and off-channel pools with cover such as woody debris and undercut banks. Most juvenile Coho Salmon spend a year in fresh water, with northerly populations spending 2 full years in fresh water. Coho in the Trinity River are thought be exclusively 3-year-life-cycle fish (1 year in fresh water). Because juvenile Coho remain in their spawning stream for a full year after emerging from the gravel, they are exposed to the full range of freshwater conditions. Most smolts migrate to the ocean between March and June, with most leaving in April and May. Coho Salmon typically spend about 16 to 18 months in the ocean before returning to their natal streams to spawn as 3- or 4-year-olds, age 1.2 or 2.2. Trinity River Coho are mostly 3-year-olds. Some precocious males, called jacks, return to spawn after only 6 months in the ocean.

Juvenile Coho Salmon in the Trinity River spend up to a full year in fresh water before migrating to the ocean. Their habitat preferences change throughout the year and are highly influenced by water temperature. During summer, when Coho are most actively feeding and growing, they spend more time closer to main channel habitats. Coho use slower water than steelhead or Chinook Salmon. Coho juveniles are more oriented to submerged objects, such as woody debris, while Chinook and steelhead select habitats in summer based largely on water movement and velocities, although the species are often intermixed in the same habitat. Juvenile Coho use the same habitats as pikeminnows, a possible reason that Coho are not present in Central Valley watersheds. Juvenile Coho would be vulnerable to predation from larger pikeminnows during warm-water periods. Pikeminnow do not occur in Southern Oregon/Northern California Coast coho streams. When the water cools in fall, juvenile Coho move farther into backwater areas or into off-channel areas and beaver ponds if available. There is often no water velocity in the areas inhabited by Coho during winter. These same off-channel habitats are often dry or unsuitable during summer because temperatures get too high.

Lewiston Dam blocks access to 109 miles of upstream habitat. Trinity River Hatchery produces Coho Salmon with a production goal of 500,000 yearlings to mitigate for the upstream habitat loss. Habitat in the Trinity River has changed since flow regulation with the encroachment of riparian vegetation restricting channel movement and limiting fry rearing habitat (Trush et al. 2000). According to the Trinity River Restoration Plan, higher peak flows are needed to restore attributes of a more alluvial river such as alternate bar features and more off-channel habitats. These are projected in the restoration plan to provide better rearing habitat for Coho Salmon than the dense riparian vegetation currently present. A number of restoration actions have been completed. A new flow schedule has provided higher spring releases to geomorphically maintain habitat. Physical habitat manipulations have been implemented providing better juvenile rearing in selected sites along the river.

9B.8.3 Population Trends

Coho Salmon were not likely the dominant species of salmon in the Trinity River before dam construction. However, Coho were widespread in the Trinity Basin ranging as far upstream as Stuarts Fork above Trinity Dam. Wild Coho in the Trinity Basin today are not abundant, and the majority of the fish returning to the river are of hatchery origin. An estimated 2 percent (200 fish) of the total Coho Salmon run in the Trinity River were composed of naturally produced Coho from 1991 through 1995 at a point in the river near Willow Creek (USFWS 1998). This, in part, prompted the threatened status listing in 1997. These estimates included a combination of hatchery produced and wild Coho. About 10 percent of the Coho were naturally produced since 1995.

9B.8.4 Hatchery Influences

The Trinity River portion of the Southern Oregon/Northern California Coast Coho Salmon ESU is predominately of hatchery origin. Termination of hatchery production of Coho Salmon at the Mad River and Rowdy Creek facilities has eliminated further potential adverse risks associated with hatchery releases from these facilities. Likewise, restrictions on recreational and commercial harvest of Coho Salmon since 1994 likely have had a positive impact on Coho Salmon adult returns.

9B.8.5 References

DFG (California Department of Fish and Game). 2002. *Status review of California coho salmon north of San Francisco.* Candidate Species Status Review Report 2002-3. Report to the California Fish and Game Commission.

NMFS (National Marine Fisheries Service). 1997. Endangered and threatened species: threatened status for southern Oregon/northern California coast evolutionarily significant unit (ESU) of coho salmon. *Federal Register* 62: 24588-24609.

Trush, W. J., S. M. McBain, and L. B. Leopold. 2000. Attributes of an alluvial river and their relation to water policy and management. *PNAS* 97: 11858-11863.

USFWS (U.S. Fish and Wildlife Service). 1997. *Klamath River (Iron Gate Dam to Seiad Creek) life history periodicities for Chinook, coho and steelhead*. U.S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office, Arcata, California.

9B.9 Sacramento Splittail (*Pogonichthys macrolepidotus*)

9B.9.1 Legal Status

Federal: None
State: Species of Special Concern

USFWS listed Sacramento Splittail as a threatened species on March 10, 1999, because of the reduction in its historical range and because of the large population decline during the 1987-93 drought (USFWS 1996, 1999). On June 23, 2000, the Federal Eastern District Court of California found the final rule to be unlawful and on September 22, 2000, remanded the determination back to USFWS for a reevaluation of the final decision. After a thorough review, USFWS removed the Sacramento Splittail from the list of threatened species (USFWS 2003) and reaffirmed this decision in 2010 (USFWS 2010).

9B.9.2 Distribution

Sacramento Splittail are endemic to the Sacramento and San Joaquin River systems of California, including the Delta and the San Francisco Bay. Historically, splittail were found in the Sacramento River as far upstream as Redding, in the Feather River to Oroville, and in the American River upstream to Folsom. In the San Joaquin River, they were once documented as far upstream as Friant (Rutter 1908). Splittail are thought to have originally ranged throughout the San Francisco estuary, with catches reported by Snyder (1905) from southern San Francisco Bay and at the mouth of Coyote Creek.

In wet years, Sacramento Splittail have been found in the San Joaquin River as far upstream as Salt Slough (Saiki 1984, Baxter 1999, Brown and Moyle 1993, Baxter 2000) and in the Tuolumne River as far upstream as Modesto (Moyle 2002), where the presence of both adults and juveniles during wet years in the 1980s and 1990s indicated successful spawning.

When spawning, splittail can be found in the lower reaches of rivers and flooded areas. Otherwise they are primarily confined to the Delta, Suisun Bay, Suisun Marsh, the lower Napa River, the lower Petaluma River, and other parts of the San Francisco estuary (Meng et al. 1994, Meng and Moyle 1995). In general, splittail are most abundant in Suisun Marsh, especially in drier years (Meng and Moyle 1995), and reportedly rare in southern San Francisco Bay (Leidy 1984). Splittail abundance appears to be highest in the northern and western Delta when population levels are low, and they are more evenly distributed throughout the Delta during successful year classes (Sommer et al. 1997, Moyle 2002).

Splittail are largely absent from the upper river reaches where they formerly occurred, residing primarily in the lower parts of the Sacramento and San Joaquin rivers and tributaries and in Central Valley lakes and sloughs (Moyle 2002, Moyle et al. 2004). In wet years, however, they have been known to ascend the Sacramento River as far as RBDD and into the lower Feather and American rivers (Baxter et al. 1996; Sommer et al. 1997; Baxter 1999, 2000). The Sutter and Yolo bypasses along the lower Sacramento River appear to be important splittail spawning areas (Sommer et al. 1997). Splittail now migrate into the San Joaquin River only during wet years, and use of the Sacramento River and its tributaries is likely more important (Moyle 2002).

9B.9.3 Life History and Habitat Requirements

9B.9.3.1 Non-Breeding

Non-reproductive adult splittail are most abundant in moderately shallow, brackish areas, but can also be found in freshwater areas with tidal or riverine flow (Moyle et al. 2004). Non-breeding splittail are found in temperatures ranging from 5 to 24°C, depending on the season, and acclimated fish can survive temperatures up to 33°C for short periods (Young and Cech 1996). Juveniles and adult splittail demonstrate optimal growth at 20ºC and signs of physiological distress only above 29ºC (Young and Cech 1995).

Because splittail are adapted for living in brackish waters with fluctuating conditions, they are tolerant of high salinities and low dissolved oxygen (DO) levels. Splittail are often found in salinities of 10 to 18 parts per thousand (ppt), although lower salinities may be preferred (Meng and Moyle 1995) and can survive low DO levels (0. 6 to 1.2 milligrams per liter for young-of-the-year, juveniles, and subadults) (Young and Cech 1995, 1996). Because splittail have a high tolerance for variable environmental conditions (Young and Cech 1996) and are generally opportunistic feeders (prey includes mysid shrimp, clams, copepods, amphipods, and terrestrial invertebrates), reduced prey abundance will not likely have major population-level impacts. Year class success appears dependent on access and availability of floodplain spawning and rearing habitats, high outflow, and wet years (Sommer et al. 1997).

9B.9.3.2 Spawning

Adults typically migrate upstream from brackish areas in January and February and spawn in fresh water on inundated floodplains in March and April (Moyle et al. 2004). Foraging in flooded areas along the main rivers, bypasses, and tidal freshwater marsh areas of Montezuma and Suisun sloughs and San Pablo Bay before the onset of spawning may contribute to spawning success and survival of adults after spawning (Moyle et al. 2004). Splittail are adapted to the wet-dry climatic cycles of Northern California and thus concentrate their reproductive effort in wet years when potential success is enhanced by the availability of inundated floodplain (Meng and Moyle 1995, Sommer et al. 1997). Splittail are thought to be fractional spawners, with individuals spawning over a protracted period—often as long as several months (Wang 1995). Older fish are believed to begin spawning first (Caywood 1974).

Splittail eggs are deposited in flooded areas among submerged vegetation, to which they adhere until hatching. Rising flows appear to be the major trigger for splittail spawning, but increases in water temperature and day length may also be factors (Moyle et al. 2004). Spawning typically occurs on inundated floodplains from February through June, with peak spawning in March and April. Information indicates that splittail spawn in open areas with moving, turbid water less than 5 feet (1.5 m) deep, among dense annual vegetation and where water temperatures are below 15°C (Moyle et al. 2004). Perhaps the most important spawning habitat in the eastern Delta is the Cosumnes River floodplain, where ripe splittail have been observed in flooded fields with cool temperatures below 15°C, turbid water, and submerged terrestrial vegetation (Crain et al. 2004).

Females are typically highly fecund, with the largest individuals potentially producing 100,000 or more eggs (Daniels and Moyle 1983, Feyrer and Baxter 1998). Fecundity has been found to be variable, however, and may be influenced by food supplies in the year before spawning (Moyle et al. 2004). The adhesive eggs are released by the female, fertilized by one or more attendant males, and adhere to vegetation until hatching (Moyle 2002). Splittail eggs, which are 0.4 to 0.6 inch (1.0 to 1.6 mm) in diameter (Wang 1986, Feyrer and Baxter 1998), begin to hatch within 3 to 7 days, depending on temperature (Bailey 1994). Eggs laid in clumps hatch more quickly than individual eggs (Moyle et al. 2004). Within 5 to 7 days after hatching, swim bladder inflation occurs, and larvae begin active swimming and feeding (Moyle 2002). Little is known regarding the tolerance of splittail eggs and developing larvae to DO, temperature, pH, or other water quality parameters, or to other factors such as physical disturbance or desiccation.

9B.9.3.3 Larvae

Juveniles are strong swimmers and are usually found in shallow (less than 6.6 feet [2 m] deep), turbid water (Young and Cech 1996). As their swimming ability increases, juveniles move away from the shallow areas near spawning sites into faster, deeper water (Moyle 2002). Floodplain habitat offers high food quality and production and low predator densities to increase juvenile growth.

After emergence, most larval splittail remain in flooded riparian areas for 10 to 14 days, most likely feeding among submerged vegetation before moving off floodplains into deeper water as they become stronger swimmers (Sommer et al. 1997, Wang 1986). Although juvenile splittail rear in upstream areas for a year or more (Baxter 1999), most move to tidal waters after only a few weeks, often in response to flow pulses (Moyle et al. 2004). The majority of juveniles move downstream into shallow, productive bay and estuarine waters from April to August (Meng and Moyle 1995). Growth likely depends on the availability of high-quality food, especially in the first year of life (Moyle et al. 2004).

9B.9.4 Population Trends

A variety of surveys have compiled splittail abundance data. None of these, however, was specifically designed to systematically sample splittail abundance, and definitive conclusions are therefore not possible (Moyle et al. 2004). Combined, the survey data indicate that successful reproduction occurs on a yearly basis, but large numbers of juvenile splittail are produced only when outflow is relatively high. Thus, the majority of adult fish in the population probably result from spawning in wet years (Moyle et al. 2004). The stock-recruitment relationship in splittail is apparently weak, indicating that given the right environmental conditions, a small number of large females can produce many young (Sommer et al. 1997, Meng and Moyle 1995).

Accounts of early fisheries suggested that splittail had large seasonal migrations (Walford 1931). Splittail migration now appears closely tied to river outflow. In wet years with increased river flow, adult splittail will still move long distances upstream to spawn, allowing juvenile rearing in upstream habitats. The upstream migration is smaller during dry years, although larvae and juveniles are often found upstream of Sacramento to Colusa or Ord Bend on the Sacramento River (Moyle et al. 2004). The tidal upper estuary, including Suisun Bay, provides most juvenile rearing habitat, although young-of-the-year may rear over a broader area, including the lower Sacramento River. Brackish water provides optimal rearing habitat for splittail.

DFW estimates that splittail during most years are only 35 to 60 percent as abundant as they were in 1940 (DFG 1992). DFW midwater trawl data indicate considerable fluctuations in splittail numbers since the mid-1960s, with abundance often tracking river and Delta outflow conditions. The overall trends include a decline from the mid-1960s to the late 1970s, somewhat of a resurgence through the mid-1980s, and another decline from the mid-1980s through 1994 (Moyle 2002). In 1995 and 1998, the population increased dramatically, demonstrating the extreme short- and long-term variability of splittail recruitment success and the apparent correlation with river outflow (Sommer et al. 1997). In 2006, when spring outflows were the highest since 1998, beach seine surveys conducted by USFWS in the lower portion of the estuary recorded the highest number of 0+ fish individuals since the surveys began in 1992 (Greiner et al. 2007). Surveys in the upper portions of the estuary showed a decline in catches of splittail and many other Delta fish. These declines were coupled with declines in zooplankton, which are the primary food source for splittail (Hieb et al. 2004). Pesticide use in the Central Valley may contribute to reduced zooplankton abundance in the Delta and thus to the POD (Oros and Werner 2005).

Splittail may also be negatively affected by the introduction of the overbite clam (*Potamocorbula amurensis*) in the 1980s, which resulted in a collapse of opossum shrimp (*Neomysis mercedis*) populations, which were a primary source of food for splittail. The recent introduction of the Siberian prawn may similarly pose a threat to splittail food sources, as the Siberian prawns prey on mysid shrimp, which make up a large portion of spittail diets (Moyle et al. 2004). River outflow in February through May can explain between 55 and 69 percent of the variability in abundance of splittail young, depending on the abundance measure. Age -0 abundance of splittail declined in the estuary during most dry years, particularly in the drought that began in 1987 (Sommer et al. 1997). However, not all wet years result in high splittail recruitment because recruitment success largely depends on the availability of flooded spawning habitat. In 1996, for example, most high river flows occurred in December and January, before the onset of the splittail spawning season (Moyle 2002).

9B.9.5 References

Bailey, H. C. 1994. Sacramento splittail work continues. *Interagency Ecological Program Newsletter* 7: Article 3.

Baxter, R. D. 1999. Status of splittail in California. *California Fish and Game* 85: 28-30.

_____. 2000. Splittail and longfin smelt. *IEP Newsletter* 13: 19-21.

Baxter, R. D., W. Harrell, and L. Grimaldo. 1996. 1995 Splittail spawning investigations. *Interagency Ecological Program Newsletter* 9: 27–31.

Brown, L. R., and P. B. Moyle. 1993. Distribution, ecology, and status of fishes of the San Joaquin River drainage, California. *California Fish and Game Bulletin* 79: 96-113.

Caywood, M. L. 1974. *Contributions to the life history of the splittail (Pogonichthys macrolepidotus) (Ayres)*. Master's thesis. California State University, Sacramento, California.

Crain, P. K., K. Whitener, and P. B. Moyle. 2004. Use of a restored central California floodplain by larvae of native and alien fishes. *American Fisheries Society Symposium* 39: 125–140.

Daniels, R. A., and P. B. Moyle. 1983. Life history of splittail (Cyprinidae: *Pogonichthys macrolepdotus*) in the Sacramento-San Joaquin Estuary. *Fishery Bulletin* 84: 105–117.

DFG (California Department of Fish and Game). 1992. *Impact of water management on splittail in the Sacramento-San Joaquin estuary*. WRINT-CDFG-Exhibit 5. State Water Resources Control Board hearing for setting interim standards for the Delta.

Feyrer, F. V., and R. D. Baxter. 1998. Splittail fecundity and egg size. *California Fish and Game* 84: 119–126.

Greiner, T., M. Fish, S. Slater, K. Hieb, J. Budrick, J. DuBois, and D. Contreras. 2007. 2006 Fishes: Annual status and trends report for the San Francisco Estuary. *Interagency Ecological Program Newsletter* 20(2).

Hieb, K., T. Greiner, and S. Slater. 2004. San Francisco Bay species: 2003 Status and trends report. *Interagency Ecological Program Newsletter* 17:17-28.

Leidy, R. A. 1984. Distribution and ecology of stream fishes in the San Francisco Bay drainage. *Hilgardia* 52: 1–175.

Meng, L., P. B. Moyle, and B. Herbold. 1994. Changes in abundance and distribution of native and introduced fishes of Suisun Marsh. *Transactions of the American Fisheries Society* 123: 498–507.

Meng, L., and P. B. Moyle. 1995. Status of splittail in the Sacramento-San Joaquin Estuary. *Transactions of the American Fisheries Society* 124: 538–549.

Moyle, P. B. 2002. *Inland fishes of California*. Revised edition. University of California Press, Berkeley.

Moyle, P. B., R. D. Baxter, T. Sommer. T. C. Foin, and S. A. Matern. 2004. Biology and population dynamics of Sacramento splittail (*Pogonichthys macrolepidotus*) in the San Francisco Estuary: a review. *San Francisco Estuary and Watershed Science*. 2: Article 3.

Oros, D. R., and I. Werner. 2005. *Pyrethroid insecticides: an analysis of use patterns, distributions, potential toxicity and fate in the Sacramento-San Joaquin Delta and Central Valley.* White Paper for the Interagency Ecological Program. SFEI Contribution 415. San Francisco Estuary Institute, Oakland, California.

Rutter, C. 1908. The fishes of the Sacramento-San Joaquin basin, with a study of their distribution and variation. *Bulletin of the U.S. Bureau of Fisheries* 27: 103-152.

Saiki, M. K. 1984. Environmental conditions and fish faunas in low elevation rivers on the irrigated San Joaquin Valley floor, California. *California Fish and Game 70*: 145-157.

Snyder, J. O. 1905. Notes on the fishes of the streams flowing into San Francisco Bay. *United States Bureau of Fisheries* 5: 327–338.

Sommer, T., R. Baxter, and B. Herbold. 1997. Resilience of splittail in the Sacramento-San Joaquin estuary. *Transactions of the American Fisheries Society* 126: 961–976.

USFWS (U.S. Fish and Wildlife Services). 1996. R*ecovery plan for the Sacramento-San Joaquin Delta native fishes*. U.S. Fish and Wildlife Service, Portland, Oregon.

_____. 1999. *Endangered and threatened wildlife and plants; determination of threatened status for the Sacramento splittail.* Federal Register 64: 5963–5981.

_____. 2003. *Endangered and Threatened Wildlife and Plants; Notice of Remanded Determination of Status for the Sacramento splittail (*Pogonichthys macrolepidotus*); Final Rule.* Federal Register 68: 55140.

_____. 2010. *Endangered and Threatened Wildlife and Plants; 12-month Finding on a Petition to list the Sacramento Splittail as Endangered or Threatened.* Federal Register 75: 62070-62095.

Walford, L. A. 1931. *Handbook of common commercial and game fishes of California*. California Department of Fish and Game Fish Bulletin 28.

Wang, J. C. S. 1986. *Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: a guide to the early life histories*. Technical Report 9. Prepared for the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary by California Department of Water Resources, California Department of Fish and Game, Bureau of Reclamation, and U.S. Fish and Wildlife Service.

_____1995. *Observations of early life stages of splittail (Pogonichthys macrolepidotus) in the Sacramento-San Joaquin estuary, 1988 to 1994.* Interagency Ecological Program Technical Report 43.

Young, P. S., and J. J. Cech, Jr. 1995. *Salinity and dissolved oxygen tolerance of young-of-the-year and juvenile Sacramento splittail*. Consensus building in resource management. American Fisheries Society, California-Nevada Chapter.

_____. 1996. Environmental tolerances and requirements of splittail. *Transactions of the American Fisheries Society* 125: 664–678.

9B.10 Delta Smelt (*Hypomesus transpacificus*)

9B.10.1 Legal Status

Federal: Threatened, Designated Critical Habitat
State: Endangered

The USFWS listed the Delta Smelt as threatened in March 1993 (USFWS 1993), and critical habitat for this species was designated in 1994 (USFWS 1994). The Delta Smelt was one of eight fish species addressed in the Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes (USFWS 1996). This recovery plan is currently under revision. The 2004 status review affirmed the need to retain the Delta Smelt as a threatened species (USFWS 2004). A 12-month finding on a petition to reclassify the Delta Smelt was completed in April 2010 and the USFWS determined that re-classifying the Delta Smelt from a threatened to an endangered species was warranted, but precluded by other higher-priority listing actions (USFWS 2010).

9B.10.2 Distribution

Delta Smelt are endemic to and resident in the Delta and San Francisco Bay. According to a recent review (Merz et al. 2011), the distribution of Delta Smelt includes an area from northern San Francisco Bay in the west, the confluence of the Sacramento and Feather rivers in the north, and the junction of Old and San Joaquin rivers in the south. The highest densities most frequently occur near the center of their range, which appears to extend from Suisun Marsh down through Grizzly Bay and east Suisun Bay through the confluence of the Sacramento and

San Joaquin rivers, and into the lower portions of the Sacramento River, Cache Slough area, and the Sacramento Deepwater Ship Channel.

Delta Smelt abundance and geographic distribution are dependent upon freshwater outflows and the salinity of the Bay and Delta (Herbold et al. 1992). There is a close association between Delta Smelt abundance and surface salinity of 0–18 practical salinity units (psu) (psu are roughly equivalent to ppt), suggesting that their distribution is determined largely by the interaction with salinity conditions as determined by tidal currents, freshwater outflow, and diffusion, rather than by geography (Bennett 2000, 2005; Moyle 2002). For instance, water clarity and salinity were found to be the most reliable abiotic predictors of Delta Smelt abundance during the summer and fall (Feyrer et al. 2007, Nobriga et al. 2008). In addition, geographic distribution for particular life stages can vary dramatically between dry and wet years. Thus, in low outflow years, Delta Smelt occur primarily in the lower Sacramento River, with the area near Decker Island consistently exhibiting greatest catch over time. In years of very high outflow, however, their distribution extends into San Pablo Bay and the Napa River (Bennett 2000).

9B.10.3 Life History and Habitat Requirements

Overall, the Delta Smelt life cycle is completed in the brackish and tidal freshwater reaches of the upper San Francisco Estuary. However, salinity requirements vary by life stage. Apart from spawning and egg-embryo development, the distribution and movements of all life stages are influenced by transport processes associated with water flows in the estuary, which also affect the quality and location of suitable open water habitat (Dege and Brown 2004; Feyrer et al. 2007; Nobriga et al. 2008).

9B.10.3.1 Spawning

Delta Smelt generally exhibit an annual, 1-year lifecycle. They are found at 0-18 psu surface salinity (Baxter et al. 1999), although most are caught at salinities less than 6.0 psu, with older juveniles and adults being found at the higher end of that gradient (Bennett 2005). Delta Smelt feed primarily on planktonic copepods, cladocerans, and amphipods (Baxter et al. 2008). In recent years, a small to moderate number of Delta Smelt have been observed in the Deep Water Ship Channel during the late fall. The Deep Water Ship Channel can provide suitable water temperatures for Delta Smelt year-round (Sommer and Mejia 2013), which likely promotes freshwater residence in Delta Smelt in this region of the Delta (Sommer and Mejia 2013).

Delta Smelt are weakly anadromous and undergo a spawning migration from the low salinity zone to freshwater in most years (Grimaldo et al. 2009; Sommer et al. 2011). Spawning migrations occur between late December and late February, typically during “first flush” periods when inflow and turbidity increase on the Sacramento and San Joaquin Rivers (Grimaldo et al. 2009, Sommer et al. 2011). Notably, spawning movements are not always upstream. Under high outflow conditions, when total outflow exceeds 100,000 cubic feet per second (cfs), adult smelt tend to concentrate and spawn in Suisun Bay, Cache Slough Complex, and

Napa River (Hobbs et al. 2007; Sommer et al. 2011). During drier years, when total outflow is less than 20,000 cfs, smelt tend to concentrate and spawn in the Cache Slough Complex and western Delta.

Adequate flows and suitable water quality are needed to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries (USFWS 1996). Adult smelt do not spawn immediately after migration to freshwater, but appear to stage in upstream habitats (Sommer et al. 2011). Spawning typically commences when water temperatures reach 12°C, which typically occurs in early March. Spawning can continue into July (Wang 1986, Sweetnam and Stevens 1993), although most spawning takes place from early April to mid-May (Moyle 2002).

Delta Smelt are believed to spawn in shallow water along edges of rivers and sloughs subject to tidal influence (USFWS 2001). Based upon the occurrence of ripe females and yolk-sac larvae, spawning areas during dry and typical years are found in the north Delta reaches of the Sacramento River (Moyle 2002). Spawning locations in the Delta have not been identified and are inferred from larval catches (Bennett 2005). Larval fish have been observed in Montezuma Slough (Wang 1986), Suisun Slough in Suisun Marsh (Moyle 2002), the Napa River estuary (Stillwater Sciences 2006), the Sacramento River above Rio Vista, and Cache, Lindsey, Georgiana, Prospect, Beaver, Hog, Sycamore, and Barker sloughs (USFWS 1996). During wet years, Delta Smelt can be found spawning throughout most of the Delta, Suisun Marsh, and west to the Napa River (Herbold et al. 1992).

Although the specific substrates or habitats used for spawning by Delta Smelt are not known, spawning habitat preferences of closely related species (Bennett 2005) suggest that spawning may occur in shallow areas over sandy substrates. Although smelt can be found within a wide salinity range, from 0 to 18.4 ppt (Swanson et al. 2000), spawning occurs within in freshwater (Wang 1986). Spawning apparently can occur at temperatures ranging from 45-72°F (7-22°C) (Moyle 2002), but most often takes place between 45 and 59°F (7 and 15°C) (Wang 1986).

Spawning is thought to occur at night during new or full moons when the tide is low (Moyle 2002). Females (2.3-2.8 in [59-70 mm] SL) typically lay between 1,200 and 2,600 eggs (Moyle et al. 1992) and the relationship between female size (FL) and fecundity has been determined to be: Number of eggs = $0.266FL^{2.089}$ (Mager 1996). Most adults die after spawning, although a small number remain in the population for a second year (Moyle 2002) and may contribute disproportionately to the egg supply because of their increased size (3.5-4.7 in [90-120 mm] SL) (Moyle 2002).

9B.10.3.2 Hatching and Larval Distribution

No data are available on optimal temperature for survival of embryos, though some data suggest that high temperatures correspond to low hatching success and low embryo survival (R. Mager, unpubl. data; as cited in Winternitz and Wadsworth 1997). According to Moyle (2002), “it is likely that survival decreases as temperature increases beyond 18°C [64°F].” At temperatures between 59 and 62°F (14.8 and 16.5°C), embryonic development is reported to take approximately 9-13 days (Mager 1996). Although hatching has been detected from late February to June, peak hatching typically occurs in April.

Newly hatched smelt begin feeding on rotifers and other microscopic prey approximately 4-5 days after hatching, maintaining a position just above the bottom with the help of a large oil globule that makes them semi-buoyant (Mager 1996). The swim bladder and fins are fully developed several weeks later, and larvae rise up into the water column (Moyle 2002). During high outflow periods, larvae are distributed more widely as the spawning range extends further west when Delta outflows are high (Hobbs et al. 2007). Dege and Brown (2004) found that larvae less than 20 mm rear 5 to 20 km upstream of X2 (Dege and Brown 2004; Sommer and Mejia 2013). As larvae grow and water temperatures increase in the Delta (to approximately 23°C), their distribution shifts towards the low salinity zone (Dege and Brown 2004; Nobriga et al. 2008), where they circulate with the abundant zooplankton (Moyle 2002). By fall, the centroid of Delta Smelt distribution is tightly coupled with X2 (Sommer et al. 2011; Sommer and Mejia 2013).

Sommer and Mejia (2013) conducted a General Additive Model (GAM) analysis of Delta Smelt catch data from the 20-mm survey to determine suitable habitat parameters. They found larval Delta Smelt are more frequently captured in turbid and low salinity water. The analysis also showed that larval smelt presence in the survey peaked when water temperatures reach 20°C with low capture probability below 10°C and above 25°C.

The abundance of suitable rearing habitat for larvae varies from year to year, depending upon when peak spawning occurs. Peak larval density may occur as late as July or August. Base flows and pulse flows that transport and provide behavioral cues for Delta Smelt larvae and juveniles from February through June may not be adequate if larval peaks occur in July or August.

9B.10.3.3 Juvenile Rearing and Growth

The specific geographic area critical to the maintenance of suitable rearing habitat for Delta Smelt extends eastward from Carquinez Strait, up the Sacramento River to its confluence with Three Mile Slough (at RM 9), and south along the San Joaquin River including Big Break (USFWS 1996). Within this area, Delta Smelt typically rear in shallow (less than 10 ft [3 m]), open estuarine waters (Moyle 2002), in salinities ranging from 2-7 ppt (Swanson and Cech 1995) where “fresh and brackish water mix and hydrodynamics are complex as a result of the meeting of tidal and riverine currents” (Moyle 2002). These conditions are typically most common in Suisun Bay, which provides vital nursery habitat for Delta Smelt. When the mixing zone is located in Suisun Bay, it provides optimal conditions for algal and zooplankton growth, an important food source for Delta Smelt (Moyle 2002). When freshwater outflow is low, the mixing zone moves further up into the deeper, narrow channels of the Delta and Sacramento River, reducing food availability and total area available to the smelt (Moyle 2002).

Water quality preferences and thresholds for Delta Smelt are not well documented. Winternitz and Wadsworth (1997) observed that fewer Delta Smelt were collected in areas of higher temperatures than in areas of lower temperatures. Because other factors were not controlled, it is not clear whether temperature or other factors were driving Delta Smelt distribution. Nobriga et al. (2000) reported that Delta Smelt tolerated slightly higher water temperatures at a salinity of 4 ppt than in fresh water, but noted that further study is needed of these potentially interacting factors. Similar to larvae, a GAM analysis of the tow net survey data shows that suitable smelt habitat is best defined by water clarity, specific conductance (salinity), water temperature (Nobriga et al. 2008). As previously noted, some juvenile smelt will remain in the Sacramento Deep Water Ship Channel during the summer and fall months. The channel is deep, turbid, and offers some temperature refuge, which may explain why smelt remain in this freshwater habitat when most other smelt at this life stage are in found in the low salinity zone.

Planktonic copepods, cladocerans, amphipods, and, to a lesser extent, insect larvae, are the primary prey items for Delta Smelt (Moyle 2002). Delta Smelt larvae have more specific prey-size requirements for first feeding. In a study conducted in the northern estuary and Delta, Lott (1998) found that smaller size classes of Delta Smelt tended to consume more nauplii and juvenile copepods, while larger size classes consumed more adult copepods. It appears that food availability after yolk-sac absorption is critical in determining success of Delta Smelt (Nobriga 1998). However, it is not known if a limited food supply contributes to reduced year-class success and therefore has population-level implications.

Juvenile Delta Smelt grow rapidly, typically reaching 1.6-2 inches (40-50 mm) FL by early August (Radtke 1966, Moyle et al. 1992). Growth rate appears to be dependent on the quality and abundance of food (Moyle 2002). Adult length (2.2-2.8 inches [55-70 mm] SL) is typically reached by September, or approximately 7-9 months after hatching (Moyle 2002). By fall, Delta Smelt are fully capable of altering their distribution to suitable habitat. Using a GAM approach, Feyrer et al. (2007) showed that Delta Smelt habitat is best defined by turbidity and specific conductance (salinity). Unlike the other analyses, Feyrer et al. (2010) converted the GAM model results to a habitat index for Delta Smelt, showing that habitat improves and expands for Delta Smelt when X2 is in Suisun Bay compared to when X2 is located at or above the confluence. The relationship between the habitat index and X2 is asymptotic, whereby the index does not increase for X2 ≤74 km or decrease for X2 ≥81 km. For the period 1967 – 2008, relative abundance of juvenile delta smelt, as measured by the fall midwater trawl index, was positively correlated with the fall habitat index (Feyrer et al. 2010).

The quantity and suitability of Delta Smelt habitat increases with higher outflow (Bennett 2005). When the near-bottom mixing zone is contained within Suisun Bay and when adequate outflow from both the Sacramento and San Joaquin rivers have allowed downstream movement, young Delta Smelt are dispersed more widely throughout a large expanse of shallow-water and marsh habitat than when the isohaline is upstream in the narrower, deeper Delta sloughs and channels. If smelt use this habitat and their distribution is wider and shifted downstream, subsequent entrainment in the winter will be reduced. Habitat conditions suitable for transport of larvae and juveniles are needed as early as February 1 and as late as August 31, because the spawning season varies from year to year and starts as early as December and extends until July (USFWS 1996). Adequate river flow is necessary to provide this transport to Suisun Bay and to maintain rearing habitat (USFWS 1996).

The abundance of many local estuarine taxa has tended to increase in years when flows into the estuary are high and the X2 location is pushed seaward (Jassby et al. 1995), implying that over the range of historical experience the quantity or suitability of estuarine habitat increases when outflows are high. Feyrer et al. (2007) reported that fall environmental quality has declined over the long-term in the core range of Delta Smelt, including Suisun Bay and the Delta. This decline was largely due to changes in salinity in Suisun Bay and the western Delta, and changes in water clarity within the Delta. Baxter et al. (2008) reported the long-term environmental quality declines for Delta Smelt and Striped Bass are defined by a lowered probability of occurrence in samples based on changes in specific conductance and Secchi depth.

Planktonic copepods, cladocerans, amphipods, and, to a lesser extent, insect larvae, are the primary prey items for Delta Smelt (Moyle 2002). Delta Smelt larvae have more specific prey-size requirements for first feeding. In a study conducted in the northern estuary and Delta, Lott (1998) found that smaller size classes of Delta Smelt tended to consume more nauplii and juvenile copepods, while larger size classes consumed more adult copepods. It appears that food availability after yolk-sac absorption is critical in determining success of Delta Smelt (Nobriga 1998). However, it is not known if a limited food supply contributes to reduced year-class success and therefore has population-level implications.

The overbite clam has been associated with large changes in phytoplankton abundance in San Francisco Bay and the western Delta (Carlton et al. 1990), causing a decrease in abundance of other species that depend on phytoplankton (zooplankton) for food. Due in part to its efficiency in filtering water, the clarity of Suisun Bay and delta waters has increased. This has affected Delta Smelt by reducing food supply and increasing its susceptibility to predation.

9B.10.4 Population Trends

California Department of Fish and Wildlife has conducted several long-term monitoring surveys that have been used to index the relative abundance of Delta Smelt. The 20-mm Survey has been conducted every year since 1995. This survey targets late-stage Delta Smelt larvae. Most sampling has occurred from April to June. The Summer Townet Survey (TNS) has been conducted nearly every year since 1959. This survey targets 38-mm Striped Bass, but collects similar-sized juvenile Delta Smelt. Most sampling has occurred from June to August. The Fall Midwater Trawl Survey (FMWT has been conducted nearly every year since 1967. This survey also targets age-0 Striped Bass, but collects Delta Smelt longer than 40 mm. The FMWT samples monthly from September to December. These abundance index time series document the long-term decline of the Delta Smelt.

Early statistical assessments of Delta Smelt population dynamics concluded that the relative abundance of the adult Delta Smelt population had only a very weak influence on subsequent juvenile abundance (Sweetnam and Stevens 1993). Thus, early attempts looked for environmental variables that were directly correlated with interannual abundance variation (e.g., Stevens and Miller 1983; Moyle et al. 1992; Sweetnam and Stevens 1993; Jassby et al. 1995). Because these analyses did not find strong support for an outflow-abundance linkage, the prevailing conceptual model was that multiple interacting factors had caused the Delta Smelt decline (Moyle et al. 1992; Bennett and Moyle 1995; Bennett 2005). It has also recently been noted that Delta Smelt's FMWT index is partly influenced by concurrent environmental conditions (Feyrer et al. 2007; 2010).

It is now recognized that Delta Smelt abundance plays an important role in subsequent smelt abundance. Bennett (2005) examined (1) the influence of adult stock (FMWT) on the next generation of juveniles (TNS); (2) the influence of the juvenile stock (TNS) on the subsequent adult stock (FMWT); (3) the influence of the FMWT on the following year's FMWT and on the FMWT two years later, and (4) the influence of the TNS abundance on the following year's TNS and on the TNS 2 years later. His conclusions were that (1) 2-year-old Delta Smelt might play an important role in Delta Smelt population dynamics, (2) it was not clear whether juvenile production was a density-independent or density dependent function of adult abundance, and (3) adult production was a density-dependent function of juvenile abundance and the carrying capacity of the estuary to support this life-stage transition had declined over time. These conclusions are also supported by Maunder and Deriso (2011).

Delta Smelt were historically one of the most common species in the San Francisco Estuary, but exhibited significant declines during the 1980s (DFG 2000). Kimmerer (2002) and Thomson et al. (2010) reported a Delta Smelt step-decline during 1981-1982. Prior to this decline, the stock-recruit data are consistent with "Ricker" type density-dependence where increasing adult abundance resulted in decreased juvenile abundance. Since the decline, recruitment has been positively and essentially linearly related to prior adult abundance, suggesting that reproduction has been basically density-independent for about the past 30 years. In contrast to the transition among generations, the weight of scientific evidence strongly supports the hypothesis that, at least over the history of IEP fish monitoring, Delta Smelt has experienced density-dependence during the juvenile stage of its life cycle (i.e., between the summer and fall) (Bennett 2005; Maunder and Deriso 2011). The most relevant aspect of this juvenile density dependence is that the carrying capacity of the estuary for Delta Smelt has likely declined (Bennett 2005).

Therefore, the USFWS (2012) believes that the Delta Smelt population decline has occurred for two basic reasons. First, the compensatory density-dependence that historically enabled juvenile abundance to rebound from low adult numbers stopped happening. This change had occurred by the early 1980s as described above. The reason is still not known, but the consequence of the change is that for the past several decades, adult abundance has driven juvenile production in a largely density-independent manner (Kimmerer 2011). Second, because juvenile carrying capacity has declined, juvenile production hits a 'ceiling' at a lower abundance than it once did. This limits adult abundance and possibly per capita fecundity, which cycles around and limits the abundance of the next generation of juveniles. The mechanism causing carrying capacity to decline is likely due to the long-term accumulation of adverse changes in both physical and biological aspects of habitat during the summer to fall (Bennett et al. 2008; Feyrer et al. 2007; 2010; Maunder and Deriso 2011).

9B.10.5 References

Baxter, R., K. Hieb, S. DeLeon, K. Fleming, and J. Orsi. 1999. *Report on the 1980–1995 fish, shrimp, and crab sampling in the San Francisco Estuary, California.* Technical Report 63. Prepared by California Department of Fish and Game, Stockton for the Interagency Ecological Program for the Sacramento-San Joaquin Estuary.

Baxter, R., R. Breuer, L. Brown, M. Chotkowski, F. Feyrer, M. Gingras, B. Herbold, A. Mueller-Solger, M. Nobriga, T. Sommer, and K. Souza. 2008. *Pelagic organism decline progress report: 2007 synthesis of results*. Technical Report 227. Interagency Ecological Program for the San Francisco Estuary. Available at: http://www.science.calwater.ca.gov/pdf/workshops/POD/2007_IEPPOD_synthesis_report_031408.pdf.

Bennett, W.A. and Moyle, P. B. 1996. Where have all the fishes gone? Interactive factors producing fish declines in the Sacramento San Joaquin Estuary. Pages 519–542 in Hollibaugh, J. T. (ed.), San Francisco Bay: The Ecosystem. San Francisco, CA: Pacific Division American Association for the Advancement of Science. Pages 519–542.

Bennett, W. A. 2000. *Delta smelt population structure and factors influencing dynamics: implications for the CALFED Ecosystem Restoration Program.* Draft white paper prepared for CALFED Bay-Delta Program. As cited by Sam Luoma (preparer) *Delta Smelt and CALFED's Environmental Water Account, Summary of a Workshop held September 7, 2001, Putah Creek Lodge, University of California, Davis*, by Randall Brown and Wim Kimmerer.

Bennett, W. A. 2005. Critical assessment of the delta smelt population in the San Francisco Estuary, California. *San Francisco Estuary & Watershed Science* 3: Article 1.

California Resources Agency. 2007. *Pelagic fish action plan.* California Department of Water Resources and California Department of Fish and Game, Sacramento, California.

Carlton, J. T., J. K. Thompson, L. E. Schemel, and F. H. Nichols. 1990. Remarkable invasion of San Francisco Bay (California, USA) by the Asian clam *Potamocorbula amurensis*. I. Introduction and dispersal. *Marine Ecology Progress Series* 66:81-94.

DFG (California Department of Fish and Game). 2000. *The status of rare, threatened, and endangered animals and plants of California: delta smelt*. DFG, Habitat Conservation Planning Branch.

Dege, M. and L. R. Brown. 2004. Effect of outflow on spring and summertime distribution and abundance of larval and juvenile fishes in the upper San francisco estuary. In: F. Feyrer, L. R. Brown, R. L. Brown, and J. J. Orsi (eds.), Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society Symposium 39:49–66.

Feyrer, F., M. L. Nobriga, and T. R. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. *Canadian Journal of Fisheries and Aquatic Sciences* 64:723–734.

Feyrer, F., Newman, K., Nobriga, M., and Sommer, T. 2010. Modeling the effects of future freshwater flow on the abiotic habitat of an imperiled estuarine fish. Estuaries and Coasts34:120–128.

Grimaldo, L. F., T. Sommer, N. Van Ark, G. Jones, E. Holland, P. B. Moyle, P. Smith and B. Herbold. 2009. Factors Affecting Fish Entrainment into Massive Water Diversion in a Tidal Freshwater Estuary: Can Fish Losses Be Managed? North America Journal of Fisheries Management 29:1253–1270.

Herbold, B., A. D. Jassby, and P. B. Moyle. 1992. *San Francisco Estuary Project: Status and trends report on aquatic resources in the San Francisco Estuary.* Prepared by University of California, Davis under Cooperative Agreement #CE009519-01-1 with the U.S. Environmental Protection Agency.

Hobbs, J. A., W. A. Bennett, J. Burton, and M. Gras. 2007. Classification of Larval and Adult Delta Smelt to Nursery Areas by Use of Trace Elemental Fingerprinting. Transactions of the American Fisheries Society 136:518–527.

Jassby, A. D., W. J. Kimmerer, S. G. Monismith, C. Armor, J. E. Cloern, T. M. Powell, J. R. Schubel, and T. J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. *Ecological Applications* 5: 272–289.

Kimmerer, W. J. 2002. Effects of Freshwater Flow on Abundance of Estuarine Organisms: Physical Effects of Trophic Linkages. Marine Ecology Progress Series 243:39–55.

Kimmerer, W. J. 2008. Losses of Sacramento River Chinook salmon and delta smelt (*Hypomesus transpacificus*) to entrainment in water diversions in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 6: Article 2.

Kimmerer, W. J. 2011. Modeling Delta Smelt Losses at the South Delta Export Facilities. San Francisco Estuary and Watershed Science 9(1). Available at: http://www.escholarship.org/uc/item/0rd2n5vb.

Lindberg, J., R. Mager, B. Bridges, S. Doroshov. 1997. Status of delta smelt culture project. *Interagency Ecological Program for the Sacramento-San Joaquin Estuary Newsletter* 10: 21–22.

Lott, J. 1998. Feeding habits of juvenile and adult delta smelt from the Sacramento-San Joaquin river estuary. *Interagency Ecological Program for the Sacramento-San Joaquin Estuary Newsletter* 11: 14–19.

Mager, R. C. 1996. *Gametogenesis, reproduction, and artificial propagation of delta smelt,* Hypomesus transpacificus*.* Doctoral dissertation. University of Davis, California. As cited in Moyle 2002.

Maunder, M. N., and R. B. Deriso. 2011. A State-Space Multistage Life Cycle Model to Evaluate Population Impacts in the Presence Of Density Dependence: Illustrated with Application to Delta Smelt (*Hypomesus transpacificus*). Canadian Journal of Fisheries and Aquatic Sciences 68:1285–1306.

Merz., J.E., S. Hamilton, P.S. Bergman, and B. Cavallo. 2011. Spatial perspective for delta smelt: a summary of contemporary survey data. California Fish and Game, 97(4), pp. 164-189.

Moyle, P. B. 2002. *Inland fishes of California.* Revised edition. University of California Press, Berkeley.

Moyle, P. B., B. Herbold, D. E. Stevens, and L. W. Miller. 1992. Life history and status of delta smelt in the Sacramento-San Joaquin estuary, California. *Transactions of the American Fisheries Society* 121: 67–77.

Nobriga, M. 1998. Evidence of food limitation in larval delta smelt. *Interagency Ecological Program for the Sacramento-San Joaquin Estuary Newsletter* 11: 20–24.

Nobriga, M., Z. Hymanson, and R. Oltmann. 2000. Environmental factors influencing the distribution and salvage of young delta smelt: a comparison of factors occurring in 1996 and 1999. *Interagency Ecological Program for the Sacramento-San Joaquin Estuary Newsletter* 13: 55–65.

Nobriga, M. L., T. R. Sommer, F. Feyrer, and K. Fleming. 2008. Long-term trends in summertime habitat suitability for delta smelt (*Hypomesus transpacificus*). *San Francisco Estuary and Watershed Science* 6.

Radtke, L. D. 1966. Distribution of smelt, juvenile sturgeon, and starry flounder in the Sacramento-San Joaquin Delta. Edited by J. L. Turner and D. W. Kelley, 115–119. Ecological studies of the Sacramento-San Joaquin Delta, Part 2. Fish Bulletin 136. California Department of Fish and Game.

Sommer, T., and Mejia, F. 2013. A place to call home: a synthesis of delta smelt habitat in the upper San Francisco Estuary. San Francisco Estuary and Watershed Science 11(2). Available at: http://www.escholarship.org/uc/item/32c8t244.

Sommer, T., F. Mejia, M. Nobriga, F. Feyrer, and L. Grimaldo. 2011. The Spawning Migration of Delta Smelt in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science 9(2):1–16.

Stevens, D. E., and L. W. Miller. 1983. Effects of river flow on abundance of young Chinook salmon, American shad, Longfin Smelt, and delta smelt in the Sacramento–San Joaquin river system. North American Journal of Fisheries Management 3:425-437.

Stillwater Sciences. 2006. *Napa River fisheries monitoring program*. Final report. (Contract DACW05-01-C-0015.). Prepared by Stillwater Sciences, Davis, California, for U.S. Army Corps of Engineers, Sacramento District, Sacramento, California.

Swanson, C., and J. J. Cech, Jr. 1995. *Environmental tolerances and requirements of the delta smelt,* Hypomesus transpacificus. Final report. Department of Wildlife, Fish and Conservation Biology, University of California, Davis. As cited by the U.S. Army Corps of Engineers and The Reclamation Board *Standard Assessment Methodology for the Sacramento River Bank Protection Project*, August 2004.

Swanson, C., P. S. Young, and J. J. Cech, Jr. 1998. Swimming performance and behavior of delta smelt: maximum performance and behavioral and kinematic limitations of swimming at submaximal velocities. *Journal of Experimental Biology* 201: 333–345.

Swanson, C., T. Reid, P. S. Young, and J. J. Cech, Jr. 2000. Comparative environmental tolerances of threatened delta smelt (*Hypomesus transpacificus*) and introduced wakasagi (*H. nipponensis*) in an altered California estuary. *Oecologia* 123: 384–390.

Sweetnam, D. A., and D. E. Stevens. 1993. *Report to the Fish and Game Commission: a status review of the delta smelt (*Hypomesus transpacificus*) in California*. Candidate Species Status Report 93-DS. California Department of Fish and Game.

Thomson, J. R, W. J. Kimmerer, L. Brown, K. B. Newman, R. Mac Nally, W. A. Bennett, F. Feyrer, and E. Fleishman. 2010. Bayesian Change-Point Analysis of Abundance Trends for Pelagic Fishes in the Upper San Francisco Estuary. Ecological Applications 20:1431–1448.

USFWS (U.S. Fish and Wildlife Service). 1993. *Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Delta Smelt.* Federal Register 58: 12854.

USFWS. 1994. *Endangered and Threatened Wildlife and Plants; Critical Habitat Determination for the Delta Smelt.* Federal Register 59: 65256.

USFWS. 1996. *Recovery plan for the Sacramento-San Joaquin Delta native fishes*. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon. Available at: http://www.ecos.fws.gov/docs/recovery_plans/1996/961126.pdf.

USFWS. 2001. *Final biological opinion on the Sacramento River Bank Protection Project on the lower Sacramento River in Solano, Sacramento, Yolo, Sutter, Colusa, Glenn, Butte, and Tehama counties, California.* Revised File Number 1-1-00-F-0126. Sacramento, California.

USFWS. 2004. Five Year Status Review for the Delta Smelt. Sacramento, CA.

USFWS. 2010. Five Year Status Review for the Delta Smelt. Sacramento, CA.

USFWS. 2012. Technical Staff Comments to the State Water Resources Control Board re: the Comprehensive (Phase 2) Review and Update to the Bay-Delta Plan. Written comments in response to the questions posed by the State Water Resources Control Board (Board) for discussion at the low-salinity zone and pelagic fish workshops that support the Comprehensive (Phase 2) Review and Update to the Bay-Delta Plan. Dated August 17, 2012.

Wang, J. C. S. 1986. *Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: a guide to the early life histories.* Technical Report 9. Prepared for Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary by California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service.

Winternitz, L., and K. Wadsworth. 1997. 1996 Temperature trends and potential impacts to salmon, delta smelt, and splittail. *Interagency Ecological Program for the Sacramento-San Joaquin Estuary Newsletter* 10: 14–17.

9B.11 Longfin Smelt (*Spirinchus thaleichthys*)

9B.11.1 Legal Status

Federal: Candidate for listing as Endangered
State: Threatened

Longfin Smelt is a state-listed threatened species throughout its range in California (DFG 2009). USFWS denied a petition for Federal listing because the population in California (and specifically the San Francisco Bay) was not believed to be sufficiently genetically isolated from other populations (USFWS 2009). The Center for Biological Diversity challenged the merits of this determination. In 2011, USFWS entered into a settlement agreement with the Center for Biological Diversity and agreed to conduct a rangewide status review and prepare a 12-month finding to be published by September 30, 2011. The 12-month finding on the petition to list the San Francisco Bay-Delta population of the Longfin Smelt as endangered or threatened was completed in March 2012. USFWS determined that listing the Longfin Smelt rangewide was not warranted at the time, but that listing the Bay-Delta DPS of Longfin Smelt was warranted but precluded by other higher priority listing actions (USFWS 2012).

9B.11.2 Distribution

Populations of the Longfin Smelt have been found in estuaries along the Pacific coast from Prince William Sound, Alaska, to the Sacramento-San Joaquin estuary (USFWS 2012). The largest population occupies the Sacramento-San Joaquin estuary, with a smaller population in Humboldt Bay and the Eel River (Moyle 2002). They may occur throughout the year in the estuary and lowest reaches of the Klamath River, but little is known of this population.

Merz et al. (2013) utilized recently available sampling data (~1959-2012) from the Interagency Ecological Program and regional monitoring programs to provide a comprehensive description of the range and temporal and geographic distribution of Longfin Smelt (Spirinchus thaleichthys) by life stage within the San Francisco Estuary. Observations occurred as far west as Tiburon in Central San Francisco Bay and south as far as the Dumbarton Bridge in South San Francisco Bay; north as far as the town of Colusa on the Sacramento River and east as far as Lathrop on the San Joaquin River. Longfin smelt were also observed in seasonally-inundated habitat of the Yolo Bypass and in tributaries like the Napa and Petaluma rivers, Cache Slough, and the Mokelumne River (Merz et al. 2013).

9B.11.3 Life History and Habitat Requirements

Longfin Smelt typically live in bays and estuaries and make seasonal migrations. During winter, they congregate for spawning in the upper reaches of the bays and lower reaches of the river deltas. Juvenile and adult Longfin Smelt have been found throughout the year in salinities ranging from pure fresh water to pure seawater, although once past the juvenile stage, they are typically collected in waters with salinities ranging from 14 to 28 ppt (Baxter 1999). Within the Delta, adult Longfin Smelt occupy water at temperatures from 16 to 20°C (61 to 68°F) and spawn in water with temperatures from 5.6 to 14.5°C (41 to 58°F) (Wang 1986).

Longfin Smelt have been observed in their winter and spring spawning period as far upstream as Isleton in the Sacramento River, Santa Clara shoal in the San Joaquin system, Hog Slough off the South-Fork Mokelumne River, and Old River south of Indian Slough (DFG 2009). Merz et al. (2013) found that adults were frequently detected in the central regions (from Carquinez Straight upstream to the Confluence), adults were also detected relatively frequently upstream of the Sacramento-San Joaquin confluence. Both adult and larval Longfin Smelt were detected relatively frequently upstream of the confluence, unlike the juvenile and subadult life stages, likely indicating that Longfin Smelt spawning habitat extends further upstream into freshwater areas than rearing habitat. Spawning adults appear to be able to disperse into upper Delta reaches and into San Francisco Bay as well. The presence of adult Longfin Smelt in San Francisco Bay during the spawning period likely relates to years with high Delta inflows, when low salinity habitat shifted westward (Merz et al. 2013). Exact spawning locations in the Delta are unknown and may vary from year to year, depending on environmental conditions. However, it seems likely that spawning locations consist of the overlap of appropriate conditions of flow, temperature, and salinity with appropriate substrate (Rosenfield 2010). Most individuals die after spawning, but occasionally a female may live to spawn a second time.

Longfin Smelt congregate in deep waters near the low salinity zone near X2 during the spawning period, and they likely make short runs upstream, possibly at night, to spawn from these locations (DFG 2009, Rosenfield 2010). Longfin Smelt in the Delta may spawn as early as November and as late as June, although spawning typically occurs from January to April (DFG 2009, Moyle 2002). The adhesive eggs are deposited on rocks or aquatic plants in the freshwater sections of bays and river deltas. Baxter et al. (2010) found that female Longfin Smelt produced between 1,900 and 18,000 eggs, with fecundity greater in fish with greater lengths.

Larval Longfin Smelt less than 12 mm (0.5 inch) in length are buoyant because they have not yet developed an air bladder; as a result, they occupy the upper one-third of the water column. Longfin Smelt develop an air bladder at approximately 12 to 15 mm (0.5 to 0.6 inch) in length and are able to migrate vertically in the water column. At this time, they shift habitat and live in the bottom two-thirds of the water column (DFG 2009). Longfin Smelt are dispersed broadly in the Delta by high flows and currents, which facilitate transport of larvae and juveniles long distances. Longfin Smelt larvae are dispersed farther downstream during high freshwater flows (Dege and Brown 2004). Longfin Smelt larvae were detected relatively frequently upstream of the Sacramento-San Joaquin confluence; greater than 73 percent of the time in the Lower Sacramento, Upper Sacramento, Cache Slough and Ship Channel, and Lower San Joaquin regions, and greater than 31 percent of the time in the East Delta and South Delta regions during the smelt larval surveys (Merz et al. 2013).

Longfin Smelt spend approximately 21 months of their 24-month life cycle in brackish or marine waters (Baxter 1999, Dege and Brown 2004). In the Bay-Delta, most Longfin Smelt spend their first year in Suisun Bay and Marsh. The remainder of their life is spent in the San Francisco Bay or the Gulf of Farallones (Moyle 2008). Based on monthly survey results, Rosenfield and Baxter (2007) inferred that the majority of Longfin Smelt from the Bay-Delta migrate out of the estuary after the first winter of their life cycle and return during late fall to winter of their second year. They noted that migration out of the estuary into nearby coastal waters is consistent with captures of Longfin Smelt in the coastal waters of the Gulf of Farallones and hypothesized that the movement is a behavioral response to warm water temperatures during summer and early fall in the shallows of south San Francisco Bay and San Pablo Bay. Some Longfin Smelt may stay in the ocean and not re-enter fresh water to spawn until the end of their third year.

In the Bay-Delta, calanoid copepods such as *Pseudodiatomus forbesi* and *Eurytemora* sp., as well as the cyclopoid copepod *Acanthocyclops vernali*, are the primary prey of Longfin Smelt during the first few months of their lives (approximately January through May) (Slater 2008). The Longfin Smelt's diet shifts to include mysids such as opossum shrimp (*Neomysis mercedis*) and other small crustaceans (*Acanthomysis* sp.) as soon as they are large enough (20 to 30 mm [0.78 to 1.18 inches]) to consume these larger prey items (DFG 2009).

Longfin Smelt numbers in the Bay-Delta have declined significantly since the 1980s (Rosenfield and Baxter 2007, Baxter et. al. 2010). Rosenfield and Baxter (2007) confirmed the positive correlation between Longfin Smelt abundance and freshwater flow that had been previously documented by others (Stevens and Miller 1983, Baxter 1999, Kimmerer 2002), noting that abundances of both adults and juveniles were significantly lower during the 1987–94 drought than during either the pre- or post-drought periods. Abundance of Longfin Smelt has remained low since 2000, even though freshwater flows increased during several of these years (Baxter et al. 2010). Abundance indices derived from the FMWT, Bay Study Midwater Trawl, and Bay Study Otter Trawl show marked declines in Longfin Smelt populations from 2002 to 2009. Longfin Smelt abundance over the last decade is the lowest recorded in the 40-year history of DFG's FMWT monitoring surveys (USFWS 2012).

Research on declines of Longfin Smelt and other pelagic fish species in the Bay-Delta since 2002 (referred to as pelagic organism decline) have most recently been summarized in the Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results (Baxter et al. 2010). Although there is substantial uncertainty about the causal mechanisms underlying the pelagic organism decline, reduced Delta freshwater flows have been identified as one of several key factors believed to contribute to recent declines in the abundance of Longfin Smelt (Baxter et al. 2010).

9B.11.4 References

Baxter, R. D. 1999. Osmeridae. Pages 179-216 in J. Orsi, editor. Report on the 1980–1995 fish, shrimp, and crab sampling in the San Francisco Estuary, California. Technical Report 63. Interagency Ecological Program. California Department of Fish and Game, Stockton, USA. Available at: http://www.bepress.com/archive/orsi_1999.

Baxter, R. D., R. Breuer, L. R. Brown, L. Conrad, F. Feyer, S. Fong, K. Gehrts, L. Grimaldo, B. Herbold, P. Hrodey, A. Mueller-Solger, T. Sommer, and K. Souza. 2010. Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results. Interagency Ecological Program for the San Francisco Estuary.

Dege, M. and L. R. Brown. 2004. Effect of outflow on spring and summertime distribution and abundance of larval and juvenile fishes in the upper San Francisco estuary. In: F. Feyrer, L. R. Brown, R. L. Brown, and J. J. Orsi (eds.), Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society Symposium 39:49–66.

DFG (California Department of Fish and Game). 2009. *A status review of the longfin smelt (*Spirinchus thaleichthys*) in California.* Report to California Fish and Game Commission.

Kimmerer, W. J. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages. *Marine Ecology Progress Series* 243:39-55.

Merz, J.E., P.S. Bergman, J.F. Melgo, and S. Hamilton. 2013. Longfin smelt: spatial dynamics and ontogeny in the San Francisco estuary, California. California Fish and Game, 99(3), pp. 122-148.

Moyle, P. B. 2002. *Inland fishes of California*. Revised edition. University of California Press, Berkeley, California.

Moyle, Peter B. 2008. *The Future of Fish in Response to Large-Scale Change in the San Francisco Estuary, California.* American Fisheries Society Symposium 64:000–000.

Rosenfield, J.A. 2010. Life history conceptual model and sub-models for longfin smelt, San Francisco Estuary population. Report for Delta Regional Ecosystem Restoration Implementation Plan. California Department of Fish and Wildlife, Sacramento, CA. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=28421.

Rosenfield, Jonathan A., and Randall D. Baxter. 2007. Population Dynamics and Distribution Patterns of Longfin Smelt in the San Francisco Estuary. *Transactions of the American Fisheries Society* 136:1577–1592. DOI: 10.1577/T06-148.1.

Slater, Steven B. 2008. Feeding Habits of Longfin Smelt in the Upper San Francisco Estuary. Longfin Smelt Diet Poster. California Department of Fish and Game, Stockton, California.

Stevens, Donald E., and Lee W. Miller. 1983. Effects of River Flow on Abundance of Young Chinook Salmon, American Shad, Longfin Smelt, and Delta Smelt in the Sacramento-San Joaquin River System. *North American Journal of Fisheries Management* 3:425-437.

USFWS (U.S. Fish and Wildlife Service). 2009. Endangered and threatened wildlife and plants; 12-month finding on a petition to list the San Francisco Bay-Delta population of the (*Spirinchus thaleichthys*) as endangered. *Federal Register* 74: 16169-16175.

_____. 2012. Endangered and threatened wildlife and plants; 12-month finding on a petition to list the San Francisco Bay-Delta population of the longfin smelt as endangered or threatened. *Federal Register* 77: 19756.

Wang, Johnson C. S. 1986. *Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories*. Prepared for the Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 9. January.

9B.12 Eulachon (*Thaleichthys pacificus*)

9B.12.1 Legal Status

Federal: Threatened
State: Species of Special Concern

9B.12.2 Summary

Eulachon are anadromous fish that occur in the lower portions of certain rivers draining into the northeastern Pacific Ocean, ranging from northern California to the southeastern Bering Sea in Bristol Bay, Alaska (Scott and Crossman 1973, Willson et al. 2006).

The southern population of Pacific Eulachon consists of populations spawning in rivers south of the Nass River in British Columbia, Canada, to and including the Mad River in California (NMFS 2009). On March 18, 2010, NMFS listed the southern DPS of Pacific Eulachon as threatened under the ESA (NMFS 2010); critical habitat was designated in 2011 (NMFS 2011). The Klamath River is near the southern limit of the range of Eulachon (Eulachon BRT 2010).

Spawning occurs in gravel riffles, with hatching about a month later. The larvae generally move downstream to the estuary following hatching.

Large spawning aggregations of Pacific Eulachon used to regularly occur in the Klamath River (Fry 1979), migrating in March and April to spawn, but they rarely moved more than 8 miles inland (NRC 2004). DFW sampled in the Klamath River from 1989 to 2003 with no Pacific Eulachon captures (USDI and DFG 2011). The Yurok Tribe sampled extensively for Pacific Eulachon in early 2011, and although tribal fishermen did not capture Pacific Eulachon from the Klamath River itself, they did recover Pacific Eulachon from the surf zone at the mouth of the river (USDI and DFG 2011).

9B.12.3 References

Eulachon BRT (Eulachon Biological Review Team). 2010. *Status review update for eulachon in Washington, Oregon, and California*. http://www.nwr.noaa.gov/Other-Marine-Species/upload/eulachon-review-update.pdf.

Fry, D. H., Jr. 1979. *Anadromous fishes of California.* California Department of Fish and Game, Sacramento.

NMFS (National Marine Fisheries Service). 2009. Endangered and threatened wildlife and plants; proposed threatened status for Southern Distinct Population Segment of eulachon. *Federal Register* 75 13012-13024.

______. 2010. Endangered and threatened wildlife and plants; threatened status for Southern Distinct Population Segment of eulachon. *Federal Register* 75 13012-13024.

______. 2011. Endangered and threatened species, designation of critical habitat for Southern Distinct Population Segment of eulachon. *Federal Register* 76: 515-536.

NRC (National Research Council). 2004. *Endangered and threatened fishes in the Klamath River basin: causes of decline and strategies for recovery*. The National Academies Press, Washington, D.C. http://www.nap.edu/openbook.php?isbn=0309090970.

Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. *Fisheries Research Board of Canada Bulletin* No. 184.

USDI and DFG (U. S. Department of the Interior and California Department of Fish and Game). 2012. *Klamath Facilities Removal environmental impact statement/ environmental impact report.* State Clearinghouse #2010062060. U.S. Department of the Interior, through the Bureau of Reclamation and California Department of Fish and Game, Sacramento, California.

Willson, M. F., R. H. Armstrong, M. C. Hermans, and K. Koski. 2006. *Eulachon: a review of biology and an annotated bibliography*. AFSC Processed Report 2006-12. National Marine Fisheries Service, Alaska Fisheries Science Center, Juneau.

9B.13 Striped Bass (*Morone saxatilis*)

9B.13.1 Legal Status

Federal: None
State: None

Striped Bass are native to the Atlantic Coast of North America and were introduced to California in 1879. Striped Bass are a large (>1 meter), long-lived (>10 years) species. They are widespread in the San Francisco Estuary watershed as juveniles and adults. Striped Bass move regularly from salt to fresh water. They require a large body of water for foraging on fish (usually estuaries or large reservoirs) and large cool rivers for spawning. Striped Bass spend most of their lives in estuaries.

9B.13.2 Distribution in Affected Area

Adult Striped Bass are distributed mainly in the lower bays and ocean during the summer, and in the Delta during fall and winter. Spawning takes place in the spring (April–June), at which time Striped Bass swim upstream to spawning grounds. In the Sacramento River, most spawning takes place between RM 77.7 and RM 121.2 (Moyle 2002). After spawning, adults move downstream into the Delta and bays (Blunt 1962).

9B.13.3 Life History and Habitat Requirements

Female Striped Bass mature at between 4 and 6 years of age and can spawn every year. In the Delta and Sacramento and San Joaquin rivers, spawning occurs from April to June at temperatures between 14°C and 21°C. Eggs are free-floating and negatively buoyant, and hatch in about two days as they drift downstream, with larvae occurring in shallow and open waters of the lower reaches of the Sacramento and San Joaquin rivers, the Delta, Suisun Bay, Montezuma Slough, and Carquinez Strait. Location of spawning varies based on temperature, flow, and salinity (Turner 1972). In the Yolo Bypass, Harrell and Sommer (2003) observed that flow pulses immediately preceding floodplain inundation triggered upstream movement of Striped Bass, resulting in successful spawning. During low flow years, spawning occurs within the Delta itself.

Newly hatched Striped Bass feed off their yolk sac for up to 8 days (Wang 1986), after which they start feeding on zooplankton. Larvae in the Sacramento River migrate into the water column from April to mid-June (Stevens 1966). In the Sacramento River, embryos and larvae are carried into the Delta and Suisun Bay (Moyle 2002). In the San Joaquin River, embryos remain in the same general area where spawning took place, as freshwater outflow is balanced by tidal currents (Moyle 2002). When larval bass from both rivers begin to feed, they are concentrated in the most productive part of the estuary—where freshwater and salt water meet or near X2 (Moyle 2002).

Striped Bass are tolerant of a wide range of environmental conditions, surviving temperatures up to 25°C (77ºF) (and up to 34°C [93ºF] for shorter periods), rapid temperature swings, low oxygen levels between 3 and 5 milligrams per liter (mg/L), and high turbidity (Moyle 2002). Hassler (1988), in a summary of environmental tolerance studies, reported that Striped Bass could tolerate dissolved oxygen concentrations ranging from 3 to 20 mg/L, and a pH range of 6 to 10, although the optimum level ranged from 6 to 12 mg/L and 7 to 9, respectively. The information compiled by Hassler (1988) suggested juveniles preferred rearing temperatures of 24 to 26°C (60.8 to 66.2°F). As Striped Bass grow, their temperature preference shifts towards cooler water (Hill et al. 1989). Adult Striped Bass appear to prefer water temperatures ranging from 20 to 24°C (68 to 75.2°F) (Emmett et al. 1991).

Typical of an anadromous species, salinity tolerance of Striped Bass also changes with age (Lal et al. 1977, Hill et al. 1989). Eggs and larvae reportedly thrive at salinities less than 3 practical salinity units (psu) (Mansueti 1958, Dovel 197l), and can tolerate salinities of 8 to 9 psu without ill effects (Morgan and Rasin 1973). Adults can apparently tolerate salinities from 0 to 34 psu or more (Rogers and Westin 1978), with a range of 10 to 20 psu reported as optimal for larger juveniles (Bogdanov et al. 1967).

9B.13.4 Biotic Interactions

Striped Bass are pelagic, opportunistic predators, feeding on invertebrates and fishes. They tend to exhibit a roving school foraging strategy (Pickard et al. 1982). Larval and juvenile Striped Bass feed on invertebrates such as copepods or opossum shrimp. In the San Francisco Bay area, juvenile bass form small schools or feeding groups (Skinner 1962) with specific prey varying with fish size, habitat, and season (Hill et al. 1989).

Striped Bass are a top predator in the Delta and are considered major predators on fish (Thomas 1967). Fish become important in the diet of juveniles when they reach a FL of 130 to 350 mm, especially late in the summer when young-of-the-year Striped Bass and shad become available (Moyle 2002). Striped Bass are primarily piscivorous as subadults, when they reach 250 to 470 mm FL (approximately age 2+). Stevens (1966) found that the importance of fish in the diet of subadult (260 to 470 mm FL) and adult (>380 mm FL) Striped Bass in the Sacramento-San Joaquin estuary varied seasonally. Fish were most prevalent in the diet of subadults in fall, and occurred most frequently in the diet of adults in fall and winter. Adult Striped Bass feed primarily on smaller Striped Bass, threadfin shad, and juvenile salmonids, as well as pelagic ocean fishes (Moyle 2002). Striped Bass can successfully switch to feeding on novel prey (Moyle 2002). Striped Bass are considered important predators on juvenile salmon in the Sacramento River (Tucker et al. 1998, Moyle 2002). Average populations of 1.7 million adults during the late 1960s to early 1970s, and 1.25 million adults during 1967-1991 (USFWS 1995), likely exerted considerable predation pressure on outmigrating juvenile salmon (Yoshiyama et al. 1998). The impact of Striped Bass on Delta Smelt and Sacramento Splittail is not known (Moyle 2002). Delta Smelt were occasional prey fish for Striped Bass in the early 1960s (Turner and Kelley 1966) but went undetected in a recent study of predator stomach contents (Nobriga and Feyrer 2007). Striped Bass are likely the primary predator of juvenile and adult Delta Smelt given their spatial overlap in pelagic habitats (NMFS 2009).

Though Striped Bass may commonly exhibit a roving school foraging strategy (Pickard et al. 1982), they appear to take advantage of prey that is concentrated at screened diversions or pumps, and may be partially responsible for the decline of some native fishes, including salmon, thicktail chub, and Sacramento perch (Tucker et al. 1998). Striped Bass are considered to be a primary cause of juvenile salmon mortality at the state water-export facility in the south Delta (USFWS 1995). Tucker et al. (1998) observed Striped Bass preying heavily on juvenile Chinook Salmon that passed through the diversion facilities at Red Bluff Diversion Dam on the Sacramento River. Juvenile Chinook Salmon were found by Thomas (1967) to be a major food item in the diet of Striped Bass in the spring and early summer during smolt outmigration through the Sacramento and San Joaquin rivers and Delta.

The introduction of the overbite clam in the 1980s has been associated with large decreases in zooplankton and phytoplankton densities in San Francisco Bay and the western Delta (Carlton et al.1990), which has decreased the amount of food available for larval and juvenile Striped Bass. The population responses of juvenile Striped Bass to winter-spring outflows changed after the overbite clam invasion as young Striped Bass relative abundance stopped responding to outflow altogether (Sommer et al. 2007). In addition to decreased copepod densities, the principal historic copepod food source, *Eurytemora affinis*, for larval and juvenile Striped Bass has largely been replaced by alien copepod species that may be energetically less desirable (Meng and Orsi 1991).

Within the Delta, adult Striped Bass feed primarily on Threadfin Shad and juvenile Striped Bass. Thus, when shortages of alternate prey exist, survival rates of juvenile bass may decrease as they become increasingly important to adult diets, resulting in an unusually high response to decreased productivity in the Delta (Moyle 2002).

9B.13.5 References

Blunt, C. E., Jr. 1962. *Striped Bass*. Delta Fish and Wildlife Protection Study. Annual Report 1, 61–86. California Department of Fish and Game. As cited by Environmental Defense Fund *A Focal Species and Ecosystem Functions Approach for Developing Public Trust Flows in the Sacramento and San Joaquin River Delta*, February 2010.

Bogdanov, A. S., S. I. Doroshev, and A. F. Karpevich. 1967. Experimental transfer of *Salmo gairdneri* and *Roccus saxatilis* from the USA for acclimatization in bodies of water of the USSR. Translated from Russian by R. M. Howland, Narragansett Marine Game Fish Research Laboratory, *R. I. Vopr. Ikhtiol* 42: 185–187. As cited Atlantic States Marine Fisheies Commission *Atlantic Coast Diadromous Fish Habitat, A Review of Utilization Threats, Recommendations for Conservation, and Research Needs, Habitat Management Series #9*, January 2009.

Carlton, J. T., J. K. Thompson, L. E. Schemel, and F. H. Nichols. 1990. Remarkable invasion of San Francisco Bay (California, USA) by the Asian clam *Potamocorbula amurensis*. I. Introduction and Dispersal. *Marine Ecology Progress Serie*s 66: 81-94.

Dovel, W. L. 1971. *Fish Eggs and Larvae of the Upper Chesapeake Bay*. Special Report 4. University of Maryland, Natural Resource Institute. As cited Atlantic States Marine Fisheies Commission *Atlantic Coast Diadromous Fish Habitat, A Review of Utilization Threats, Recommendations for Conservation, and Research Needs, Habitat Management Series #9*, January 2009.

Emmett, R. L., S. L. Stone, S. A. Hinton, and M. E. Monaco. 1991. *Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries. Volume 2: Species Life History Summaries*. ELMR Report No. 8. NOS/NOAA Strategic Environmental Assessment Division, Rockville, Maryland.

Harrell, W. C., and T. R. Sommer. 2003. Patterns of adult fish use on California's Yolo Bypass floodplain. *California Riparian Systems: Processes and Floodplain Management, Ecology, and Restoration*, pp. 88–93. 2001 Riparian Habitat and Floodplains Conference Proceedings. Edited by P. M. Faber. Riparian Habitat Joint Venture, Sacramento, California. http://www.water.ca.gov/aes/docs/HarrellSommer_2003.pdf.

Hassler, T. J. 1988. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest): Striped Bass.* Biological Report 82(11.82). U.S Army Corps of Engineers, Vicksburg, Mississippi, and U.S. Fish and Wildlife Service, Washington, DC.

Hill, J., J. W. Evans, and M. J. Van Den Avyle. 1989. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Atlantic): Striped Bass*. U.S. Fish and Wildlife Service Biological Report 82(11.118). U.S Army Corps of Engineers.

Lal, K., R. Lasker, and A. Kuljis. 1977. Acclimation and rearing of striped bass larvae in seawater. *California Fish and Game* 63: 210–218.

Mansueti, R. 1958. *Eggs, Larvae and Young of the Striped Bass,* Roccus saxatilis. Contribution 112. Maryland Department of Research and Education, Solomans.

Meng, L., and J. J. Orsi. 1991. Selective predation by larval striped bass on native and introduced copepods. *Transactions of the American Fisheries Society* 120: 187–192.

Morgan, R. P., and V. J. Rasin. 1973. Effects of salinity and temperature on the development of eggs and larvae of striped bass and white perch. Appendix X in *Hydrographic and Ecological Effects of Enlargement of the Chesapeake and Delaware Canal*. Final Report DACW-61-71-C-0062. U.S. Army Corps of Engineers, Philadelphia District. As cited by Environmental Defense Fund *A Focal Species and Ecosystem Functions Approach for Developing Public Trust Flows in the Sacramento and San Joaquin River Delta*, February 2010.

Moyle, P. B. 2002. *Inland Fishes of California*. Revised edition. University of California Press, Berkeley, California.

NMFS (National Marine Fisheries Service). 2009. Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project. Southwest Region. http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/ocap.html.

Nobriga, M. L., and F. Feyrer. 2007. Shallow-water piscivore-prey dynamics in California's Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 5: Article 4.

Pickard, A., A. M. Grover, and F. A. Hall, Jr. 1982. *An Evaluation of Predator Composition at Three Locations on the Sacramento River*. Technical Report 2. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary.

Rogers, B. A., and D. T. Westin. 1978. *A Culture Methodology for Striped Bass*. Report No. 660/3-78-000. U.S. Environmental Protection Agency, Ecological Research Series, Washington D.C. As cited Atlantic States Marine Fisheies Commission *Atlantic Coast Diadromous Fish Habitat, A Review of Utilization Threats, Recommendations for Conservation, and Research Needs, Habitat Management Series #9*, January 2009.

Skinner, J. E. 1962. *A Historical Review of the Fish and Wildlife Resources of the San Francisco Bay Area*. Report No. 1. California Department of Fish and Game, Water Projects Branch.

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The collapse of pelagic fishes in the upper San Francisco Estuary. *Fisheries* 32: 270–277.

Stevens, D. E. 1966. *Food Habits of Striped Bass,* Roccus saxatilis*, in the Sacramento-San Joaquin Delta*. Ecological Studies of the Sacramento-San Joaquin Delta, Part II, pp. 68–96. Edited by J. L. Turner and D. W. Kelley. Fish Bulletin 136. California Department of Fish and Game.

Thomas, J. L. 1967. The diet of juvenile and adult striped bass, *Roccus saxatilis*, in the Sacramento-San Joaquin river system. *California Fish and Game* 53: 49–62.

Tucker, M. E., C. M. Williams, and R. R. Johnson. 1998. *Abundance, Food Habits, and Life History Aspects of Sacramento Squawfish and Striped Bass at the Red Bluff Diversion Complex, California, 1994–1996.* Red Bluff Research Pumping Plant Report No. 4. U.S. Fish and Wildlife Service, Red Bluff, California.

Turner, J. L. 1972. Striped bass. In *Ecological Studies of the Sacramento-San Joaquin Estuary*, pp. 36-43. Edited by J. E. Skinner. California Department of Fish and Game Delta Fish Wildlife Protection Studies Report 8.

Turner, J. L., and D. W. Kelley. 1966. *Ecological Studies of the Sacramento-San Joaquin Delta*. Fish Bulletin 136. California Department of Fish and Game.

USFWS (U.S. Fish and Wildlife Service). 1995. *Working Paper on Restoration Needs: Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California.* Volume 3. Prepared for USFWS under the direction of the Anadromous Fish Restoration Program Core Group, Stockton, California.

Wang, J. C. S. 1986. *Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: a Guide to the Early Life Histories*. Technical Report 9. Prepared for Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary by California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley region of California. *North American Journal of Fisheries Management* 18: 487–521.

9B.14 Southern Resident Killer Whale (*Orcinus orca*)

9B.14.1 Legal Status

Federal: Endangered
State: None

Three distinct forms of Killer Whales, termed residents, transients, and offshores, are recognized in the northeastern Pacific Ocean. Resident Killer Whales in U.S. waters are distributed from Alaska to California, with four distinct communities recognized: Southern, Northern, Southern Alaska, and Western Alaska (Krahn et al. 2002, 2004). Resident Killer Whales are fish eaters and live in stable matrilineal pods. Of these, only the Southern Resident Distinct Population Segment (DPS) is listed as endangered.

The designated critical habitat does not overlap with the action area for this consultation, nor are there any discernible changes to the physical environment that occur within designated critical that could be correlated to project operations. The only potential effects of project operations on the identified physical or biological features essential to conservation would be to prey quantity, quality, and availability. Project operations have the potential to affect only a portion of juvenile salmon originating in California's Central Valley streams. As discussed earlier, salmon originating in California streams are estimated to contribute between 3 and 5 percent of the salmon population off the Washington coast based on analysis of troll catches. These estimates were made based on data collected during the time of year when the Southern Residents are present. As discussed above, the majority of the fish attributed to California streams that are affected by the project are expected to be hatchery fish.

9B.14.2 Distribution

The Southern Resident Killer Whale DPS is designated as endangered under the ESA (NMFS 2005). This DPS primarily occurs in the inland waters of Washington state and southern Vancouver Island, particularly during the spring, summer, and fall, but members of the population have been observed off coastal California in Monterey Bay, near the Farallon Islands, and off Point Reyes (Heimlich-Boran 1988, Felleman et al. 1991, Olson 1998, Osborne 1999, NMFS 2005). The action area is outside of the DPS's designated Critical Habitat, which is in Washington state (NMFS 2006a).

9B.14.3 Life History and Habitat Requirements

Southern Resident Killer Whales spend a significant portion of the year in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound, particularly during the spring, summer, and fall, when all three pods are regularly present in the Georgia Basin (defined as the Georgia Strait, San Juan

Islands, and Strait of Juan de Fuca) (Heimlich-Boran 1988, Felleman et al. 1991, Olson 1998, Osborne 1999). The Southern Resident population consists of three pods, identified as J, K, and L pods. Typically, K and L pods arrive in May or June and spend most of their time in this core area until departing in October or November. During this time, both pods also make frequent trips lasting a few days to the outer coasts of Washington and southern Vancouver Island (Ford et al. 2000). J pod continues to spend intermittent periods of time in the Georgia Basin and Puget Sound during late fall, winter, and early spring.

While the Southern Residents are in inland waters during the warmer months, all of the pods concentrate their activities in Haro Strait, Boundary Passage, the southern Gulf Islands, the eastern end of the Strait of Juan de Fuca, and several localities in the southern Georgia Strait (Heimlich-Boran 1988, Felleman et al. 1991, Olson 1998, Ford et al. 2000). In general, they spend less time elsewhere, including other sections of the Georgia Strait, Strait of Juan de Fuca, and San Juan Islands, Admiralty Inlet west of Whidbey Island, and Puget Sound. Individual pods are similar in their preferred areas of use (Olson 1998), although there are some seasonal and temporal differences in certain areas visited by each pod (Hauser 2006). For example, J pod visits Rosario Strait more frequently than K or L pods (Hauser 2006). The movements of Southern Resident Killer Whales relate to those of their preferred prey—salmon. Pods commonly seek out and forage in areas where salmon occur, especially those associated with migrating salmon (Heimlich-Boran 1986, 1988; Nichol and Shackleton 1996). Notable locations of particularly high use include Haro Strait and Boundary Passage, the southern tip of Vancouver Island, Swanson Channel off North Pender Island, and the mouth of the Fraser River delta, which is visited by all three pods in September and October (Felleman et al. 1991, Ford et al. 2000). These sites are major corridors for migrating salmon.

Wild female Southern Resident Killer Whales give birth to their first surviving calf between the ages of 12 and 16 years (mean = about 14.9 years) (Olesiuk et al. 1990, Matkin et al. 2003). Females produce an average of 5.4 surviving calves during a reproductive life span lasting about 25 years (Olesiuk et al. 1990). Males become sexually mature at body lengths ranging from 5.2 to 6.4 meters, which corresponds to between the ages of 10 and 17.5 years (mean = about 15 years) (Christensen 1984, Perrin and Reilly 1984, Duffield and Miller 1988, Olesiuk et al. 1990), and are presumed to remain sexually active throughout their adult lives (Olesiuk et al. 1990).

Southern Resident Killer Whales are known to consume 22 species of fish and one species of squid (Scheffer and Slipp 1948; Ford et al. 1998, 2000; Ford and Ellis 2005; Saulitis et al. 2000). Ford and Ellis (2005) found that salmon represent over 96 percent of the prey consumed during the spring, summer, and fall. Chinook Salmon were selected over other species, comprising over 70 percent of the identified salmonids taken. This preference occurred despite the much lower abundance of Chinook in the study area in comparison to other salmonids and is probably related to the species' large size, high fat and energy content, and year-round occurrence in the area. Other salmonids eaten in smaller amounts include chum (22 percent of the diet), pink (3 percent), coho (2 percent), sockeye (less than 1 percent), and steelhead (less than 1 percent) (Ford and Ellis 2005). This work suggested an overall preference of these whales for Chinook during the summer and fall, but also revealed extensive feeding on chum salmon in the fall.

Southern Resident Killer Whale survival and fecundity are correlated with Chinook Salmon abundance (Ward et al. 2009, Ford et al. 2009). Southern Resident Killer Whales could potentially be affected by changes in salmon populations caused by the Proposed Action, because their survival and fecundity appear dependent on the abundance of Chinook Salmon (Ward et al. 2009, Ford et al. 2009).

Chinook Salmon originating from the Fraser River are the dominant prey of resident Killer Whales in the summer months when they are usually in inland marine waters (Hanson et al. 2010). Less is known of their diet during the remainder of the year (September through May), when they spend much of their time in outer coastal waters, and may range from central California to northern British Columbia (Hanson et al. 2010). However, it is believed likely that they preferentially feed on Chinook Salmon when available, and roughly in proportion to their relative abundance (Hanson et al. 2010). Hanson et al. (2010) found Southern Resident stomachs to contain several different ESUs of salmon, including Central Valley fall-run Chinook Salmon.

NMFS (2008) estimated the biological requirements of Southern Resident Killer Whales including the diet composition and number of salmon the population requires in their coastal range. NMFS estimated that the current population of Southern Residents at the time (87) would be required to consume between 392,555 and 470,288 salmon based on diet compositions and bioenergetic needs in their coastal range. These estimates were based on Chinook Salmon comprising 70 to 88 percent of their diet.

Salmon originating in California streams are estimated to contribute 3 percent of the salmon population off the Washington coast based on genetic stock identification (GSI) of Washington troll catch in May of 1981 and 1982 (Utter et al. 1983). Research in the mid-1970s estimated California's contribution at 5 percent (Wright 1976). More recent data from Collaborative Research on Oregon Ocean Salmon using GSI estimate that 59 percent of salmon analyzed from the Oregon commercial harvest (June–October 2006) were Central Valley fall-run or spring-run Chinook Salmon (https://fp.pacificfishtrax.org/portal/). It is important to note that these percentages could vary during different years or seasons.

Reclamation funds the operation and maintenance of the Coleman, Livingstone, and Nimbus hatcheries. These hatcheries have a combined yearly production goal of 17,200,000 Chinook Salmon smolts. DWR funds the operation of the Feather River hatcheries for production of approximately 8 million Chinook Salmon smolts annually (yearly production goal).

Analysis of Chinook Salmon otoliths in 1999 and 2002 found that the contribution of hatchery-produced fish (from the Sacramento and San Joaquin river system) made up approximately 90 percent of the ocean fishery off the central California coast from Bodega Bay to Monterey Bay (Barnett-Johnson et al. 2007). Similar studies have not been completed to assess the percentage that Central Valley hatcheries contribute to the salmon originating from California off the Oregon and Washington coasts, but it suggests that hatchery fish would likely be the majority.

Based on observations of captive Killer Whales, studies have extrapolated the energy requirements of wild Killer Whales and estimate an average size value for the five salmon species combined. Osborne (1999) estimated that adult Killer Whales would consume 28 to 34 adult salmon per day, and that younger Killer Whales (less than 13 years of age) would consume about 15 to 17 salmon per day to meet their daily energy requirements. Extrapolating these results, the Southern Resident population (approximately 90 individuals) would consume about 750,000 to 850,000 adult salmon per year.

9B.14.4 Population Trends

Some evidence suggests that until the mid- to late-1800s, the Southern Resident Killer Whale population may have numbered more than 200 animals (Krahn et al. 2002). This estimate was based, in part, on a recent genetic analysis of microsatellite DNA, which found that the genetic diversity of the Southern Resident population resembles that of the Northern Residents (Barrett-Lennard 2000, Barrett-Lennard and Ellis 2001), and concluded that the two populations were possibly once similar in size. Recent efforts to assess the Killer Whale population during the past century have been hindered by an absence of empirical information prior to 1974 (NMFS 2006b). For example, a report by Scheffer and Slipp (1948) is the only pre-1974 account of Southern Resident abundance in the area, and it merely noted that the species was “frequently seen” during the 1940s in the Strait of Juan de Fuca, northern Puget Sound, and off the coast of the Olympic Peninsula, with smaller numbers along Washington’s outer coast. Olesiuk et al. (1990) estimated the Southern Resident population size in 1967 to be 96 animals. At about this time, marine mammals became popular attractions in zoos and marine parks, which increased the demand for interesting and exotic display animals. Between 1967 and 1973, it is estimated that 47 Killer Whales, mostly immature, were taken from the Southern Resident population for public display. The rapid removal of individual whales caused an immediate decline in numbers (Ford et al. 2000). By 1971, the level of removal decreased the population by about 30 percent, to approximately 67 whales (Olesiuk et al. 1990). In 1993, two decades after the live capture of Killer Whales ended, the three Southern Resident pods—J, K, and L—totaled 96 animals (Ford et al. 2000).

Over the past decade, the Southern Resident population has fluctuated. For example, the population appeared to experience a period of recovery by increasing to 99 whales in 1995, but then declined by 20 percent to 79 whales in 2001 (-3.3 percent per year) before another slight increase to 83 whales in 2003 (Ford et al. 2000, Carretta et al. 2004). NMFS (2008) estimated the 2007 population to be 87 whales. The population estimate in 2006 was approximately

90 animals (+3.5 percent per year since 2001); the decline in the 1990s, unstable population status, and population structure (e.g., few reproductive age males and non-calving adult females) continue to be causes for concern. Moreover, it is unclear whether the recent increasing trend will continue because these observations may represent an anomaly in the general pattern of survival or a longer-term shift in the survival pattern.

9B.14.5 References

Barnett-Johnson, R., C. B. Grimes, C. F. Royer, and C. J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (*Oncorhynchus tshawytscha*) to the ocean fishery using otolith microstructure as natural tags. *Canadian Journal of Fisheries and Aquatic Sciences* 64: 1683-1692.

Barrett-Lennard, L. G. 2000. *Population Structure and Mating Patterns of Killer Whales as Revealed by DNA Analysis*. Doctoral dissertation. University of British Columbia, Vancouver, B.C.

Barrett-Lennard, L. G., and G. M. Ellis. 2001. *Population Structure and Genetic Variability in Northeastern Pacific Killer Whales: Towards an Assessment of Population Viability.* Research Document 2001/065. Department of Fisheries and Oceans Canada, Nanaimo, British Columbia.

Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, and M. Lowry. 2004. *U.S. Pacific Marine Mammal Stock Assessments: 2003.* NOAA-TM-NMFS-SWFSC-358. National Marine Fisheries Service.

Christensen, I. 1984. Growth and reproduction of killer whales, *Orcinus orca*, in Norwegian coastal waters. *Reports of the International Whaling Commission (Special Issue)* 6: 253–258.

Duffield, D. A., and K. W. Miller. 1988. Demographic features of killer whales in oceanaria in the United States and Canada, 1965-1987. In *North Atlantic Killer Whales*, pp. 297-306. Edited by J. Sigurjónsson, and S. Leatherwood. Workshop on North Atlantic Killer Whales. A special issue of *Journal of the Marine Research Institute Reykjavik* 11. As cited in http://www.orcahome.de/growthrate.htm.

Felleman, F. L., J. R. Heimlich-Boran, R. W. Osborne. 1991. Feeding ecology of the killer whale (*Orcinus orca*). In *Dolphin Societies*, pp. 113-147. Edited by K. Pryor and K. S. Norris. University of California Press, Berkeley.

Ford, J. K. B., and G. M. Ellis. 2005. *Prey Selection and Food Sharing by Fish-eating Resident Killer Whales (Orcinus orca) in British Columbia*. Canadian Science Advisory Secretariat Research Document 2005/041.

Ford, J. K. B., G. M. Ellis, L. G. Barrett-Lennard, A. B. Morton, R. S. Palm, and K. C. Balcomb, III. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. *Canadian Journal of Zoology* 76: 1456-1471.

Ford, J. K. B., G. M. Ellis, and K. C. Balcomb. 2000. *Killer Whales: the Natural History and Genealogy of* Orcinus orca *in British Columbia and Washington State*. Second edition. UBC Press, Vancouver, British Columbia.

Ford, J. K. B., G. M. Ellis, P. F. Olesiuk, K. C. Balcomb, III. 2010. Linking killer whale survival and prey abundance: food limitations in the oceans' apex predator? *Biology Letters* doi:10.1098/rsbl.2009.0468.

Hanson, M. B., R. W. Baird, J. K. B. Ford, J. Hempelmann-Halos, D. M. Van Doornik, J. R. Candy, C. K. Emmons, G. S. Schorr, B. Gisborne, K. L. Ayres, S. K. Wasser, K. C. Balcomb, K. Balcomb-Bartok, J. G. Sneva, and M. J. Ford. 2010. Species and stock identification of prey consumed by endangered Southern Resident Killer Whales in their summer range. *Endangered Species Research* 11: 69-82.

Hauser, D. D. W. 2006. *Summer Space Use of Southern Resident Killer Whales (Orcinus orca) within Washington and British Columbia Inshore Waters.* Master's thesis. University of Washington, Seattle.

Heimlich-Boran, J. R. 1988. Behavioral ecology of killer whales (*Orcinus orca*) in the Pacific Northwest. *Canadian Journal of Zoology* 66: 565-578.

Krahn, M. M., P. R. Wade, S. T. Kalinowski, M. E. Dahlheim, B. L. Taylor, M. B. Hanson, G. M. Ylitalo, R. P. Angliss, J. E. Stein, and R. S. Waples. 2002. *Status Review of Southern Resident Killer Whales (*Orcinus orca*) under the Endangered Species Act.* NOAA Technical Memorandum NMFS-NWFSC-54. National Marine Fisheries Service.

Krahn, M., M. J. Ford, W. F. Perrin, P. R. Wade, R. P. Angliss, M. B. Hanson, B. L. Taylor, G. M. Ylitalo, M. E. Dahlheim, J. E. Stein, and R. S. Waples. 2002. *Status Review of Southern Resident Killer Whales (*Orcinus orca*) under the Endangered Species Act*. NOAA Technical Memorandum NMFS-NWFSC-62. National Marine Fisheries Service.

Matkin, C. O., G. Ellis, L. B. Lennard, H. Yurk, E. Saulitis, D. Scheel, P. Olesiuk, and G. Ylitalo. 2003. *Photographic and Acoustic Monitoring of Killer Whales in Prince William Sound and Kenai Fjords.* Exxon Valdez Oil Spill Restoration Project. North Gulf Oceanic Society, Homer, Alaska.

Nichol, L. M., and D. M. Shackleton, 1996. Seasonal movements and foraging behaviour of northern resident killer whales (*Orcinus orca*) in relation to the inshore distribution of salmon (*Oncorhynchus* spp.) in British Columbia. *Canadian Journal of Zoology* 74: 983–991.

NMFS (National Marine Fisheries Service). 2005. Endangered and threatened wildlife and plants: endangered status for Southern Resident killer whales. *Federal Register* 70: 69903-69912.

_____. 2006a. Endangered and threatened species; designation of critical habitat for Southern Resident killer whale. *Federal Register* 71: 69054-69070.

_____. 2006b. *Proposed Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*)*. National Marine Fisheries Service, Northwest Region, Seattle, Washington. As cited by *Reclamation Biological assessment on the continued long-term operations of the Central Valley Project and the State Water Project*, August 2008.

_____. 2008. Chinook prey availability and biological requirements in coastal range of Southern Residents, re: Supplemental comprehensive analysis of Southern Resident killer whales. Memorandum to D. R. Lohn, NMFS, from D. D. Darm, NMFS, Northwest Region, Seattle, Washington. April 11.

Olesiuk, P. F., M. A. Bigg, and G. M. Ellis. 1990. Life history and population dynamics of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. *Rep. International Whaling Commission (Special Issue)* 12: 209-244.

Olson, J. M. 1998. *Temporal and Spatial Distribution Patterns of Sightings of Southern Community and Transient Orcas in the Inland Waters of Washington and British Columbia.* Master's thesis, Western Washington University, Bellingham. As cited in NMFS 2005.

Osborne, R. W. 1999. *A Historical Ecology of Salish Sea "Resident" Killer Whales (*Orcinus orca*): with Implications for Management.* Doctoral dissertation. University of Victoria, Victoria, British Columbia.

Perrin, W. F., and S. B. Reilly. 1984. Reproductive parameters of dolphins and small whales of the family *Delphinidae*. In *Reproduction in Whales, Dolphins and Porpoises*, pp. 97-134. Edited by W. F. Perrin, R. L. Brownell Jr., and D. P. DeMaster. International Whaling Commission (Special Issue 6), Cambridge, England.

Saulitis, E., C. Matkin, L. Barett-Lennard, K. Heise, and G. Ellis. 2000. Foraging strategies of sympatric killer whale (*Orcinus orca*) populations in Prince William Sound, Alaska. *Marine Mammal Science* 16: 94-109.

Scheffer, V. B., and J. W. Slipp. 1948. The whales and dolphins of Washington State with a key to the cetaceans of the west coast of North America. *American Midland Naturalist* 39: 257-337.

Utter, F., D. Teel, and G. Milner. 1983. *Genetic Stock Identification Study, 1981-1982*. Final report, Project No. 197900100. Bonneville Power Administration, Portland, Oregon.

Ward, E. J., E. E. Holmes, and K .C. Balcomb. 2009. Quantifying the effects of prey abundance on killer whale reproduction. *Journal of Applied Ecology* 46: 632-640.

Wright, S. G. 1976. *Status of Washington's Commercial Troll Fishery in the Mid-1970s.* Technical Report No. 21. Washington Department of Fisheries, Olympia. As cited by *Reclamation Biological assessment on the continued long-term operations of the Central Valley Project and the State Water Project*, August 2008.

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Appendix 9C

Reclamation Salmon Mortality Model Analysis Documentation

This appendix provides information about the methods and assumptions used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the Bureau of Reclamation (Reclamation) Salmon Mortality Model. It is organized in two main sections that are briefly described below:

- Section 9C.1: Reclamation Salmon Mortality Model Methodology and Assumptions
  - The EIS Salmon Mortality analysis uses the Reclamation Salmon Mortality model to quantify salmon early life stage (pre-spawned eggs, fertilized eggs, and pre-emergent fry) losses on the Trinity, Sacramento, Feather, American, and Stanislaus Rivers. This section briefly describes the overall analytical approach and assumptions of the Reclamation Salmon Mortality model.
- Section 9C.2: Reclamation Salmon Mortality Model Results
  - This section presents the salmon early life stage (pre-spawned eggs, fertilized eggs, and pre-emergent fry) mortality percentage of Trinity River Fall-Run, Sacramento River fall-run, late fall-run, spring-run, and winter-run, Feather River fall-run, American River fall-run, and Stanislaus River fall-run Chinook Salmon. Statistics are presented in tabular format.

9.C.1 Reclamation Salmon Mortality Model Methodology and Assumptions

9.C.1.1 Reclamation Salmon Mortality Model Methodology

The Reclamation Salmon Mortality Model simulates the early life stage mortality of Chinook Salmon along reaches of the Trinity (below Lewiston Dam to Burnt Ranch), Sacramento (below Keswick Dam to Princeton), Feather (below the Fish Dam to the Sacramento River confluence), American (below Nimbus Dam to the Sacramento River confluence), and Stanislaus Rivers (below Goodwin Dam to Riverbank). The model sets an initial spawning distribution along the different river reaches (as a percentage) and uses water temperature data to simulate egg development and mortality based on temperature relationships specified in the model. Daily water temperature results for the Sacramento, American, and Stanislaus rivers come from the HEC5Q models; and monthly water temperature results for the Trinity and Feather rivers come from the Reclamation Temperature Model are used as an input to Reclamation Salmon Mortality Model. The final output from the Reclamation Salmon Mortality Model used in this analysis is the resulting annual percent mortality. Operations Criteria and Plan (OCAP)

Biological Assessment (BA) Appendix L (Reclamation 2008) provides detailed description of the Reclamation Salmon Mortality Model structure, assumptions, and processes.

9.C.1.2 Reclamation Salmon Mortality Model Analysis Scenario Assumptions

This section describes the assumptions for the Reclamation Salmon Mortality Model analysis for the No Action Alternative, Second Basis of Comparison, and other alternatives.

The following CalSim II model simulations were performed as the basis of evaluating the impacts of Alternatives 1 through 5 as compared to the No Action Alternative, and the No Action Alternative and Alternatives 1 through 5 as compared to the Second Basis of Comparison:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for simulation purposes, considered the same as Second Basis of Comparison.
- Alternative 5

Assumptions for each of these alternatives were developed with the surface water modeling tools and are described in Appendix 5A, Section B.

Alternative 1 modeling assumptions are the same as the Second Basis of Comparison, and Alternative 2 modeling assumptions are the same as the No Action Alternative; therefore, the assumptions for those alternatives are not discussed separately in this document.

Assumptions for each of these alternatives are reflected to monthly CalSim II flow data that are used in the HEC5Q and Reclamation Temperature Models to generate flow and water temperature data that are then used in the Reclamation Salmon Mortality Model. Table 9C.1 provides the assumed spawning distributions for fall-, late fall-, winter-, and spring-Run Chinook Salmon on the Sacramento River in simulating various scenarios in this EIS. The OCAP BA Appendix L (Reclamation 2008) Tables L-2 to L-5 provide the assumed spawning distributions for Trinity River, Feather River, American River, and Stanislaus River fall-run Chinook Salmon.

Table 9C.1 Upper Sacramento River Spawning Distributions

Reach	No.	River Reach	Spawning Distribution (%)			
			Fall	Late Fall	Winter	Spring
UPPER	1	Keswick Dam – ACID Dam	16.28%	67.6%	45.03%	12.43%
	2	ACID Dam – Hwy 44	5.48%	5.0%	42.09%	32.77%
	3	Hwy 44 – Upper Anderson Bridge	12.26%	3.7%	12.23%	27.66%
	4	Upper Anderson Bridge – Balls Ferry	16.19%	7.9%	0.26%	10.90%
	5	Balls Ferry – Jellys Ferry	23.08%	8.0%	0.28%	8.75%
	6	Jellys Ferry – Bend Bridge	6.61%	1.0%	0.06%	2.58%
	7	Bend Bridge – Red Bluff Pumping Plant (previously Red Bluff Diversion Dam)	3.48%	0.5%	0.00%	0.83%
	Total – Upper Salmon Reach		**83.37%**	**93.8%**	**99.95%**	**95.92%**
MIDDLE	8	Red Bluff Pumping Plant – Tehama Bridge	10.82%	3.1%	0.05%	4.08%
	9	Tehama Bridge – Woodson Bridge	3.07%	1.2%	0.00%	0.00%
	10	Woodson Bridge – Hamilton City	1.82%	1.1%	0.00%	0.00%
	Total – Middle Salmon Reach		**15.71%**	**5.4%**	**0.05%**	**4.08%**
LOWER	11	Hamilton City – Ord Ferry	0.82%	0.6%	0.00%	0.0%
	12	Ord Ferry – Princeton	0.10%	0.2%	0.00%	0.0%
	Total – Lower Salmon Reach		**0.92%**	**0.8%**	**0.0%**	**0.0%**

NOTE:

Sacramento River salmon spawning distributions were revised based on average 2003-2014 redd survey data, provided by David Swank at National Marine Fisheries Service in April 2015.

9.C.2 Reclamation Salmon Mortality Model Results

Results are provided for each of the following runs separately:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1
- Alternative 3
- Alternative 5

In addition, the same statistics are provided for the following comparisons to establish changes of the alternative with respect to one of the bases of comparison:

- Alternative 1 compared to No Action Alternative
- Alternative 3 compared to No Action Alternative
- Alternative 5 compared to No Action Alternative

- No Action Alternative compared to Second Basis of Comparison
- Alternative 1 compared to Second Basis of Comparison
- Alternative 3 compared to Second Basis of Comparison
- Alternative 5 compared to Second Basis of Comparison

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

The results are provided as tables summarizing the annual losses with long-term averages over the 82-year CalSim II simulation period. Averages are also provided by water year type.

The following results are presented in this section:

- B.1. Sacramento River Percent Salmon Loss Summary – Fall-Run Chinook Salmon
- B.2. Sacramento River Percent Salmon Loss Summary – Late Fall-Run Chinook Salmon
- B.3. Sacramento River Percent Salmon Loss Summary – Spring-Run Chinook Salmon
- B.4. Sacramento River Percent Salmon Loss Summary – Winter-Run Chinook Salmon
- B.5. Trinity River Percent Salmon Loss Summary – Fall-Run Chinook Salmon
- B.6. American River Percent Salmon Loss Summary – Fall-Run Chinook Salmon
- B.7. Feather River Percent Salmon Loss Summary – Fall-Run Chinook Salmon
- B.8. Stanislaus River Percent Salmon Loss Summary – Fall-Run Chinook Salmon

9.C.3 References

Reclamation (Bureau of Reclamation). 2008. *2008 Central Valley Project and State Water Project Operations Criteria and Plan Biological Assessment*, Appendix L Reclamation Salmon Mortality Model.

Table B-1. Sacramento River Percent Mortality - Fall-Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	17.0	---	-0.1
Wet	10.7	---	-0.8
Above Normal	10.5	---	-1.3
Below Normal	15.3	---	0.1
Dry	17.3	---	-0.1
Critical	37.9	---	2.4
Second Basis of Comparison			
Long-term Average	17.1	0.1	
Wet	11.5	0.8	---
Above Normal	11.9	1.3	---
Below Normal	15.2	-0.1	---
Dry	17.4	0.1	---
Critical	35.5	-2.4	---
Alternative 3			
Long-term Average	16.8	-0.2	-0.3
Wet	11.3	0.6	-0.2
Above Normal	11.6	1.0	-0.3
Below Normal	14.7	-0.7	-0.6
Dry	16.9	-0.4	-0.5
Critical	35.6	-2.3	0.1
Alternative 5			
Long-term Average	16.9	-0.1	-0.2
Wet	10.6	0.0	-0.8
Above Normal	10.4	-0.1	-1.4
Below Normal	15.0	-0.3	-0.2
Dry	17.0	-0.3	-0.5
Critical	38.5	0.6	3.0

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-2. Sacramento River Percent Mortality - Late Fall-Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	3.1	---	0.4
Wet	3.1	---	0.8
Above Normal	2.4	---	0.5
Below Normal	2.5	---	-0.1
Dry	2.7	---	0.1
Critical	4.8	---	0.2
Second Basis of Comparison			
Long-term Average	2.7	-0.4	
Wet	2.2	-0.8	---
Above Normal	1.9	-0.5	---
Below Normal	2.6	0.1	---
Dry	2.5	-0.1	---
Critical	4.6	-0.2	---
Alternative 3			
Long-term Average	2.7	-0.4	0.0
Wet	2.3	-0.8	0.0
Above Normal	1.8	-0.6	-0.1
Below Normal	2.6	0.1	0.0
Dry	2.6	-0.1	0.1
Critical	4.6	-0.2	-0.1
Alternative 5			
Long-term Average	3.1	0.0	0.4
Wet	3.0	0.0	0.8
Above Normal	2.4	0.0	0.5
Below Normal	2.4	-0.1	-0.1
Dry	2.7	0.0	0.2
Critical	4.9	0.1	0.2

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-3. Sacramento River Percent Mortality - Spring-Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	21.9	---	0.7
Wet	6.3	---	-2.4
Above Normal	4.8	---	-2.4
Below Normal	13.3	---	0.8
Dry	19.4	---	0.7
Critical	84.8	---	10.4
Second Basis of Comparison			
Long-term Average	21.1	-0.7	
Wet	8.6	2.4	---
Above Normal	7.2	2.4	---
Below Normal	12.5	-0.8	---
Dry	18.6	-0.7	---
Critical	74.3	-10.4	---
Alternative 3			
Long-term Average	21.1	-0.7	0.0
Wet	8.4	2.1	-0.3
Above Normal	7.3	2.4	0.0
Below Normal	10.8	-2.5	-1.6
Dry	17.5	-1.9	-1.1
Critical	78.1	-6.6	3.8
Alternative 5			
Long-term Average	21.9	0.1	0.8
Wet	6.3	0.0	-2.4
Above Normal	4.9	0.0	-2.4
Below Normal	13.3	0.0	0.8
Dry	18.1	-1.3	-0.6
Critical	87.4	2.6	13.1

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-4. Sacramento River Percent Mortality - Winter-Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	5.0	---	0.7
Wet	0.6	---	-0.1
Above Normal	0.1	---	0.0
Below Normal	0.2	---	-0.8
Dry	0.3	---	0.0
Critical	31.4	---	5.4
Second Basis of Comparison			
Long-term Average	4.3	-0.7	
Wet	0.6	0.1	---
Above Normal	0.1	0.0	---
Below Normal	1.0	0.8	---
Dry	0.3	0.0	---
Critical	26.0	-5.4	---
Alternative 3			
Long-term Average	4.2	-0.8	-0.1
Wet	0.6	0.1	0.0
Above Normal	0.1	0.0	0.0
Below Normal	1.0	0.7	0.0
Dry	0.3	-0.1	0.0
Critical	25.3	-6.0	-0.7
Alternative 5			
Long-term Average	4.6	-0.4	0.3
Wet	0.6	0.0	-0.1
Above Normal	0.1	0.0	0.0
Below Normal	0.3	0.0	-0.8
Dry	0.3	0.0	0.0
Critical	28.9	-2.5	2.9

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-5. Trinity River Percent Mortality - Fall-Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	4.0	---	0.2
Wet	1.3	---	-0.6
Above Normal	1.5	---	0.2
Below Normal	3.8	---	0.5
Dry	2.5	---	0.2
Critical	14.8	---	1.8
Second Basis of Comparison			
Long-term Average	3.7	-0.2	
Wet	1.9	0.6	---
Above Normal	1.2	-0.2	---
Below Normal	3.4	-0.5	---
Dry	2.3	-0.2	---
Critical	13.0	-1.8	---
Alternative 3			
Long-term Average	3.7	-0.2	0.0
Wet	1.9	0.5	-0.1
Above Normal	1.2	-0.2	0.0
Below Normal	3.2	-0.6	-0.2
Dry	2.2	-0.3	-0.1
Critical	13.3	-1.5	0.3
Alternative 5			
Long-term Average	3.9	0.0	0.2
Wet	1.3	0.0	-0.6
Above Normal	1.4	0.0	0.2
Below Normal	3.6	-0.2	0.3
Dry	2.5	0.0	0.2
Critical	14.9	0.1	1.9

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-6. American River Percent Mortality - Fall-Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	23.2	---	0.2
Wet	22.6	---	-0.6
Above Normal	23.2	---	0.6
Below Normal	23.5	---	2.0
Dry	22.9	---	-0.1
Critical	25.0	---	0.1
Second Basis of Comparison			
Long-term Average	23.1	-0.2	
Wet	23.2	0.6	---
Above Normal	22.7	-0.6	---
Below Normal	21.5	-2.0	---
Dry	23.0	0.1	---
Critical	24.9	-0.1	---
Alternative 3			
Long-term Average	23.2	-0.1	0.1
Wet	23.2	0.6	-0.1
Above Normal	22.6	-0.6	0.0
Below Normal	21.8	-1.7	0.3
Dry	22.9	0.0	-0.1
Critical	25.4	0.4	0.6
Alternative 5			
Long-term Average	23.0	-0.3	-0.1
Wet	22.7	0.1	-0.5
Above Normal	22.5	-0.7	-0.2
Below Normal	22.5	-1.0	1.0
Dry	22.9	0.0	-0.1
Critical	24.7	-0.3	-0.2

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-7. Feather River Percent Mortality - Fall Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	7.2	---	0.2
Wet	4.6	---	2.8
Above Normal	3.4	---	0.2
Below Normal	8.4	---	-0.9
Dry	7.7	---	-0.9
Critical	14.5	---	-3.0
Second Basis of Comparison			
Long-term Average	7.0	-0.2	
Wet	1.7	-2.8	---
Above Normal	3.1	-0.2	---
Below Normal	9.2	0.9	---
Dry	8.6	0.9	---
Critical	17.4	3.0	---
Alternative 3			
Long-term Average	6.0	-1.1	-0.9
Wet	1.9	-2.7	0.1
Above Normal	2.9	-0.4	-0.2
Below Normal	6.8	-1.6	-2.4
Dry	7.8	0.0	-0.8
Critical	14.6	0.2	-2.8
Alternative 5			
Long-term Average	6.9	-0.2	-0.1
Wet	4.5	0.0	2.8
Above Normal	3.2	-0.2	0.1
Below Normal	10.6	2.3	1.4
Dry	7.4	-0.3	-1.1
Critical	13.9	-0.6	-3.6

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-8. Stanislaus River Percent Mortality - Fall-Run Chinook Salmon

	Percent Mortality	Difference from No Action Alternative	Difference from Second Basis of Comparison
	%	%	%
No Action Alternative			
Long-term Average	7.0	---	-0.4
Wet	1.6	---	0.1
Above Normal	5.3	---	-0.1
Below Normal	4.4	---	0.3
Dry	4.9	---	-0.3
Critical	14.4	---	-1.5
Second Basis of Comparison			
Long-term Average	7.4	0.4	
Wet	1.5	-0.1	---
Above Normal	5.4	0.1	---
Below Normal	4.1	-0.3	---
Dry	5.1	0.3	---
Critical	15.9	1.5	---
Alternative 3			
Long-term Average	6.2	-0.8	-1.2
Wet	1.6	0.0	0.1
Above Normal	4.0	-1.3	-1.4
Below Normal	3.8	-0.6	-0.3
Dry	4.2	-0.7	-0.9
Critical	13.4	-1.0	-2.5
Alternative 5			
Long-term Average	8.5	1.5	1.0
Wet	1.8	0.2	0.3
Above Normal	6.4	1.1	1.0
Below Normal	6.1	1.6	2.0
Dry	7.0	2.2	1.9
Critical	16.9	2.5	1.0

Notes: All results are based on the 82-year simulation period. The water year types are defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Appendix 9D

SALMOD Analysis Documentation

This appendix provides information about the methods and assumptions used for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the SALMOD model. It is organized in two main sections that are briefly described below:

- Section 9D.1: SALMOD Methodology and Assumptions
  - The analysis uses the SALMOD model to quantify fall-run, late fall-run, spring-run, and winter-run Chinook Salmon survival and mortality for different life-stages within the Sacramento River, specifically from below Keswick Dam to the Red Bluff Pumping Plant (previously at Red Bluff Diversion Dam). This section briefly describes the overall analytical approach and assumptions of the SALMOD Model.
- Section 9D.2: SALMOD Model Results
  - This section presents the production (survival) and mortality by life-stages and various causes of Sacramento River fall-run, late fall-run, spring-run, and winter-run Chinook Salmon. Statistics are presented in exceedance plots and in tabular format.

9D.1 SALMOD Methodology and Assumptions

9D.1.1 SALMOD Methodology

The SALMOD model simulates the life-stage dynamics of fall-run, late fall-run, spring-run, and winter-run Chinook Salmon populations within the Sacramento River, from below Keswick Dam to the Red Bluff Diversion Dam. The model uses daily flow and temperature data from the Sacramento River HEC5Q model to simulate the annual growth, movement, and mortality of the various riverine life stages of the four Chinook Salmon populations based on an initial annual adult population that resets each biological year. The dynamics simulated are based on assumptions and relations specified in the model. The final output from SALMOD used in this analysis is annual production (number of surviving members of each life-stage) and annual mortality based on a variety of factors, including temperature and habitat (flow) based mortality. The 2008 Operations Criteria and Plan (OCAP) Biological Assessment (BA), Appendix P provides detailed description of the SALMOD model structure, assumptions, and processes (Reclamation 2008).

9D.1.2 SALMOD Analysis Scenario Assumptions

This section describes the assumptions for the SALMOD analysis for the No Action Alternative, Second Basis of Comparison, and other alternatives.

The following CalSim II model simulations were performed as the basis of evaluating the impacts of the Alternatives 1 through 5 as compared to the No Action Alternative, and the No Action Alternative and Alternatives 1 through 5 as compared to the Second Basis of Comparison:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for simulation purposes, considered the same as Second Basis of Comparison.
- Alternative 5

Assumptions for each of these alternatives were developed with the surface water modeling tools and are described in Appendix 5A, Section B.

Alternative 1 modeling assumptions are the same as the Second Basis of Comparison, and Alternative 2 modeling assumptions are the same as the No Action Alternative; therefore, the assumptions for those alternatives are not discussed separately in this document.

Assumptions for each of these alternatives are reflected in monthly CalSim II flow data that are used in the Sacramento River HEC5Q Model to generate daily flow and temperature data that are input to the SALMOD model. For this analysis, the initial population of adult were assumed to be 23,356 for fall-run, 5,545 for late fall-run, 500 for spring-run, and 4,108 for winter-run based on geometric mean of 2003-2014 GrandTab escapement data provided by David Swank at the National Marine Fisheries Service (NMFS) in April 2015. For spring-run, the number of adults in the mainstem Sacramento River are significantly low (arithmetic mean of 69). Based on further discussion with NMFS, 500 adults were assumed as the input in SALMOD. The assumed spawning distribution by reach is shown in Table 9D.1. Assumptions of the spawning distributions were based on average 2003-2014 Redd survey data, provided by David Swank at NMFS in April 2015.

Table 9D.1 Upper Sacramento River Spawning Distributions.

River Reach	Spawning Distribution (%) Fall	Spawning Distribution (%) Late Fall	Spawning Distribution (%) Spring	Spawning Distribution (%) Winter
Keswick Dam – Anderson Cottonwood Irrigation District (ACID) Dam	19.50	71.30	12.80	45.10
ACID Dam – Highway 44 Bridge	6.60	5.20	33.90	42.10
Highway 44 Bridge – Airport Road Bridge	14.70	3.90	29.70	12.20
Airport Road Bridge – Balls Ferry	19.40	8.90	11.10	0.30
Balls Ferry – Battle Creek	12.50	5.90	7.40	0.10
Battle Creek – Jellys Ferry	15.20	3.10	1.50	0.10
Jellys Ferry – Bend Bridge	8.00	1.20	2.60	0.10
Bend Bridge – Red Bluff Pumping Plant (previously Red Bluff Diversion Dam)	4.20	0.60	0.80	0.00

9D.2 SALMOD Results

Results are provided for each of the following runs separately:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1
- Alternative 3
- Alternative 5

In addition, the same statistics are provided for the following comparisons to establish changes of the alternative with respect to one of the bases of comparison:

- Alternative 1 compared to No Action Alternative
- Alternative 3 compared to No Action Alternative
- Alternative 5 compared to No Action Alternative
- No Action Alternative compared to Second Basis of Comparison
- Alternative 1 compared to Second Basis of Comparison
- Alternative 3 compared to Second Basis of Comparison
- Alternative 5 compared to Second Basis of Comparison

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

The first set of results is provided as probability of exceedance curves of annual production and mortality for the four Sacramento River salmonid populations. For this analysis, exceedance plots for annual production and mortality were generated based on the 82-year CalSim II time period for each of the alternatives and basis of comparison. Differences among alternatives were evaluated using the exceedance probability corresponding to varying levels of survival. The results are provided at the end of this appendix in the following subsections:

- B.1. Fall-Run Chinook Salmon
- B.2. Late Fall-Run Chinook Salmon
- B.3. Spring-Run Chinook Salmon
- B.4. Winter-Run Chinook Salmon

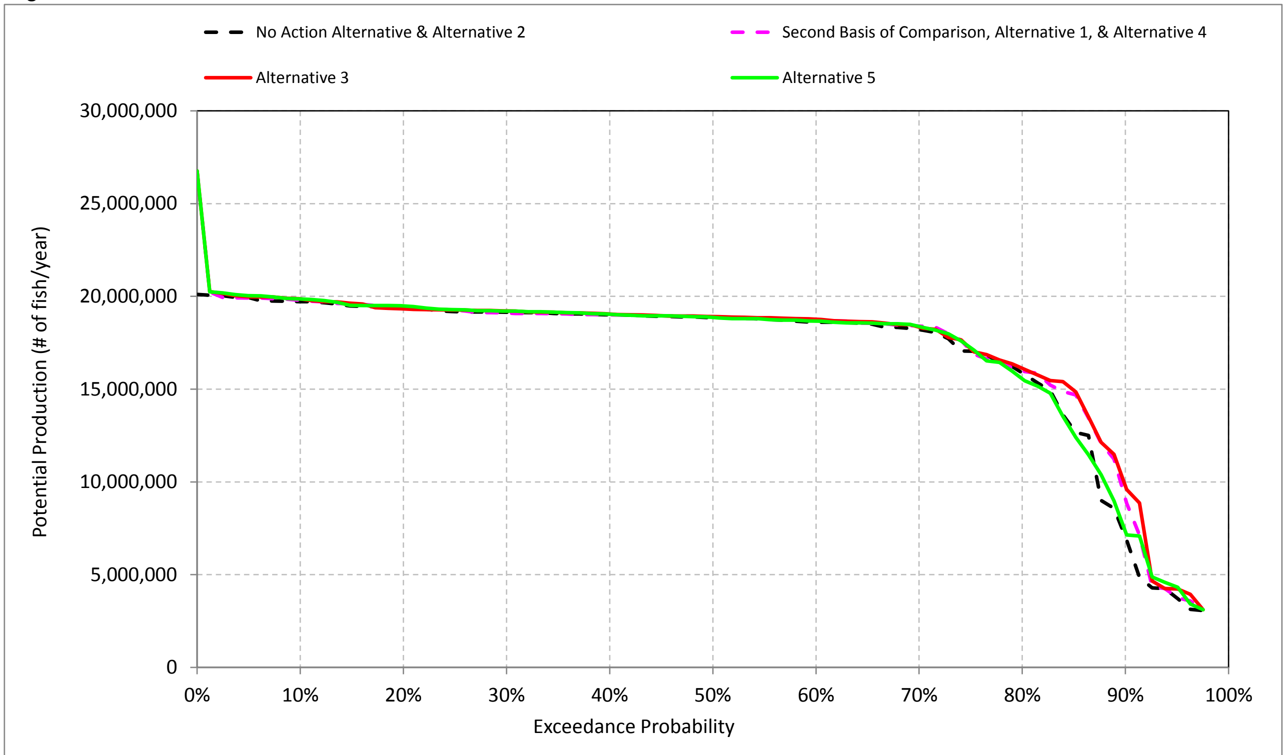
The second set of results is provided as tables summarizing the comparison between alternatives of annual production and mortality with long-term averages over the entire CalSim II simulation period. Averages are also provided by water year type.

9D.3 References

Reclamation (Bureau of Reclamation). 2008. *2008 Central Valley Project and State Water Project Operations Criteria and Plan Biological Assessment*, Appendix P SALMOD Model.

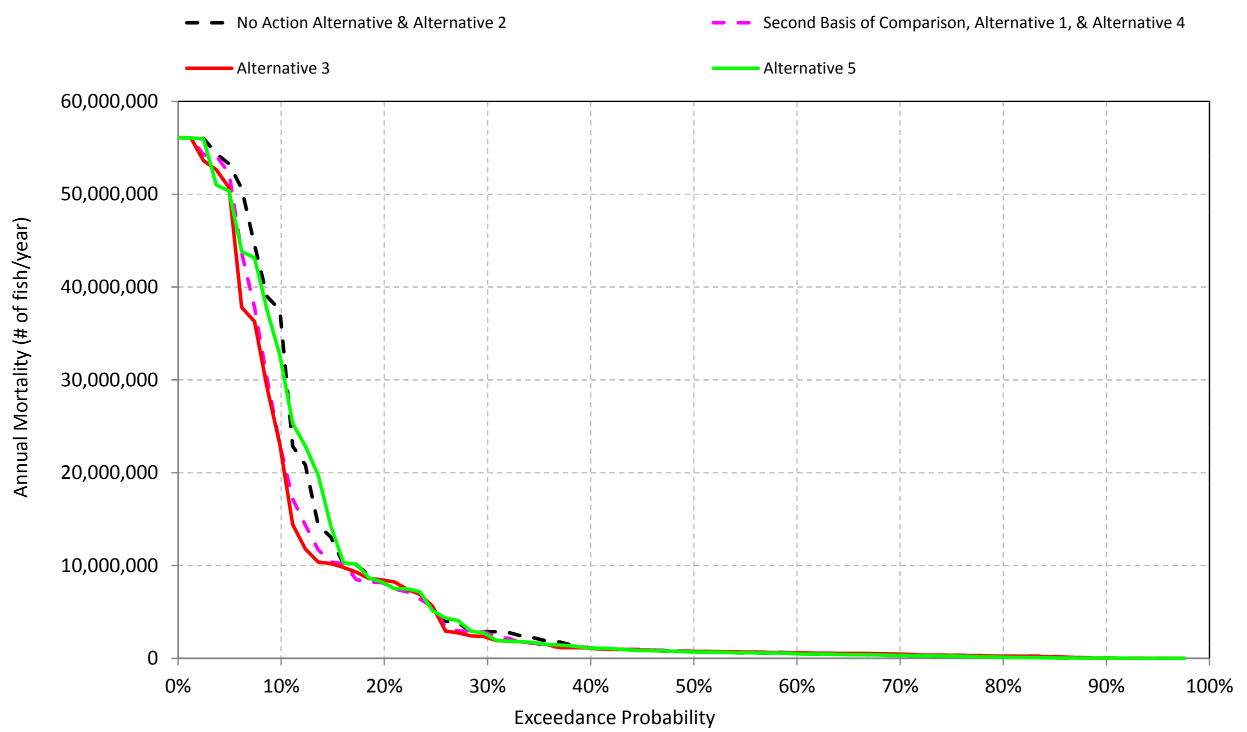
B.1. Fall-Run Chinook Salmon

Figure B-1-1. Annual Potential Production for Fall-Run Chinook Salmon



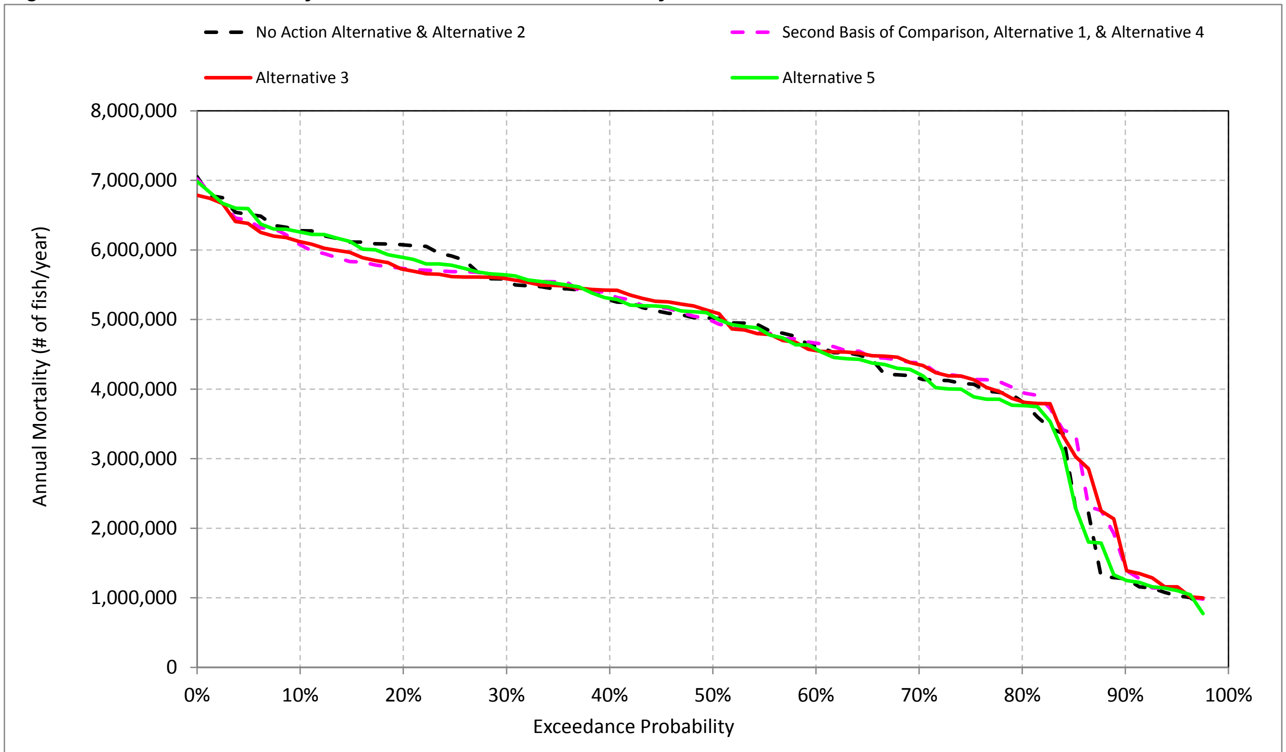
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-2. Annual Mortality for Fall-Run Chinook Salmon - Eggs



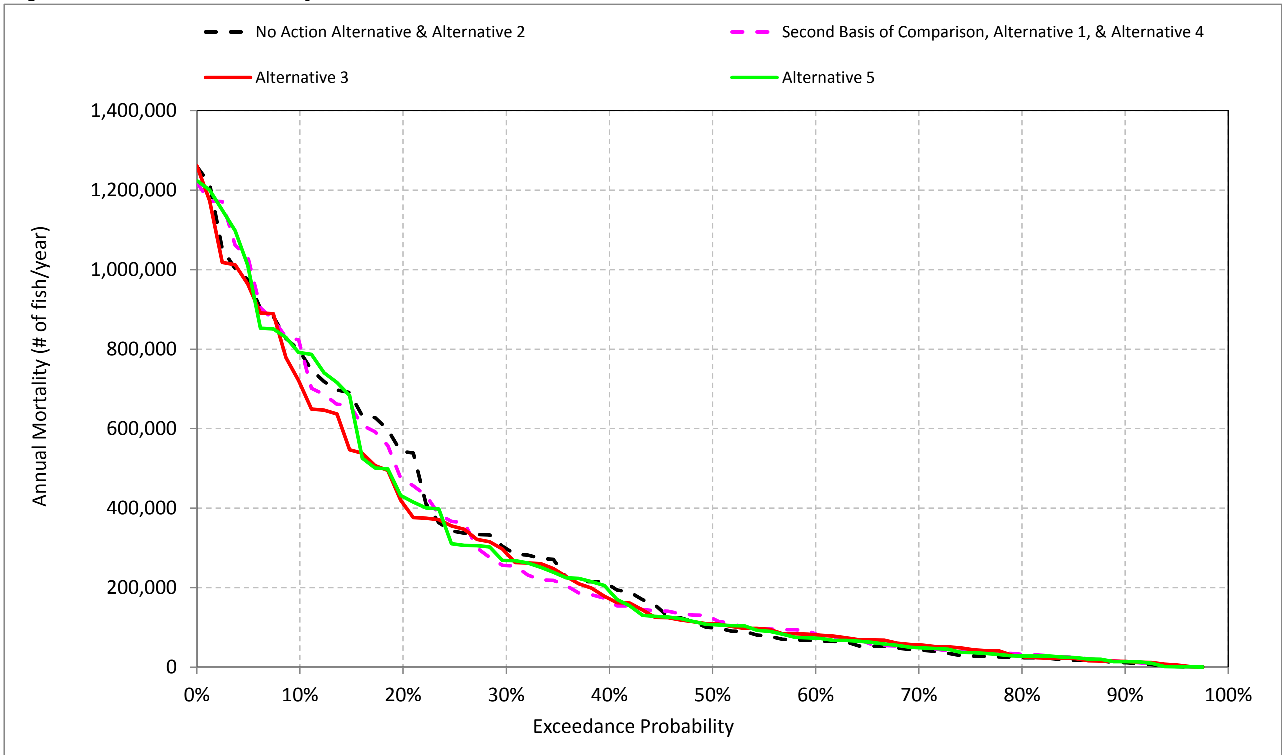
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-3. Annual Mortality for Fall-Run Chinook Salmon - Fry



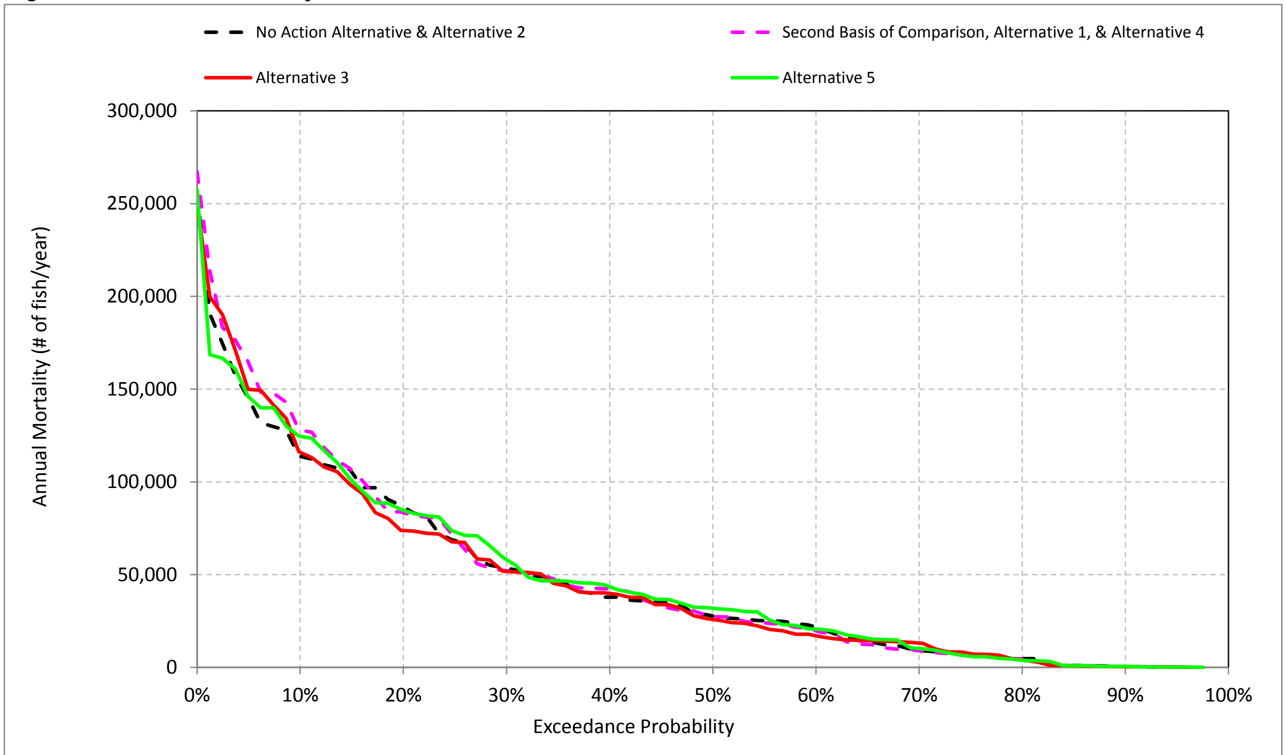
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-4. Annual Mortality for Fall-Run Chinook Salmon - Pre-Smolt



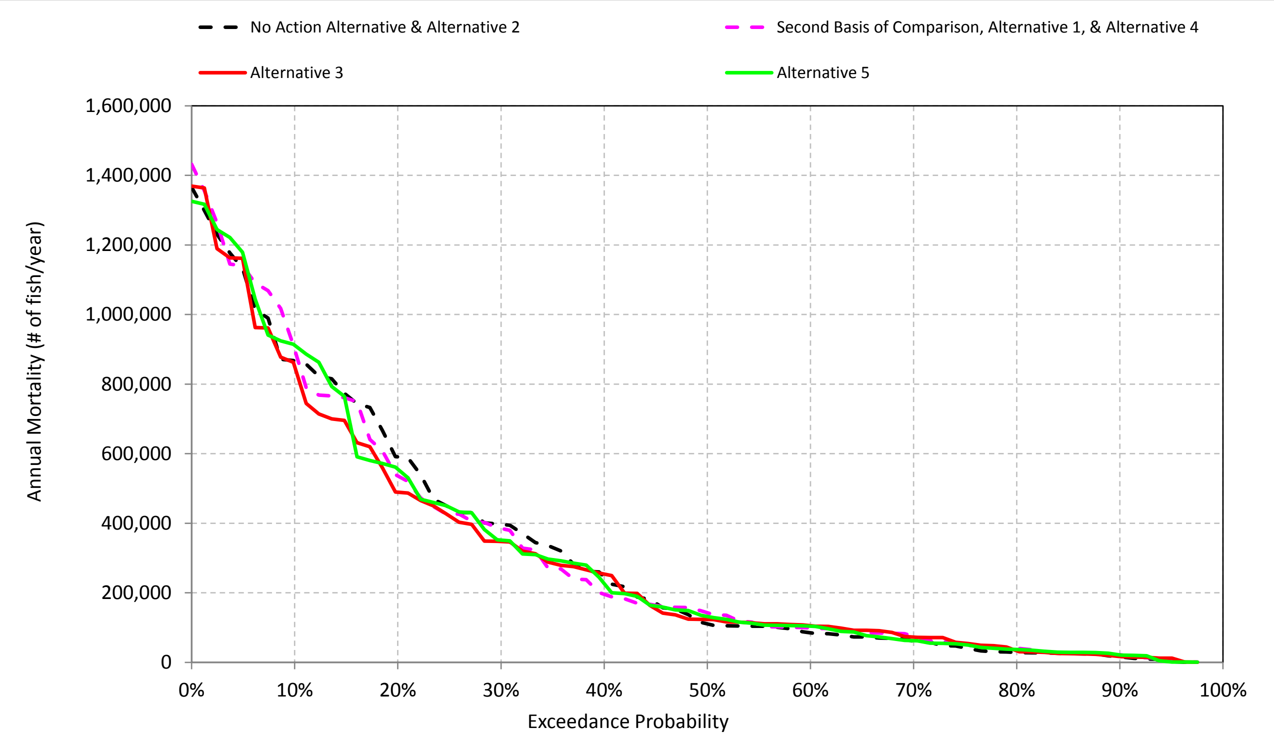
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-5. Annual Mortality for Fall-Run Chinook Salmon - Immature Smolt



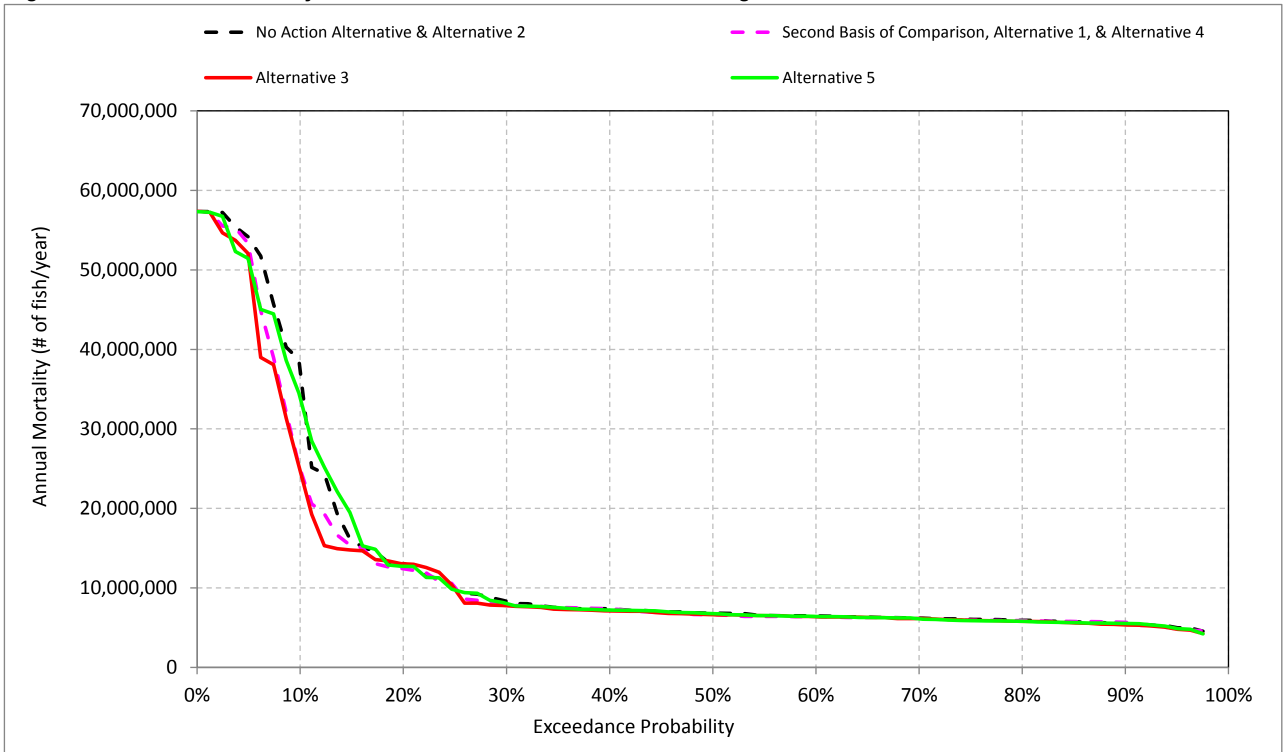
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-6. Annual Mortality for Fall-Run Chinook Salmon - Pre- & Immature Smolts



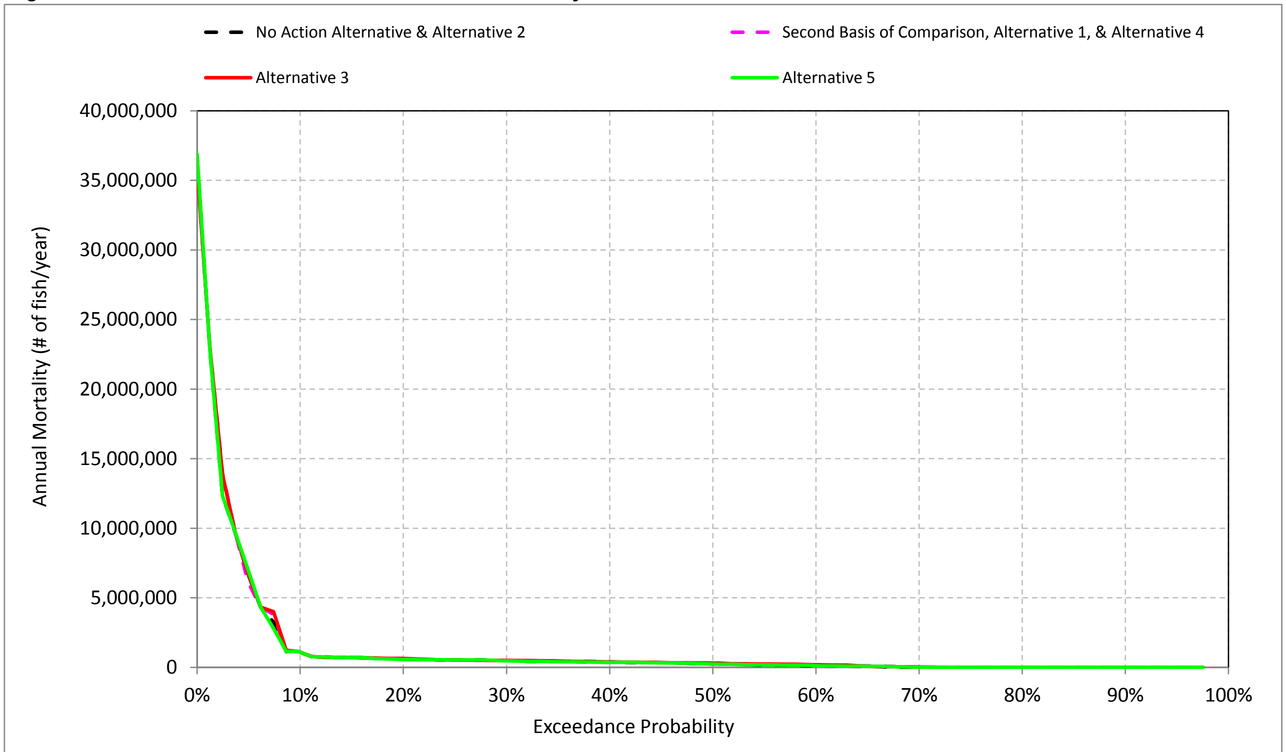
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-7. Annual Mortality for Fall-Run Chinook Salmon - All Lifestages



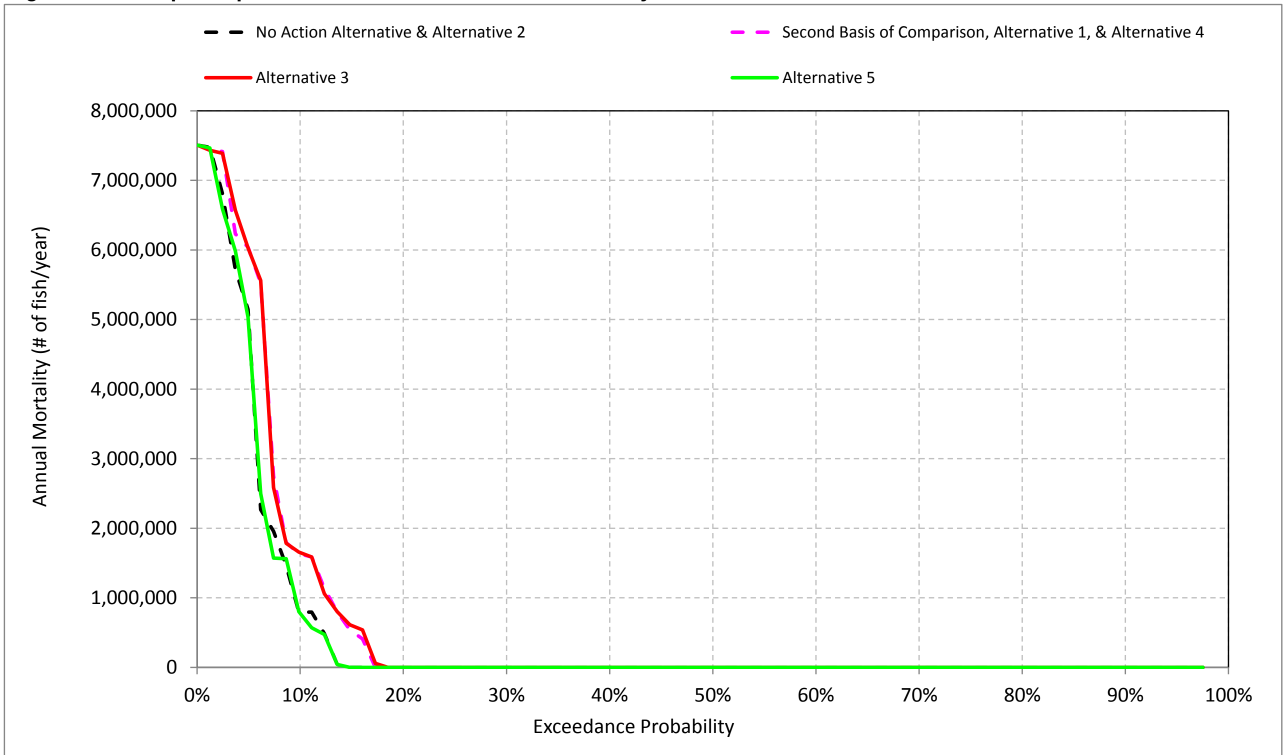
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-8. Incubation - Habitat based Annual Mortality for Fall-Run Chinook Salmon



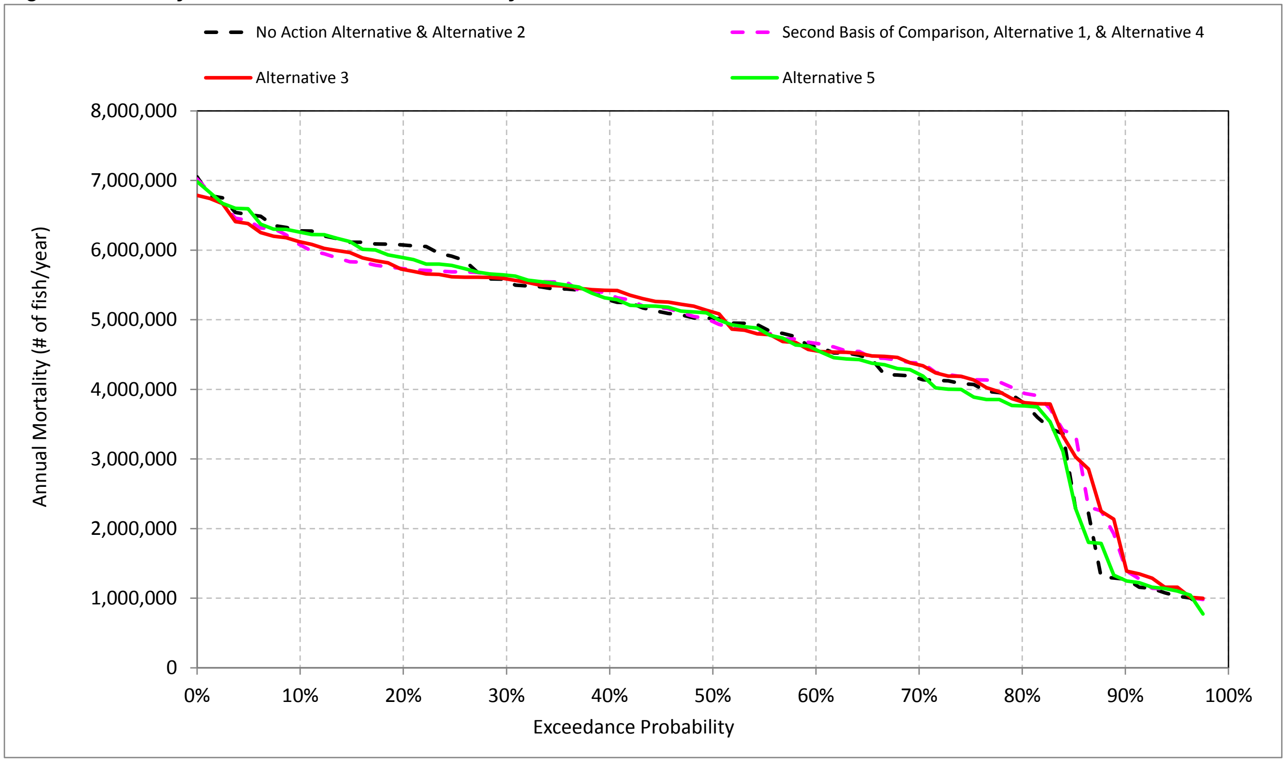
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-9. Super-imposition - Habitat based Annual Mortality for Fall-Run Chinook Salmon



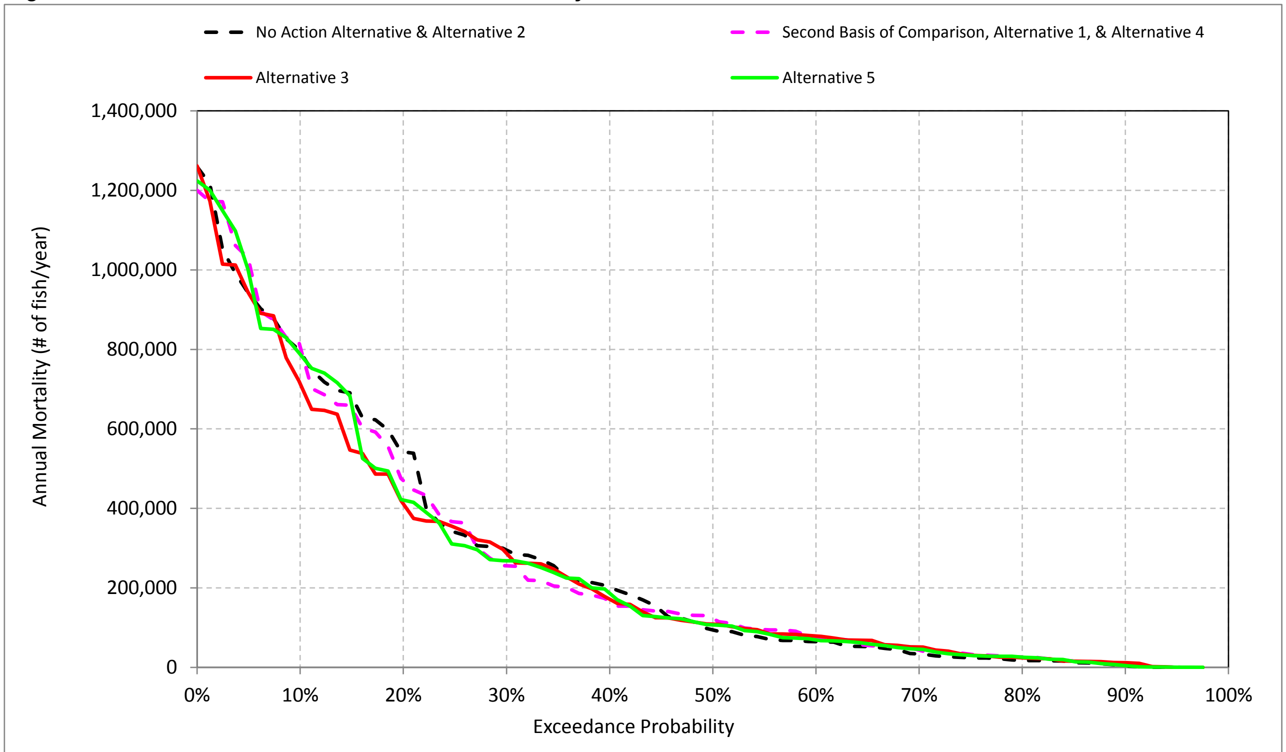
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-10. Fry - Habitat based Annual Mortality for Fall-Run Chinook Salmon



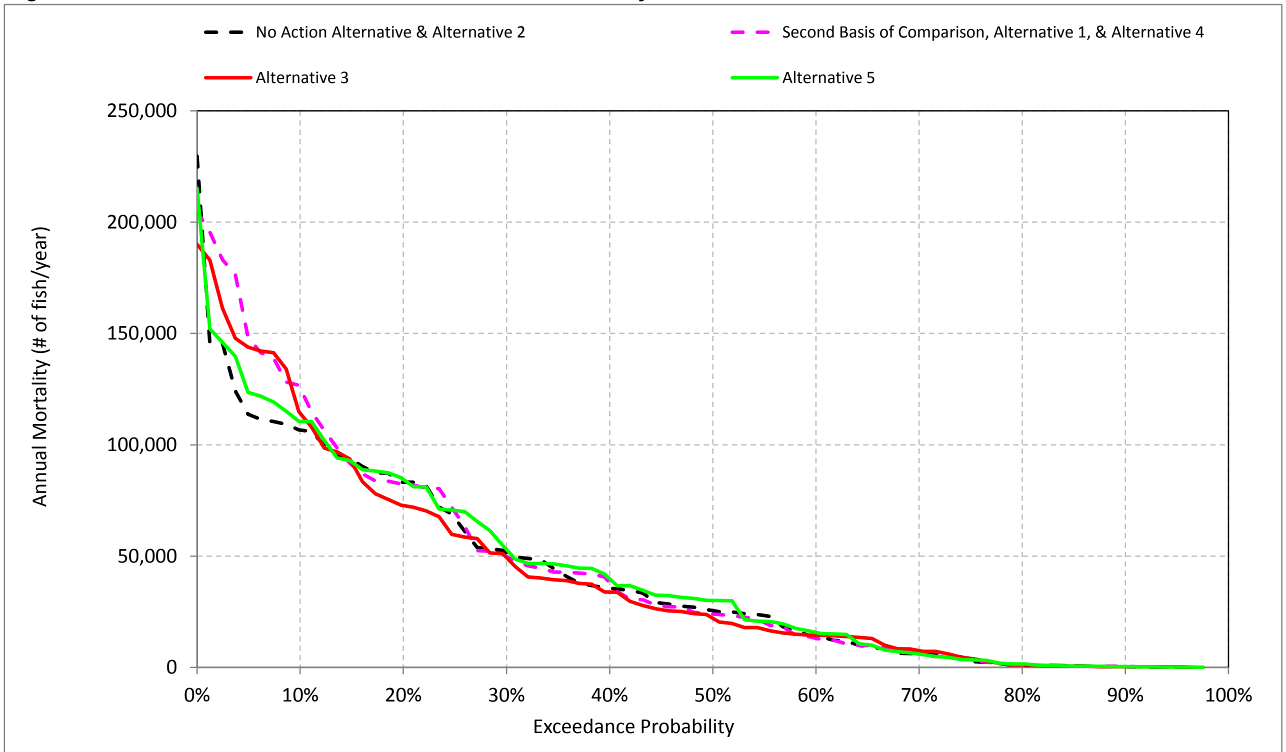
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-11. Pre-smolt - Habitat based Annual Mortality for Fall-Run Chinook Salmon



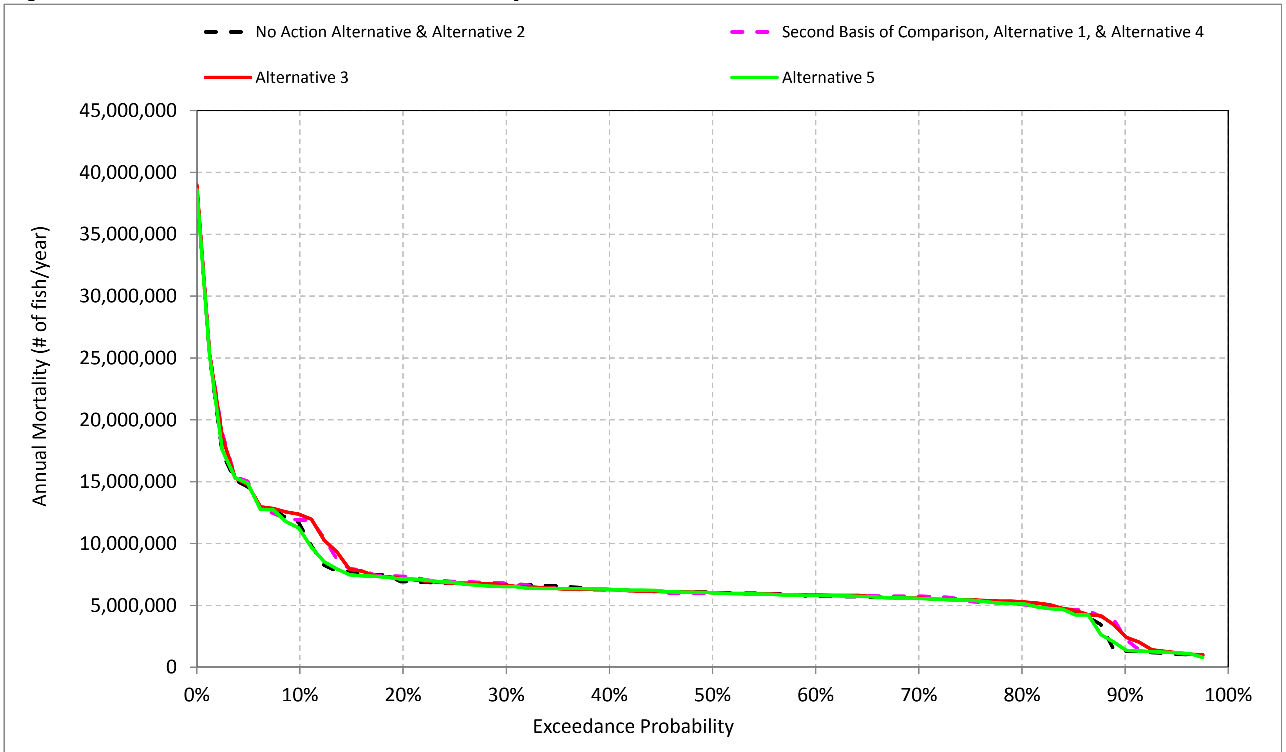
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-12. Immature Smolt - Habitat based Annual Mortality for Fall-Run Chinook Salmon



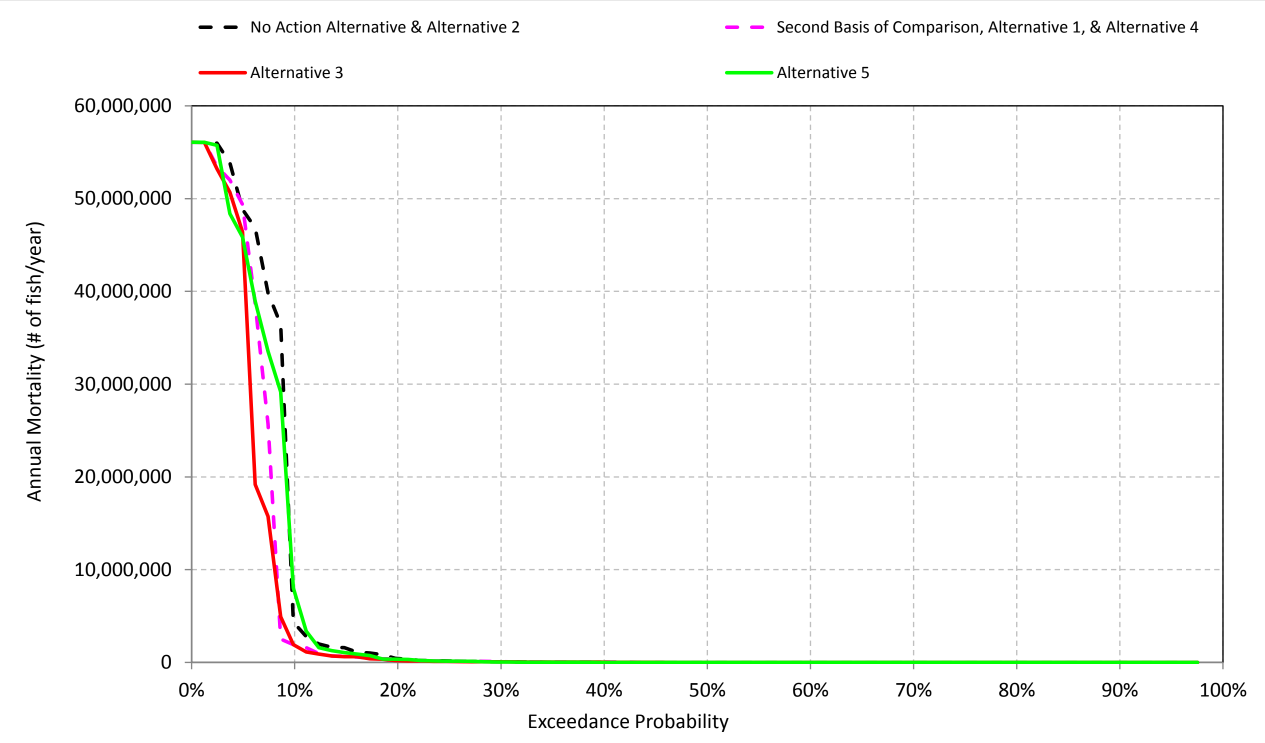
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-13. Total Habitat based Annual Mortality for Fall-Run Chinook Salmon



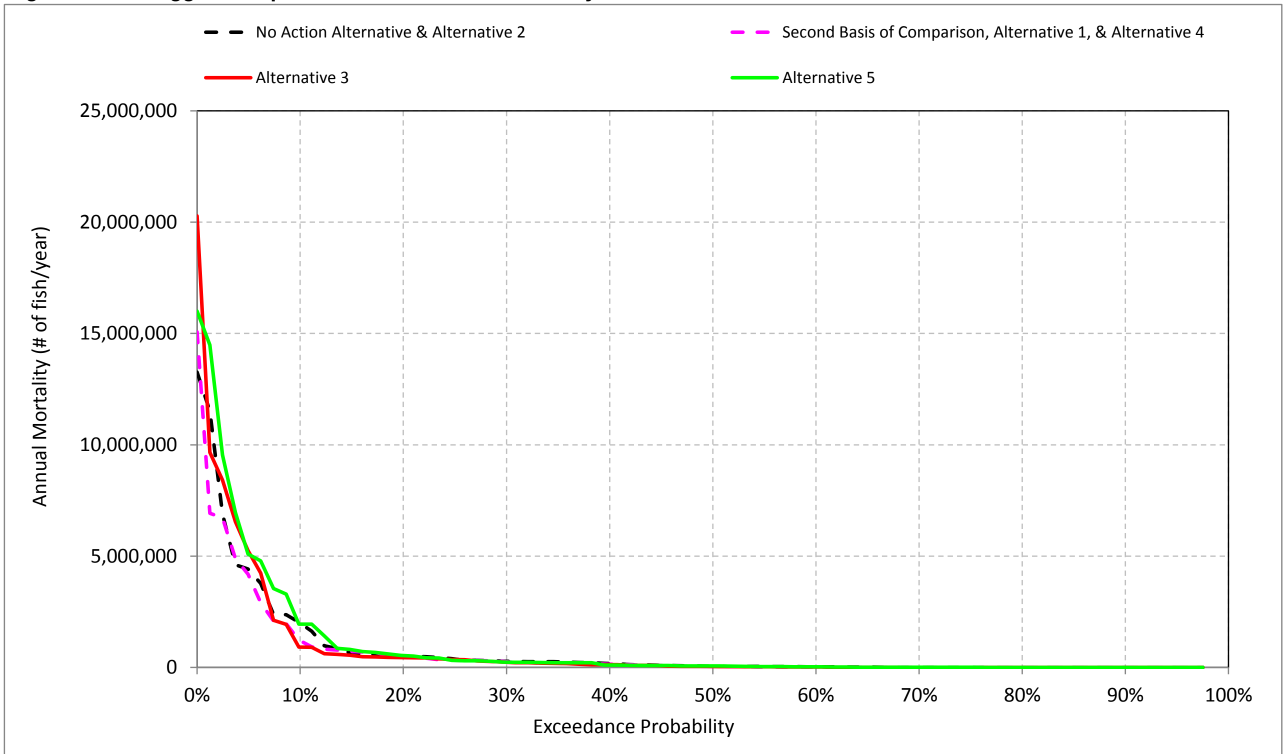
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-14. Pre-Spawn Mortality - Temperature based Annual Mortality for Fall-Run Chinook Salmon



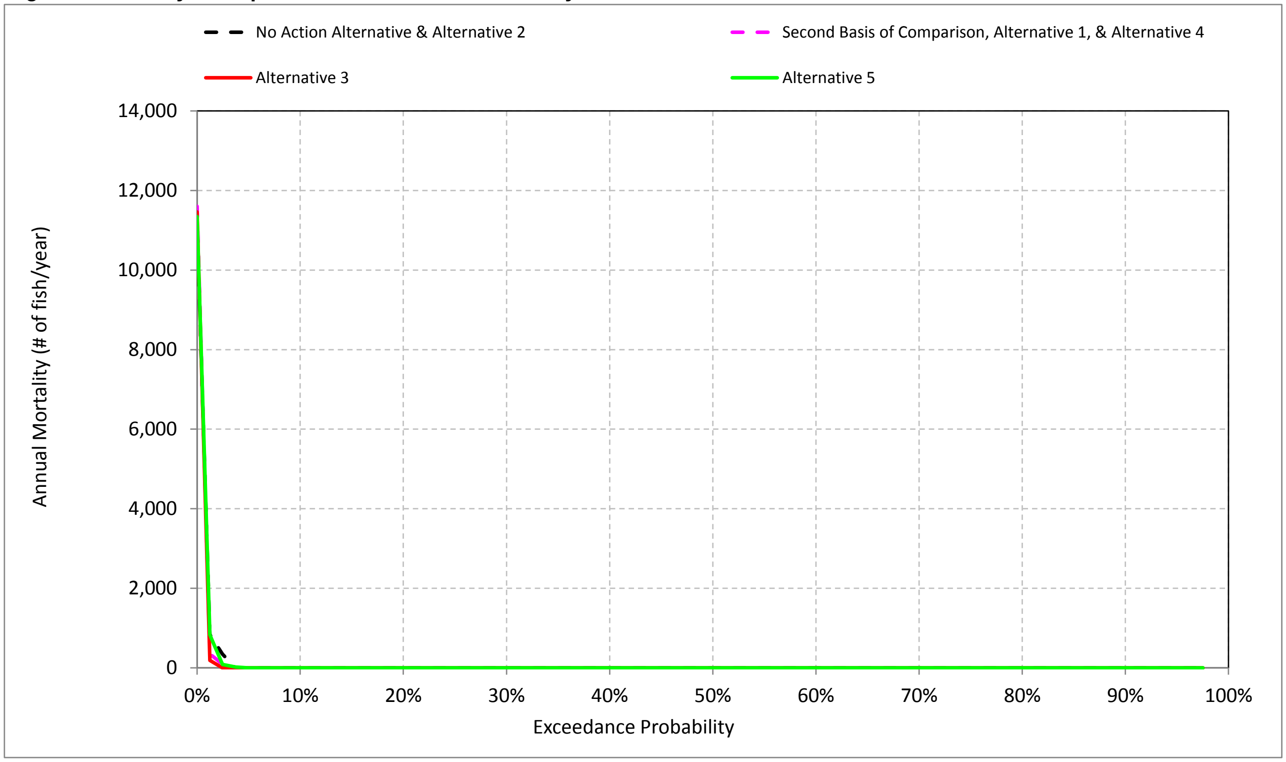
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-15. Eggs - Temperature based Annual Mortality for Fall-Run Chinook Salmon



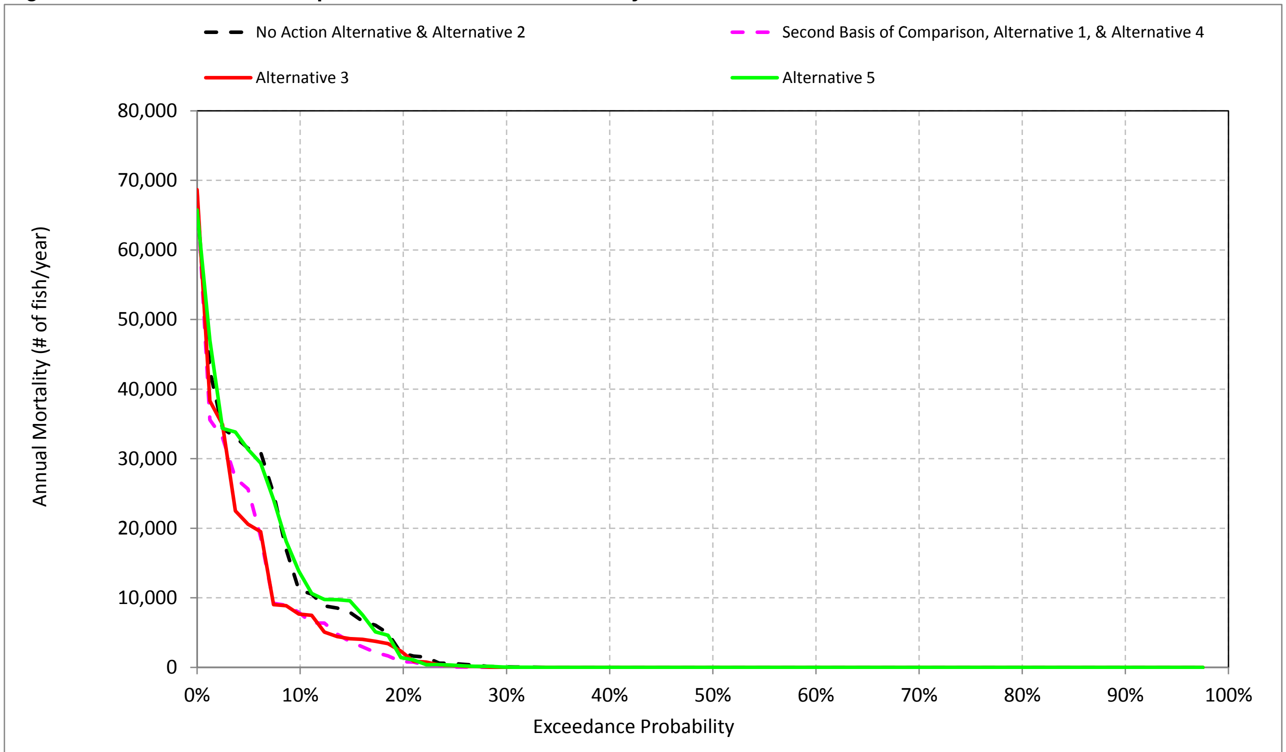
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-16. Fry - Temperature based Annual Mortality for Fall-Run Chinook Salmon



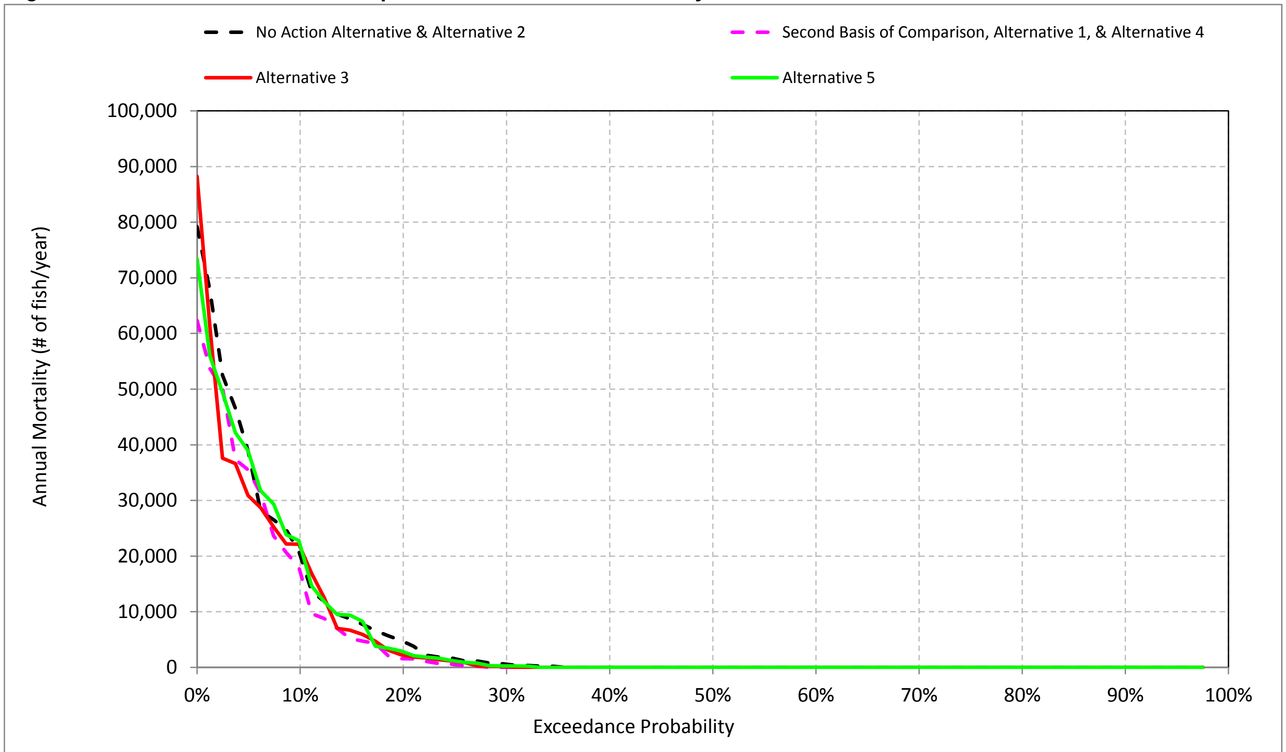
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-17. Pre-smolt - Temperature based Annual Mortality for Fall-Run Chinook Salmon



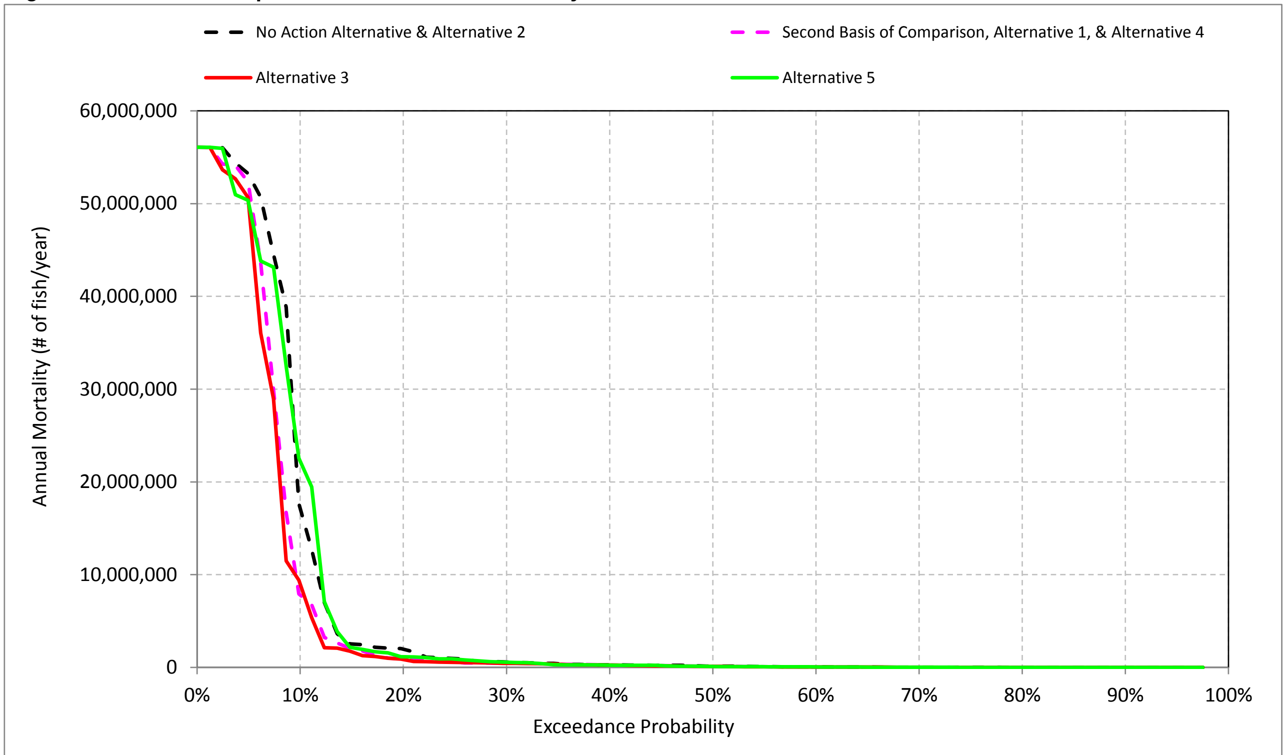
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-18. Immature Smolt - Temperature based Annual Mortality for Fall-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-19. Total Temperature based Annual Mortality for Fall-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-1. Annual Potential Production for Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	16,838,069
Alternative 1	17,037,309
Difference	199,240
Percent Difference[3]	1
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	16,537,313
Alternative 1	16,525,365
Difference	-11,948
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	15,696,855
Alternative 1	15,746,827
Difference	49,972
Percent Difference	0
Below Normal (17.5%)	
No Action Alternative	17,922,930
Alternative 1	17,847,310
Difference	-75,620
Percent Difference	0
Dry (22.5%)	
No Action Alternative	17,754,135
Alternative 1	17,934,726
Difference	180,590
Percent Difference	1
Critical (15%)	
No Action Alternative	15,800,949
Alternative 1	16,930,799
Difference	1,129,850
Percent Difference	7

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-1-2. Annual Mortality by Life Stage for Fall-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)				
Analysis Period	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	7,894,954	4,684,028	272,676	47,521	320,197
Alternative 1	7,110,950	4,709,109	269,215	49,405	318,621
Difference	-784,003	25,081	-3,461	1,885	-1,576
Percent Difference[3]	-10	1	-1	4	0
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	6,019,065	5,201,105	74,435	15,865	90,301
Alternative 1	6,023,551	5,129,591	71,744	16,838	88,581
Difference	4,486	-71,514	-2,692	973	-1,719
Percent Difference	0	-1	-4	6	-2
Above Normal (12.5%)					
No Action Alternative	11,831,604	5,007,353	161,828	32,005	193,834
Alternative 1	11,326,553	5,120,441	96,157	31,173	127,329
Difference	-505,051	113,088	-65,672	-833	-66,505
Percent Difference	-4	2	-41	-3	-34
Below Normal (17.5%)					
No Action Alternative	4,975,839	4,911,742	266,079	45,556	311,635
Alternative 1	4,943,736	4,895,243	284,538	50,880	335,418
Difference	-32,103	-16,499	18,459	5,324	23,783
Percent Difference	-1	0	7	12	8
Dry (22.5%)					
No Action Alternative	6,357,019	4,408,740	501,702	61,525	563,227
Alternative 1	5,846,335	4,371,799	440,615	59,727	500,342
Difference	-510,683	-36,940	-61,087	-1,798	-62,885
Percent Difference	-8	-1	-12	-3	-11
Critical (15%)					
No Action Alternative	14,391,374	3,441,525	458,729	110,322	569,051
Alternative 1	10,379,320	3,744,097	566,311	117,959	684,270
Difference	-4,012,054	302,572	107,582	7,638	115,220
Percent Difference	-28	9	23	7	20

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-1-3. Annual Mortality by Cause for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	5,949,693	6,949,486	12,899,179
Alternative 1	5,010,581	7,128,100	12,138,680
Difference	-939,112	178,614	-760,499
Percent Difference[3]	-16	3	-6
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	927,546	10,382,925	11,310,471
Alternative 1	485,103	10,756,621	11,241,723
Difference	-442,443	373,695	-68,747
Percent Difference	-48	4	-1
Above Normal (12.5%)			
No Action Alternative	11,689,545	5,343,245	17,032,790
Alternative 1	11,136,551	5,437,771	16,574,323
Difference	-552,994	94,526	-458,468
Percent Difference	-5	2	-3
Below Normal (17.5%)			
No Action Alternative	4,200,054	5,999,162	10,199,216
Alternative 1	4,155,751	6,018,646	10,174,397
Difference	-44,304	19,484	-24,819
Percent Difference	-1	0	0
Dry (22.5%)			
No Action Alternative	5,983,150	5,345,836	11,328,986
Alternative 1	5,469,925	5,248,551	10,718,477
Difference	-513,224	-97,285	-610,509
Percent Difference	-9	-2	-5
Critical (15%)			
No Action Alternative	14,038,861	4,363,089	18,401,950
Alternative 1	10,019,091	4,788,596	14,807,687
Difference	-4,019,770	425,507	-3,594,263
Percent Difference	-29	10	-20

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-4. Annual Mortality by Cause and Life Stage for Fall-Run Chinook Salmon

Analysis Period	Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
	Annual Mortality[4] (# of Fish/year)							
Long-term								
Full Simulation Period[1]								
No Action Alternative	5,139,812	1,955,690	799,452	154	4,683,874	10,275	309,922	12,899,179
Alternative 1	4,292,224	2,108,590	710,136	151	4,708,958	8,069	310,552	12,138,680
Difference	-847,588	152,900	-89,315	-3	25,084	-2,206	630	-760,499
Percent Difference[3]	-16	8	-11	-2	1	-21	0	-6
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	213,200	5,097,346	708,520	428	5,200,677	5,398	84,903	11,310,471
Alternative 1	76,487	5,544,710	402,355	446	5,129,145	5,816	82,766	11,241,723
Difference	-136,713	447,364	-306,165	18	-71,532	417	-2,137	-68,747
Percent Difference	-64	9	-43	4	-1	8	-3	-1
Above Normal (12.5%)								
No Action Alternative	11,397,132	146,831	287,640	34	5,007,318	4,738	189,095	17,032,790
Alternative 1	10,875,176	194,605	256,772	9	5,120,432	4,595	122,734	16,574,323
Difference	-521,956	47,774	-30,868	-26	113,113	-144	-66,361	-458,468
Percent Difference	-5	33	-11	-74	2	-3	-35	-3
Below Normal (17.5%)								
No Action Alternative	4,050,002	780,040	145,797	60	4,911,682	4,196	307,440	10,199,216
Alternative 1	4,055,314	789,925	98,496	25	4,895,218	1,915	333,503	10,174,397
Difference	5,312	9,886	-47,300	-35	-16,465	-2,280	26,064	-24,819
Percent Difference	0	1	-32	-58	0	-54	8	0
Dry (22.5%)								
No Action Alternative	5,226,978	377,492	752,548	0	4,408,740	3,623	559,604	11,328,986
Alternative 1	4,603,020	378,293	865,023	0	4,371,799	1,883	498,459	10,718,477
Difference	-623,959	801	112,475	0	-36,940	-1,740	-61,145	-610,509
Percent Difference	-12	0	15	0	-1	-48	-11	-5
Critical (15%)								
No Action Alternative	11,740,400	395,039	2,255,935	0	3,441,525	42,525	526,526	18,401,950
Alternative 1	7,750,732	392,537	2,236,052	0	3,744,097	32,307	651,963	14,807,687
Difference	-3,989,668	-2,502	-19,884	0	302,572	-10,218	125,438	-3,594,263
Percent Difference	-34	-1	-1	0	9	-24	24	-20

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-5. Annual Mortality by All Factors for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	5,139,812	1,449,851	505,839	799,452	154	4,683,874	4,419	268,257	5,856	41,665	12,899,179
Alternative 1	4,292,224	1,473,372	635,217	710,136	151	4,708,958	3,312	265,903	4,757	44,648	12,138,680
Difference	-847,588	23,521	129,379	-89,315	-3	25,084	-1,106	-2,354	-1,099	2,984	-760,499
Percent Difference[3]	-16	2	26	-11	-2	1	-25	-1	-19	7	-6
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	213,200	3,859,065	1,238,281	708,520	428	5,200,677	4,236	70,199	1,162	14,703	11,310,471
Alternative 1	76,487	3,907,496	1,637,214	402,355	446	5,129,145	4,203	67,541	1,613	15,225	11,241,723
Difference	-136,713	48,431	398,933	-306,165	18	-71,532	-33	-2,659	451	522	-68,747
Percent Difference	-64	1	32	-43	4	-1	-1	-4	39	4	-1
Above Normal (12.5%)											
No Action Alternative	11,397,132	67,263	79,569	287,640	34	5,007,318	3,300	158,529	1,438	30,567	17,032,790
Alternative 1	10,875,176	114,650	79,955	256,772	9	5,120,432	3,015	93,141	1,579	29,593	16,574,323
Difference	-521,956	47,387	386	-30,868	-26	113,113	-285	-65,387	141	-974	-458,468
Percent Difference	-5	70	0	-11	-74	2	-9	-41	10	-3	-3
Below Normal (17.5%)											
No Action Alternative	4,050,002	246,033	534,007	145,797	60	4,911,682	2,887	263,192	1,308	44,248	10,199,216
Alternative 1	4,055,314	257,762	532,163	98,496	25	4,895,218	1,115	283,424	801	50,079	10,174,397
Difference	5,312	11,729	-1,844	-47,300	-35	-16,465	-1,773	20,232	-508	5,832	-24,819
Percent Difference	0	5	0	-32	-58	0	-61	8	-39	13	0
Dry (22.5%)											
No Action Alternative	5,226,978	377,492	0	752,548	0	4,408,740	1,403	500,298	2,220	59,306	11,328,986
Alternative 1	4,603,020	378,293	0	865,023	0	4,371,799	423	440,192	1,460	58,267	10,718,477
Difference	-623,959	801	0	112,475	0	-36,940	-980	-60,107	-760	-1,038	-610,509
Percent Difference	-12	0	0	15	0	-1	-70	-12	-34	-2	-5
Critical (15%)											
No Action Alternative	11,740,400	395,039	0	2,255,935	0	3,441,525	12,058	446,671	30,467	79,854	18,401,950
Alternative 1	7,750,732	392,537	0	2,236,052	0	3,744,097	8,529	557,782	23,779	94,181	14,807,687
Difference	-3,989,668	-2,502	0	-19,884	0	302,572	-3,529	111,111	-6,689	14,327	-3,594,263
Percent Difference	-34	-1	0	-1	0	9	-29	25	-22	18	-20

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-6. Annual Potential Production for Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	16,838,069
Alternative 3	17,129,024
Difference	290,955
Percent Difference[3]	2
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	16,537,313
Alternative 3	16,544,696
Difference	7,383
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	15,696,855
Alternative 3	15,897,563
Difference	200,708
Percent Difference	1
Below Normal (17.5%)	
No Action Alternative	17,922,930
Alternative 3	17,877,415
Difference	-45,515
Percent Difference	0
Dry (22.5%)	
No Action Alternative	17,754,135
Alternative 3	18,382,793
Difference	628,657
Percent Difference	4
Critical (15%)	
No Action Alternative	15,800,949
Alternative 3	16,667,512
Difference	866,563
Percent Difference	5

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-1-7. Annual Mortality by Life Stage for Fall-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)				
Analysis Period	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	7,894,954	4,684,028	272,676	47,521	320,197
Alternative 3	6,873,719	4,709,136	258,786	47,224	306,009
Difference	-1,021,235	25,108	-13,891	-297	-14,187
Percent Difference[3]	-13	1	-5	-1	-4
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	6,019,065	5,201,105	74,435	15,865	90,301
Alternative 3	5,981,293	5,099,805	75,392	16,365	91,757
Difference	-37,772	-101,300	957	500	1,457
Percent Difference	-1	-2	1	3	2
Above Normal (12.5%)					
No Action Alternative	11,831,604	5,007,353	161,828	32,005	193,834
Alternative 3	10,983,177	5,061,047	110,803	26,403	137,207
Difference	-848,427	53,694	-51,025	-5,602	-56,627
Percent Difference	-7	1	-32	-18	-29
Below Normal (17.5%)					
No Action Alternative	4,975,839	4,911,742	266,079	45,556	311,635
Alternative 3	4,905,579	4,909,824	267,778	50,091	317,869
Difference	-70,260	-1,918	1,699	4,535	6,234
Percent Difference	-1	0	1	10	2
Dry (22.5%)					
No Action Alternative	6,357,019	4,408,740	501,702	61,525	563,227
Alternative 3	4,403,331	4,450,665	464,033	59,943	523,976
Difference	-1,953,687	41,925	-37,668	-1,583	-39,251
Percent Difference	-31	1	-8	-3	-7
Critical (15%)					
No Action Alternative	14,391,374	3,441,525	458,729	110,322	569,051
Alternative 3	11,384,504	3,723,000	461,093	109,012	570,105
Difference	-3,006,871	281,476	2,364	-1,310	1,055
Percent Difference	-21	8	1	-1	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-1-8. Annual Mortality by Cause for Fall-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)		
Analysis Period	**Temperature**	**Flow**	**Total**
	Long-term		
Full Simulation Period[1]			
No Action Alternative	5,949,693	6,949,486	12,899,179
Alternative 3	4,751,566	7,137,299	11,888,865
Difference	-1,198,127	187,813	-1,010,314
Percent Difference[3]	-20	3	-8
	Water Year Types[2]		
Wet (32.5%)			
No Action Alternative	927,546	10,382,925	11,310,471
Alternative 3	389,939	10,782,916	11,172,855
Difference	-537,606	399,991	-137,615
Percent Difference	-58	4	-1
Above Normal (12.5%)			
No Action Alternative	11,689,545	5,343,245	17,032,790
Alternative 3	10,788,099	5,393,332	16,181,431
Difference	-901,446	50,087	-851,359
Percent Difference	-8	1	-5
Below Normal (17.5%)			
No Action Alternative	4,200,054	5,999,162	10,199,216
Alternative 3	4,135,609	5,997,663	10,133,272
Difference	-64,445	-1,499	-65,944
Percent Difference	-2	0	-1
Dry (22.5%)			
No Action Alternative	5,983,150	5,345,836	11,328,986
Alternative 3	4,017,083	5,360,888	9,377,972
Difference	-1,966,066	15,053	-1,951,014
Percent Difference	-33	0	-17
Critical (15%)			
No Action Alternative	14,038,861	4,363,089	18,401,950
Alternative 3	10,991,653	4,685,957	15,677,609
Difference	-3,047,208	322,868	-2,724,340
Percent Difference	-22	7	-15

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-9. Annual Mortality by Cause and Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	5,139,812	1,955,690	799,452	154	4,683,874	10,275	309,922	12,899,179
Alternative 3	3,882,019	2,130,887	860,812	146	4,708,991	8,589	297,421	11,888,865
Difference	-1,257,793	175,198	61,360	-8	25,116	-1,686	-12,501	-1,010,314
Percent Difference[3]	-24	9	8	-5	1	-16	-4	-8
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	213,200	5,097,346	708,520	428	5,200,677	5,398	84,903	11,310,471
Alternative 3	37,613	5,597,671	346,009	441	5,099,364	5,877	85,881	11,172,855
Difference	-175,587	500,325	-362,510	13	-101,313	478	978	-137,615
Percent Difference	-82	10	-51	3	-2	9	1	-1
Above Normal (12.5%)								
No Action Alternative	11,397,132	146,831	287,640	34	5,007,318	4,738	189,095	17,032,790
Alternative 3	10,309,394	196,462	477,321	0	5,061,047	1,384	135,823	16,181,431
Difference	-1,087,738	49,631	189,681	-34	53,729	-3,354	-53,273	-851,359
Percent Difference	-10	34	66	-100	1	-71	-28	-5
Below Normal (17.5%)								
No Action Alternative	4,050,002	780,040	145,797	60	4,911,682	4,196	307,440	10,199,216
Alternative 3	4,049,375	773,748	82,456	14	4,909,811	3,764	314,105	10,133,272
Difference	-627	-6,292	-63,341	-46	-1,871	-431	6,665	-65,944
Percent Difference	0	-1	-43	-77	0	-10	2	-1
Dry (22.5%)								
No Action Alternative	5,226,978	377,492	752,548	0	4,408,740	3,623	559,604	11,328,986
Alternative 3	3,355,934	388,784	658,614	0	4,450,665	2,536	521,440	9,377,972
Difference	-1,871,044	11,291	-93,934	0	41,925	-1,088	-38,164	-1,951,014
Percent Difference	-36	3	-12	0	1	-30	-7	-17
Critical (15%)								
No Action Alternative	11,740,400	395,039	2,255,935	0	3,441,525	42,525	526,526	18,401,950
Alternative 3	7,449,300	428,029	3,507,175	0	3,723,000	35,178	534,928	15,677,609
Difference	-4,291,101	32,990	1,251,240	0	281,475	-7,347	8,402	-2,724,340
Percent Difference	-37	8	55	0	8	-17	2	-15

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-10. Annual Mortality by All Factors for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	5,139,812	1,449,851	505,839	799,452	154	4,683,874	4,419	268,257	5,856	41,665	12,899,179
Alternative 3	3,882,019	1,491,155	639,732	860,812	146	4,708,991	3,342	255,443	5,247	41,977	11,888,865
Difference	-1,257,793	41,304	133,893	61,360	-8	25,116	-1,077	-12,814	-609	313	-1,010,314
Percent Difference[3]	-24	3	26	8	-5	1	-24	-5	-10	1	-8
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	213,200	3,859,065	1,238,281	708,520	428	5,200,677	4,236	70,199	1,162	14,703	11,310,471
Alternative 3	37,613	3,945,868	1,651,803	346,009	441	5,099,364	4,272	71,120	1,605	14,761	11,172,855
Difference	-175,587	86,803	413,522	-362,510	13	-101,313	36	921	442	58	-137,615
Percent Difference	-82	2	33	-51	3	-2	1	1	38	0	-1
Above Normal (12.5%)											
No Action Alternative	11,397,132	67,263	79,569	287,640	34	5,007,318	3,300	158,529	1,438	30,567	17,032,790
Alternative 3	10,309,394	116,493	79,969	477,321	0	5,061,047	576	110,227	808	25,595	16,181,431
Difference	-1,087,738	49,230	401	189,681	-34	53,729	-2,724	-48,301	-630	-4,972	-851,359
Percent Difference	-10	73	1	66	-100	1	-83	-30	-44	-16	-5
Below Normal (17.5%)											
No Action Alternative	4,050,002	246,033	534,007	145,797	60	4,911,682	2,887	263,192	1,308	44,248	10,199,216
Alternative 3	4,049,375	242,891	530,857	82,456	14	4,909,811	2,116	265,663	1,649	48,442	10,133,272
Difference	-627	-3,142	-3,151	-63,341	-46	-1,871	-771	2,470	340	4,195	-65,944
Percent Difference	0	-1	-1	-43	-77	0	-27	1	26	9	-1
Dry (22.5%)											
No Action Alternative	5,226,978	377,492	0	752,548	0	4,408,740	1,403	500,298	2,220	59,306	11,328,986
Alternative 3	3,355,934	388,784	0	658,614	0	4,450,665	698	463,335	1,837	58,105	9,377,972
Difference	-1,871,044	11,291	0	-93,934	0	41,925	-705	-36,963	-382	-1,200	-1,951,014
Percent Difference	-36	3	0	-12	0	1	-50	-7	-17	-2	-17
Critical (15%)											
No Action Alternative	11,740,400	395,039	0	2,255,935	0	3,441,525	12,058	446,671	30,467	79,854	18,401,950
Alternative 3	7,449,300	428,029	0	3,507,175	0	3,723,000	9,030	452,064	26,148	82,864	15,677,609
Difference	-4,291,101	32,990	0	1,251,240	0	281,475	-3,028	5,392	-4,320	3,010	-2,724,340
Percent Difference	-37	8	0	55	0	8	-25	1	-14	4	-15

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-11. Annual Potential Production for Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	16,838,069
Alternative 5	16,908,477
Difference	70,408
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	16,537,313
Alternative 5	16,493,092
Difference	-44,221
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	15,696,855
Alternative 5	15,891,098
Difference	194,243
Percent Difference	1
Below Normal (17.5%)	
No Action Alternative	17,922,930
Alternative 5	17,951,192
Difference	28,262
Percent Difference	0
Dry (22.5%)	
No Action Alternative	17,754,135
Alternative 5	18,003,040
Difference	248,905
Percent Difference	1
Critical (15%)	
No Action Alternative	15,800,949
Alternative 5	15,797,949
Difference	-3,000
Percent Difference	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-1-12. Annual Mortality by Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	7,894,954	4,684,028	272,676	47,521	320,197
Alternative 5	7,723,389	4,663,905	266,371	49,003	315,374
Difference	-171,565	-20,123	-6,305	1,482	-4,823
Percent Difference[3]	-2	0	-2	3	-2
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	6,019,065	5,201,105	74,435	15,865	90,301
Alternative 5	6,169,444	5,177,967	78,031	16,578	94,608
Difference	150,379	-23,138	3,595	712	4,308
Percent Difference	2	0	5	4	5
Above Normal (12.5%)					
No Action Alternative	11,831,604	5,007,353	161,828	32,005	193,834
Alternative 5	11,229,256	4,990,191	153,381	34,302	187,683
Difference	-602,348	-17,162	-8,448	2,296	-6,151
Percent Difference	-5	0	-5	7	-3
Below Normal (17.5%)					
No Action Alternative	4,975,839	4,911,742	266,079	45,556	311,635
Alternative 5	4,934,725	4,906,604	268,136	45,725	313,861
Difference	-41,114	-5,138	2,056	169	2,226
Percent Difference	-1	0	1	0	1
Dry (22.5%)					
No Action Alternative	6,357,019	4,408,740	501,702	61,525	563,227
Alternative 5	5,727,952	4,357,900	490,190	66,478	556,668
Difference	-629,067	-50,840	-11,512	4,953	-6,559
Percent Difference	-10	-1	-2	8	-1
Critical (15%)					
No Action Alternative	14,391,374	3,441,525	458,729	110,322	569,051
Alternative 5	14,415,310	3,454,056	430,811	109,120	539,931
Difference	23,936	12,531	-27,918	-1,202	-29,120
Percent Difference	0	0	-6	-1	-5

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-1-13. Annual Mortality by Cause for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
	Long-term		
Full Simulation Period[1]			
No Action Alternative	5,949,693	6,949,486	12,899,179
Alternative 5	5,781,882	6,920,785	12,702,667
Difference	-167,811	-28,701	-196,511
Percent Difference[3]	-3	0	-2
	Water Year Types[2]		
Wet (32.5%)			
No Action Alternative	927,546	10,382,925	11,310,471
Alternative 5	1,088,909	10,353,111	11,442,020
Difference	161,363	-29,814	131,549
Percent Difference	17	0	1
Above Normal (12.5%)			
No Action Alternative	11,689,545	5,343,245	17,032,790
Alternative 5	11,083,720	5,323,409	16,407,129
Difference	-605,825	-19,836	-625,661
Percent Difference	-5	0	-4
Below Normal (17.5%)			
No Action Alternative	4,200,054	5,999,162	10,199,216
Alternative 5	4,169,106	5,986,084	10,155,190
Difference	-30,948	-13,078	-44,026
Percent Difference	-1	0	0
Dry (22.5%)			
No Action Alternative	5,983,150	5,345,836	11,328,986
Alternative 5	5,349,191	5,293,329	10,642,520
Difference	-633,958	-52,507	-686,466
Percent Difference	-11	-1	-6
Critical (15%)			
No Action Alternative	14,038,861	4,363,089	18,401,950
Alternative 5	14,062,400	4,346,896	18,409,296
Difference	23,539	-16,193	7,347
Percent Difference	0	0	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-14. Annual Mortality by Cause and Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	5,139,812	1,955,690	799,452	154	4,683,874	10,275	309,922	12,899,179
Alternative 5	4,786,653	1,951,663	985,073	154	4,663,751	10,003	305,371	12,702,667
Difference	-353,159	-4,026	185,621	0	-20,123	-272	-4,551	-196,511
Percent Difference[3]	-7	0	23	0	0	-3	-1	-2
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	213,200	5,097,346	708,520	428	5,200,677	5,398	84,903	11,310,471
Alternative 5	348,257	5,086,105	735,082	436	5,177,531	5,134	89,475	11,442,020
Difference	135,058	-11,241	26,562	8	-23,146	-265	4,572	131,549
Percent Difference	63	0	4	2	0	-5	5	1
Above Normal (12.5%)								
No Action Alternative	11,397,132	146,831	287,640	34	5,007,318	4,738	189,095	17,032,790
Alternative 5	10,385,418	149,961	693,877	9	4,990,182	4,417	183,266	16,407,129
Difference	-1,011,714	3,130	406,236	-26	-17,136	-321	-5,830	-625,661
Percent Difference	-9	2	141	-75	0	-7	-3	-4
Below Normal (17.5%)								
No Action Alternative	4,050,002	780,040	145,797	60	4,911,682	4,196	307,440	10,199,216
Alternative 5	4,052,333	769,810	112,581	59	4,906,545	4,133	309,728	10,155,190
Difference	2,331	-10,229	-33,215	0	-5,137	-63	2,289	-44,026
Percent Difference	0	-1	-23	-1	0	-1	1	0
Dry (22.5%)								
No Action Alternative	5,226,978	377,492	752,548	0	4,408,740	3,623	559,604	11,328,986
Alternative 5	4,376,903	382,888	968,162	1	4,357,898	4,125	552,543	10,642,520
Difference	-850,076	5,395	215,614	1	-50,841	502	-7,061	-686,466
Percent Difference	-16	1	29	0	-1	14	-1	-6
Critical (15%)								
No Action Alternative	11,740,400	395,039	2,255,935	0	3,441,525	42,525	526,526	18,401,950
Alternative 5	11,208,869	393,784	2,812,657	0	3,454,056	40,874	499,057	18,409,296
Difference	-531,531	-1,255	556,722	0	12,531	-1,651	-27,469	7,347
Percent Difference	-5	0	25	0	0	-4	-5	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-15. Annual Mortality by All Factors for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year)										
	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	5,139,812	1,449,851	505,839	799,452	154	4,683,874	4,419	268,257	5,856	41,665	12,899,179
Alternative 5	4,786,653	1,450,386	501,277	985,073	154	4,663,751	4,489	261,882	5,514	43,488	12,702,667
Difference	-353,159	535	-4,561	185,621	0	-20,123	70	-6,375	-342	1,824	-196,511
Percent Difference[3]	-7	0	-1	23	0	0	2	-2	-6	4	-2
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	213,200	3,859,065	1,238,281	708,520	428	5,200,677	4,236	70,199	1,162	14,703	11,310,471
Alternative 5	348,257	3,861,662	1,224,443	735,082	436	5,177,531	4,005	74,026	1,129	15,449	11,442,020
Difference	135,058	2,597	-13,838	26,562	8	-23,146	-231	3,827	-33	746	131,549
Percent Difference	63	0	-1	4	2	0	-5	5	-3	5	1
Above Normal (12.5%)											
No Action Alternative	11,397,132	67,263	79,569	287,640	34	5,007,318	3,300	158,529	1,438	30,567	17,032,790
Alternative 5	10,385,418	69,983	79,978	693,877	9	4,990,182	3,244	150,137	1,173	33,128	16,407,129
Difference	-1,011,714	2,721	409	406,236	-26	-17,136	-56	-8,391	-265	2,561	-625,661
Percent Difference	-9	4	1	141	-75	0	-2	-5	-18	8	-4
Below Normal (17.5%)											
No Action Alternative	4,050,002	246,033	534,007	145,797	60	4,911,682	2,887	263,192	1,308	44,248	10,199,216
Alternative 5	4,052,333	236,463	533,348	112,581	59	4,906,545	2,782	265,353	1,350	44,375	10,155,190
Difference	2,331	-9,570	-659	-33,215	0	-5,137	-105	2,161	42	128	-44,026
Percent Difference	0	-4	0	-23	-1	0	-4	1	3	0	0
Dry (22.5%)											
No Action Alternative	5,226,978	377,492	0	752,548	0	4,408,740	1,403	500,298	2,220	59,306	11,328,986
Alternative 5	4,376,903	382,888	0	968,162	1	4,357,898	1,827	488,363	2,298	64,180	10,642,520
Difference	-850,076	5,395	0	215,614	1	-50,841	424	-11,936	79	4,874	-686,466
Percent Difference	-16	1	0	29	0	-1	30	-2	4	8	-6
Critical (15%)											
No Action Alternative	11,740,400	395,039	0	2,255,935	0	3,441,525	12,058	446,671	30,467	79,854	18,401,950
Alternative 5	11,208,869	393,784	0	2,812,657	0	3,454,056	12,558	418,253	28,316	80,804	18,409,296
Difference	-531,531	-1,255	0	556,722	0	12,531	500	-28,418	-2,151	949	7,347
Percent Difference	-5	0	0	25	0	0	4	-6	-7	1	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-16. Annual Potential Production for Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	17,037,309
No Action Alternative	16,838,069
Difference	-199,240
Percent Difference[3]	-1
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	16,525,365
No Action Alternative	16,537,313
Difference	11,948
Percent Difference	0
Above Normal (12.5%)	
Second Basis of Comparison	15,746,827
No Action Alternative	15,696,855
Difference	-49,972
Percent Difference	0
Below Normal (17.5%)	
Second Basis of Comparison	17,847,310
No Action Alternative	17,922,930
Difference	75,620
Percent Difference	0
Dry (22.5%)	
Second Basis of Comparison	17,934,726
No Action Alternative	17,754,135
Difference	-180,590
Percent Difference	-1
Critical (15%)	
Second Basis of Comparison	16,930,799
No Action Alternative	15,800,949
Difference	-1,129,850
Percent Difference	-7

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-1-17. Annual Mortality by Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	7,110,950	4,709,109	269,215	49,405	318,621
No Action Alternative	7,894,954	4,684,028	272,676	47,521	320,197
Difference	784,003	-25,081	3,461	-1,885	1,576
Percent Difference[3]	11	-1	1	-4	0
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	6,023,551	5,129,591	71,744	16,838	88,581
No Action Alternative	6,019,065	5,201,105	74,435	15,865	90,301
Difference	-4,486	71,514	2,692	-973	1,719
Percent Difference	0	1	4	-6	2
Above Normal (12.5%)					
Second Basis of Comparison	11,326,553	5,120,441	96,157	31,173	127,329
No Action Alternative	11,831,604	5,007,353	161,828	32,005	193,834
Difference	505,051	-113,088	65,672	833	66,505
Percent Difference	4	-2	68	3	52
Below Normal (17.5%)					
Second Basis of Comparison	4,943,736	4,895,243	284,538	50,880	335,418
No Action Alternative	4,975,839	4,911,742	266,079	45,556	311,635
Difference	32,103	16,499	-18,459	-5,324	-23,783
Percent Difference	1	0	-6	-10	-7
Dry (22.5%)					
Second Basis of Comparison	5,846,335	4,371,799	440,615	59,727	500,342
No Action Alternative	6,357,019	4,408,740	501,702	61,525	563,227
Difference	510,683	36,940	61,087	1,798	62,885
Percent Difference	9	1	14	3	13
Critical (15%)					
Second Basis of Comparison	10,379,320	3,744,097	566,311	117,959	684,270
No Action Alternative	14,391,374	3,441,525	458,729	110,322	569,051
Difference	4,012,054	-302,572	-107,582	-7,638	-115,220
Percent Difference	39	-8	-19	-6	-17

1 Based on the 80-year simulation period
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.
3 Relative difference of the Annual average
4 Mortality values do not include base mortality
5 Eggs mortality includes pre-spawn mortality

Table B-1-18. Annual Mortality by Cause for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	5,010,581	7,128,100	12,138,680
No Action Alternative	5,949,693	6,949,486	12,899,179
Difference	939,112	-178,614	760,499
Percent Difference[3]	19	-3	6
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	485,103	10,756,621	11,241,723
No Action Alternative	927,546	10,382,925	11,310,471
Difference	442,443	-373,695	68,747
Percent Difference	91	-3	1
Above Normal (12.5%)			
Second Basis of Comparison	11,136,551	5,437,771	16,574,323
No Action Alternative	11,689,545	5,343,245	17,032,790
Difference	552,994	-94,526	458,468
Percent Difference	5	-2	3
Below Normal (17.5%)			
Second Basis of Comparison	4,155,751	6,018,646	10,174,397
No Action Alternative	4,200,054	5,999,162	10,199,216
Difference	44,304	-19,484	24,819
Percent Difference	1	0	0
Dry (22.5%)			
Second Basis of Comparison	5,469,925	5,248,551	10,718,477
No Action Alternative	5,983,150	5,345,836	11,328,986
Difference	513,224	97,285	610,509
Percent Difference	9	2	6
Critical (15%)			
Second Basis of Comparison	10,019,091	4,788,596	14,807,687
No Action Alternative	14,038,861	4,363,089	18,401,950
Difference	4,019,770	-425,507	3,594,263
Percent Difference	40	-9	24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-19. Annual Mortality by Cause and Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	4,292,224	2,108,590	710,136	151	4,708,958	8,069	310,552	12,138,680
No Action Alternative	5,139,812	1,955,690	799,452	154	4,683,874	10,275	309,922	12,899,179
Difference	847,588	-152,900	89,315	3	-25,084	2,206	-630	760,499
Percent Difference[3]	20	-7	13	2	-1	27	0	6
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	76,487	5,544,710	402,355	446	5,129,145	5,816	82,766	11,241,723
No Action Alternative	213,200	5,097,346	708,520	428	5,200,677	5,398	84,903	11,310,471
Difference	136,713	-447,364	306,165	-18	71,532	-417	2,137	68,747
Percent Difference	179	-8	76	-4	1	-7	3	1
Above Normal (12.5%)								
Second Basis of Comparison	10,875,176	194,605	256,772	9	5,120,432	4,595	122,734	16,574,323
No Action Alternative	11,397,132	146,831	287,640	34	5,007,318	4,738	189,095	17,032,790
Difference	521,956	-47,774	30,868	26	-113,113	144	66,361	458,468
Percent Difference	5	-25	12	287	-2	3	54	3
Below Normal (17.5%)								
Second Basis of Comparison	4,055,314	789,925	98,496	25	4,895,218	1,915	333,503	10,174,397
No Action Alternative	4,050,002	780,040	145,797	60	4,911,682	4,196	307,440	10,199,216
Difference	-5,312	-9,886	47,300	35	16,465	2,280	-26,064	24,819
Percent Difference	0	-1	48	138	0	119	-8	0
Dry (22.5%)								
Second Basis of Comparison	4,603,020	378,293	865,023	0	4,371,799	1,883	498,459	10,718,477
No Action Alternative	5,226,978	377,492	752,548	0	4,408,740	3,623	559,604	11,328,986
Difference	623,959	-801	-112,475	0	36,940	1,740	61,145	610,509
Percent Difference	14	0	-13	0	1	92	12	6
Critical (15%)								
Second Basis of Comparison	7,750,732	392,537	2,236,052	0	3,744,097	32,307	651,963	14,807,687
No Action Alternative	11,740,400	395,039	2,255,935	0	3,441,525	42,525	526,526	18,401,950
Difference	3,989,668	2,502	19,884	0	-302,572	10,218	-125,438	3,594,263
Percent Difference	51	1	1	0	-8	32	-19	24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-20. Annual Mortality by All Factors for Fall-Run Chinook Salmon

Analysis Period	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
	Annual Mortality[4] (# of Fish/year)										
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	4,292,224	1,473,372	635,217	710,136	151	4,708,958	3,312	265,903	4,757	44,648	12,138,680
No Action Alternative	5,139,812	1,449,851	505,839	799,452	154	4,683,874	4,419	268,257	5,856	41,665	12,899,179
Difference	847,588	-23,521	-129,379	89,315	3	-25,084	1,106	2,354	1,099	-2,984	760,499
Percent Difference[3]	20	-2	-20	13	2	-1	33	1	23	-7	6
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	76,487	3,907,496	1,637,214	402,355	446	5,129,145	4,203	67,541	1,613	15,225	11,241,723
No Action Alternative	213,200	3,859,065	1,238,281	708,520	428	5,200,677	4,236	70,199	1,162	14,703	11,310,471
Difference	136,713	-48,431	-398,933	306,165	-18	71,532	33	2,659	-451	-522	68,747
Percent Difference	179	-1	-24	76	-4	1	1	4	-28	-3	1
Above Normal (12.5%)											
Second Basis of Comparison	10,875,176	114,650	79,955	256,772	9	5,120,432	3,015	93,141	1,579	29,593	16,574,323
No Action Alternative	11,397,132	67,263	79,569	287,640	34	5,007,318	3,300	158,529	1,438	30,567	17,032,790
Difference	521,956	-47,387	-386	30,868	26	-113,113	285	65,387	-141	974	458,468
Percent Difference	5	-41	0	12	287	-2	9	70	-9	3	3
Below Normal (17.5%)											
Second Basis of Comparison	4,055,314	257,762	532,163	98,496	25	4,895,218	1,115	283,424	801	50,079	10,174,397
No Action Alternative	4,050,002	246,033	534,007	145,797	60	4,911,682	2,887	263,192	1,308	44,248	10,199,216
Difference	-5,312	-11,729	1,844	47,300	35	16,465	1,773	-20,232	508	-5,832	24,819
Percent Difference	0	-5	0	48	138	0	159	-7	63	-12	0
Dry (22.5%)											
Second Basis of Comparison	4,603,020	378,293	0	865,023	0	4,371,799	423	440,192	1,460	58,267	10,718,477
No Action Alternative	5,226,978	377,492	0	752,548	0	4,408,740	1,403	500,298	2,220	59,306	11,328,986
Difference	623,959	-801	0	-112,475	0	36,940	980	60,107	760	1,038	610,509
Percent Difference	14	0	0	-13	0	1	232	14	52	2	6
Critical (15%)											
Second Basis of Comparison	7,750,732	392,537	0	2,236,052	0	3,744,097	8,529	557,782	23,779	94,181	14,807,687
No Action Alternative	11,740,400	395,039	0	2,255,935	0	3,441,525	12,058	446,671	30,467	79,854	18,401,950
Difference	3,989,668	2,502	0	19,884	0	-302,572	3,529	-111,111	6,689	-14,327	3,594,263
Percent Difference	51	1	0	1	0	-8	41	-20	28	-15	24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-21. Annual Potential Production for Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	17,037,309
Alternative 3	17,129,024
Difference	91,715
Percent Difference[3]	1
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	16,525,365
Alternative 3	16,544,696
Difference	19,331
Percent Difference	0
Above Normal (12.5%)	
Second Basis of Comparison	15,746,827
Alternative 3	15,897,563
Difference	150,736
Percent Difference	1
Below Normal (17.5%)	
Second Basis of Comparison	17,847,310
Alternative 3	17,877,415
Difference	30,105
Percent Difference	0
Dry (22.5%)	
Second Basis of Comparison	17,934,726
Alternative 3	18,382,793
Difference	448,067
Percent Difference	2
Critical (15%)	
Second Basis of Comparison	16,930,799
Alternative 3	16,667,512
Difference	-263,288
Percent Difference	-2

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-1-22. Annual Mortality by Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	7,110,950	4,709,109	269,215	49,405	318,621
Alternative 3	6,873,719	4,709,136	258,786	47,224	306,009
Difference	-237,232	27	-10,430	-2,182	-12,611
Percent Difference[3]	-3	0	-4	-4	-4
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	6,023,551	5,129,591	71,744	16,838	88,581
Alternative 3	5,981,293	5,099,805	75,392	16,365	91,757
Difference	-42,258	-29,786	3,648	-473	3,176
Percent Difference	-1	-1	5	-3	4
Above Normal (12.5%)					
Second Basis of Comparison	11,326,553	5,120,441	96,157	31,173	127,329
Alternative 3	10,983,177	5,061,047	110,803	26,403	137,207
Difference	-343,376	-59,394	14,647	-4,769	9,878
Percent Difference	-3	-1	15	-15	8
Below Normal (17.5%)					
Second Basis of Comparison	4,943,736	4,895,243	284,538	50,880	335,418
Alternative 3	4,905,579	4,909,824	267,778	50,091	317,869
Difference	-38,157	14,582	-16,760	-789	-17,549
Percent Difference	-1	0	-6	-2	-5
Dry (22.5%)					
Second Basis of Comparison	5,846,335	4,371,799	440,615	59,727	500,342
Alternative 3	4,403,331	4,450,665	464,033	59,943	523,976
Difference	-1,443,004	78,865	23,419	215	23,634
Percent Difference	-25	2	5	0	5
Critical (15%)					
Second Basis of Comparison	10,379,320	3,744,097	566,311	117,959	684,270
Alternative 3	11,384,504	3,723,000	461,093	109,012	570,105
Difference	1,005,183	-21,096	-105,218	-8,947	-114,165
Percent Difference	10	-1	-19	-8	-17

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-1-23. Annual Mortality by Cause for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	5,010,581	7,128,100	12,138,680
Alternative 3	4,751,566	7,137,299	11,888,865
Difference	-259,015	9,199	-249,816
Percent Difference[3]	-5	0	-2
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	485,103	10,756,621	11,241,723
Alternative 3	389,939	10,782,916	11,172,855
Difference	-95,164	26,295	-68,868
Percent Difference	-20	0	-1
Above Normal (12.5%)			
Second Basis of Comparison	11,136,551	5,437,771	16,574,323
Alternative 3	10,788,099	5,393,332	16,181,431
Difference	-348,452	-44,440	-392,892
Percent Difference	-3	-1	-2
Below Normal (17.5%)			
Second Basis of Comparison	4,155,751	6,018,646	10,174,397
Alternative 3	4,135,609	5,997,663	10,133,272
Difference	-20,141	-20,983	-41,125
Percent Difference	0	0	0
Dry (22.5%)			
Second Basis of Comparison	5,469,925	5,248,551	10,718,477
Alternative 3	4,017,083	5,360,888	9,377,972
Difference	-1,452,842	112,337	-1,340,505
Percent Difference	-27	2	-13
Critical (15%)			
Second Basis of Comparison	10,019,091	4,788,596	14,807,687
Alternative 3	10,991,653	4,685,957	15,677,609
Difference	972,562	-102,640	869,922
Percent Difference	10	-2	6

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-24. Annual Mortality by Cause and Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	4,292,224	2,108,590	710,136	151	4,708,958	8,069	310,552	12,138,680
Alternative 3	3,882,019	2,130,887	860,812	146	4,708,991	8,589	297,421	11,888,865
Difference	-410,205	22,298	150,676	-5	32	520	-13,131	-249,816
Percent Difference[3]	-10	1	21	-3	0	6	-4	-2
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	76,487	5,544,710	402,355	446	5,129,145	5,816	82,766	11,241,723
Alternative 3	37,613	5,597,671	346,009	441	5,099,364	5,877	85,881	11,172,855
Difference	-38,874	52,961	-56,345	-5	-29,781	61	3,115	-68,868
Percent Difference	-51	1	-14	-1	-1	1	4	-1
Above Normal (12.5%)								
Second Basis of Comparison	10,875,176	194,605	256,772	9	5,120,432	4,595	122,734	16,574,323
Alternative 3	10,309,394	196,462	477,321	0	5,061,047	1,384	135,823	16,181,431
Difference	-565,781	1,857	220,549	-9	-59,385	-3,210	13,088	-392,892
Percent Difference	-5	1	86	-100	-1	-70	11	-2
Below Normal (17.5%)								
Second Basis of Comparison	4,055,314	789,925	98,496	25	4,895,218	1,915	333,503	10,174,397
Alternative 3	4,049,375	773,748	82,456	14	4,909,811	3,764	314,105	10,133,272
Difference	-5,939	-16,178	-16,041	-12	14,593	1,849	-19,399	-41,125
Percent Difference	0	-2	-16	-46	0	97	-6	0
Dry (22.5%)								
Second Basis of Comparison	4,603,020	378,293	865,023	0	4,371,799	1,883	498,459	10,718,477
Alternative 3	3,355,934	388,784	658,614	0	4,450,665	2,536	521,440	9,377,972
Difference	-1,247,086	10,491	-206,409	0	78,865	653	22,981	-1,340,505
Percent Difference	-27	3	-24	0	2	35	5	-13
Critical (15%)								
Second Basis of Comparison	7,750,732	392,537	2,236,052	0	3,744,097	32,307	651,963	14,807,687
Alternative 3	7,449,300	428,029	3,507,175	0	3,723,000	35,178	534,928	15,677,609
Difference	-301,433	35,492	1,271,124	0	-21,096	2,870	-117,035	869,922
Percent Difference	-4	9	57	0	-1	9	-18	6

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-25. Annual Mortality by All Factors for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	4,292,224	1,473,372	635,217	710,136	151	4,708,958	3,312	265,903	4,757	44,648	12,138,680
Alternative 3	3,882,019	1,491,155	639,732	860,812	146	4,708,991	3,342	255,443	5,247	41,977	11,888,865
Difference	-410,205	17,783	4,515	150,676	-5	32	30	-10,460	490	-2,671	-249,816
Percent Difference[3]	-10	1	1	21	-3	0	1	-4	10	-6	-2
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	76,487	3,907,496	1,637,214	402,355	446	5,129,145	4,203	67,541	1,613	15,225	11,241,723
Alternative 3	37,613	3,945,868	1,651,803	346,009	441	5,099,364	4,272	71,120	1,605	14,761	11,172,855
Difference	-38,874	38,372	14,589	-56,345	-5	-29,781	69	3,579	-8	-465	-68,868
Percent Difference	-51	1	1	-14	-1	-1	2	5	-1	-3	-1
Above Normal (12.5%)											
Second Basis of Comparison	10,875,176	114,650	79,955	256,772	9	5,120,432	3,015	93,141	1,579	29,593	16,574,323
Alternative 3	10,309,394	116,493	79,969	477,321	0	5,061,047	576	110,227	808	25,595	16,181,431
Difference	-565,781	1,843	14	220,549	-9	-59,385	-2,439	17,086	-771	-3,998	-392,892
Percent Difference	-5	2	0	86	-100	-1	-81	18	-49	-14	-2
Below Normal (17.5%)											
Second Basis of Comparison	4,055,314	257,762	532,163	98,496	25	4,895,218	1,115	283,424	801	50,079	10,174,397
Alternative 3	4,049,375	242,891	530,857	82,456	14	4,909,811	2,116	265,663	1,649	48,442	10,133,272
Difference	-5,939	-14,871	-1,307	-16,041	-12	14,593	1,001	-17,761	848	-1,637	-41,125
Percent Difference	0	-6	0	-16	-46	0	90	-6	106	-3	0
Dry (22.5%)											
Second Basis of Comparison	4,603,020	378,293	0	865,023	0	4,371,799	423	440,192	1,460	58,267	10,718,477
Alternative 3	3,355,934	388,784	0	658,614	0	4,450,665	698	463,335	1,837	58,105	9,377,972
Difference	-1,247,086	10,491	0	-206,409	0	78,865	275	23,144	378	-162	-1,340,505
Percent Difference	-27	3	0	-24	0	2	65	5	26	0	-13
Critical (15%)											
Second Basis of Comparison	7,750,732	392,537	0	2,236,052	0	3,744,097	8,529	557,782	23,779	94,181	14,807,687
Alternative 3	7,449,300	428,029	0	3,507,175	0	3,723,000	9,030	452,064	26,148	82,864	15,677,609
Difference	-301,433	35,492	0	1,271,124	0	-21,096	501	-105,719	2,369	-11,317	869,922
Percent Difference	-4	9	0	57	0	-1	6	-19	10	-12	6

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-26. Annual Potential Production for Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	17,037,309
Alternative 5	16,908,477
Difference	-128,832
Percent Difference[3]	-1
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	16,525,365
Alternative 5	16,493,092
Difference	-32,272
Percent Difference	0
Above Normal (12.5%)	
Second Basis of Comparison	15,746,827
Alternative 5	15,891,098
Difference	144,271
Percent Difference	1
Below Normal (17.5%)	
Second Basis of Comparison	17,847,310
Alternative 5	17,951,192
Difference	103,882
Percent Difference	1
Dry (22.5%)	
Second Basis of Comparison	17,934,726
Alternative 5	18,003,040
Difference	68,315
Percent Difference	0
Critical (15%)	
Second Basis of Comparison	16,930,799
Alternative 5	15,797,949
Difference	-1,132,850
Percent Difference	-7

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-1-27. Annual Mortality by Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	7,110,950	4,709,109	269,215	49,405	318,621
Alternative 5	7,723,389	4,663,905	266,371	49,003	315,374
Difference	612,438	-45,204	-2,845	-402	-3,247
Percent Difference[3]	9	-1	-1	-1	-1
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	6,023,551	5,129,591	71,744	16,838	88,581
Alternative 5	6,169,444	5,177,967	78,031	16,578	94,608
Difference	145,893	48,376	6,287	-260	6,027
Percent Difference	2	1	9	-2	7
Above Normal (12.5%)					
Second Basis of Comparison	11,326,553	5,120,441	96,157	31,173	127,329
Alternative 5	11,229,256	4,990,191	153,381	34,302	187,683
Difference	-97,297	-130,250	57,224	3,129	60,354
Percent Difference	-1	-3	60	10	47
Below Normal (17.5%)					
Second Basis of Comparison	4,943,736	4,895,243	284,538	50,880	335,418
Alternative 5	4,934,725	4,906,604	268,136	45,725	313,861
Difference	-9,011	11,362	-16,403	-5,155	-21,557
Percent Difference	0	0	-6	-10	-6
Dry (22.5%)					
Second Basis of Comparison	5,846,335	4,371,799	440,615	59,727	500,342
Alternative 5	5,727,952	4,357,900	490,190	66,478	556,668
Difference	-118,383	-13,900	49,576	6,751	56,326
Percent Difference	-2	0	11	11	11
Critical (15%)					
Second Basis of Comparison	10,379,320	3,744,097	566,311	117,959	684,270
Alternative 5	14,415,310	3,454,056	430,811	109,120	539,931
Difference	4,035,990	-290,041	-135,500	-8,839	-144,340
Percent Difference	39	-8	-24	-7	-21

1 Based on the 80-year simulation period
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.
3 Relative difference of the Annual average
4 Mortality values do not include base mortality
5 Eggs mortality includes pre-spawn mortality

Table B-1-28. Annual Mortality by Cause for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	5,010,581	7,128,100	12,138,680
Alternative 5	5,781,882	6,920,785	12,702,667
Difference	771,302	-207,314	563,987
Percent Difference[3]	15	-3	5
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	485,103	10,756,621	11,241,723
Alternative 5	1,088,909	10,353,111	11,442,020
Difference	603,806	-403,510	200,296
Percent Difference	124	-4	2
Above Normal (12.5%)			
Second Basis of Comparison	11,136,551	5,437,771	16,574,323
Alternative 5	11,083,720	5,323,409	16,407,129
Difference	-52,831	-114,362	-167,193
Percent Difference	0	-2	-1
Below Normal (17.5%)			
Second Basis of Comparison	4,155,751	6,018,646	10,174,397
Alternative 5	4,169,106	5,986,084	10,155,190
Difference	13,356	-32,563	-19,207
Percent Difference	0	-1	0
Dry (22.5%)			
Second Basis of Comparison	5,469,925	5,248,551	10,718,477
Alternative 5	5,349,191	5,293,329	10,642,520
Difference	-120,734	44,777	-75,957
Percent Difference	-2	1	-1
Critical (15%)			
Second Basis of Comparison	10,019,091	4,788,596	14,807,687
Alternative 5	14,062,400	4,346,896	18,409,296
Difference	4,043,309	-441,700	3,601,609
Percent Difference	40	-9	24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-29. Annual Mortality by Cause and Life Stage for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	4,292,224	2,108,590	710,136	151	4,708,958	8,069	310,552	12,138,680
Alternative 5	4,786,653	1,951,663	985,073	154	4,663,751	10,003	305,371	12,702,667
Difference	494,428	-156,926	274,936	3	-45,207	1,934	-5,181	563,987
Percent Difference[3]	12	-7	39	2	-1	24	-2	5
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	76,487	5,544,710	402,355	446	5,129,145	5,816	82,766	11,241,723
Alternative 5	348,257	5,086,105	735,082	436	5,177,531	5,134	89,475	11,442,020
Difference	271,771	-458,605	332,727	-10	48,386	-682	6,709	200,296
Percent Difference	355	-8	83	-2	1	-12	8	2
Above Normal (12.5%)								
Second Basis of Comparison	10,875,176	194,605	256,772	9	5,120,432	4,595	122,734	16,574,323
Alternative 5	10,385,418	149,961	693,877	9	4,990,182	4,417	183,266	16,407,129
Difference	-489,758	-44,644	437,104	0	-130,249	-178	60,531	-167,193
Percent Difference	-5	-23	170	-4	-3	-4	49	-1
Below Normal (17.5%)								
Second Basis of Comparison	4,055,314	789,925	98,496	25	4,895,218	1,915	333,503	10,174,397
Alternative 5	4,052,333	769,810	112,581	59	4,906,545	4,133	309,728	10,155,190
Difference	-2,981	-20,115	14,085	34	11,327	2,218	-23,775	-19,207
Percent Difference	0	-3	14	137	0	116	-7	0
Dry (22.5%)								
Second Basis of Comparison	4,603,020	378,293	865,023	0	4,371,799	1,883	498,459	10,718,477
Alternative 5	4,376,903	382,888	968,162	1	4,357,898	4,125	552,543	10,642,520
Difference	-226,117	4,595	103,139	1	-13,901	2,243	54,084	-75,957
Percent Difference	-5	1	12	0	0	119	11	-1
Critical (15%)								
Second Basis of Comparison	7,750,732	392,537	2,236,052	0	3,744,097	32,307	651,963	14,807,687
Alternative 5	11,208,869	393,784	2,812,657	0	3,454,056	40,874	499,057	18,409,296
Difference	3,458,137	1,247	576,606	0	-290,041	8,567	-152,907	3,601,609
Percent Difference	45	0	26	0	-8	27	-23	24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-1-30. Annual Mortality by All Factors for Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	4,292,224	1,473,372	635,217	710,136	151	4,708,958	3,312	265,903	4,757	44,648	12,138,680
Alternative 5	4,786,653	1,450,386	501,277	985,073	154	4,663,751	4,489	261,882	5,514	43,488	12,702,667
Difference	494,428	-22,986	-133,940	274,936	3	-45,207	1,176	-4,021	758	-1,160	563,987
Percent Difference[3]	12	-2	-21	39	2	-1	36	-2	16	-3	5
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	76,487	3,907,496	1,637,214	402,355	446	5,129,145	4,203	67,541	1,613	15,225	11,241,723
Alternative 5	348,257	3,861,662	1,224,443	735,082	436	5,177,531	4,005	74,026	1,129	15,449	11,442,020
Difference	271,771	-45,835	-412,770	332,727	-10	48,386	-198	6,485	-484	224	200,296
Percent Difference	355	-1	-25	83	-2	1	-5	10	-30	1	2
Above Normal (12.5%)											
Second Basis of Comparison	10,875,176	114,650	79,955	256,772	9	5,120,432	3,015	93,141	1,579	29,593	16,574,323
Alternative 5	10,385,418	69,983	79,978	693,877	9	4,990,182	3,244	150,137	1,173	33,128	16,407,129
Difference	-489,758	-44,667	23	437,104	0	-130,249	228	56,996	-406	3,535	-167,193
Percent Difference	-5	-39	0	170	-4	-3	8	61	-26	12	-1
Below Normal (17.5%)											
Second Basis of Comparison	4,055,314	257,762	532,163	98,496	25	4,895,218	1,115	283,424	801	50,079	10,174,397
Alternative 5	4,052,333	236,463	533,348	112,581	59	4,906,545	2,782	265,353	1,350	44,375	10,155,190
Difference	-2,981	-21,299	1,184	14,085	34	11,327	1,668	-18,071	550	-5,704	-19,207
Percent Difference	0	-8	0	14	137	0	150	-6	69	-11	0
Dry (22.5%)											
Second Basis of Comparison	4,603,020	378,293	0	865,023	0	4,371,799	423	440,192	1,460	58,267	10,718,477
Alternative 5	4,376,903	382,888	0	968,162	1	4,357,898	1,827	488,363	2,298	64,180	10,642,520
Difference	-226,117	4,595	0	103,139	1	-13,901	1,404	48,171	838	5,912	-75,957
Percent Difference	-5	1	0	12	0	0	332	11	57	10	-1
Critical (15%)											
Second Basis of Comparison	7,750,732	392,537	0	2,236,052	0	3,744,097	8,529	557,782	23,779	94,181	14,807,687
Alternative 5	11,208,869	393,784	0	2,812,657	0	3,454,056	12,558	418,253	28,316	80,804	18,409,296
Difference	3,458,137	1,247	0	576,606	0	-290,041	4,029	-139,529	4,538	-13,377	3,601,609
Percent Difference	45	0	0	26	0	-8	47	-25	19	-14	24

1 Based on the 80-year simulation period

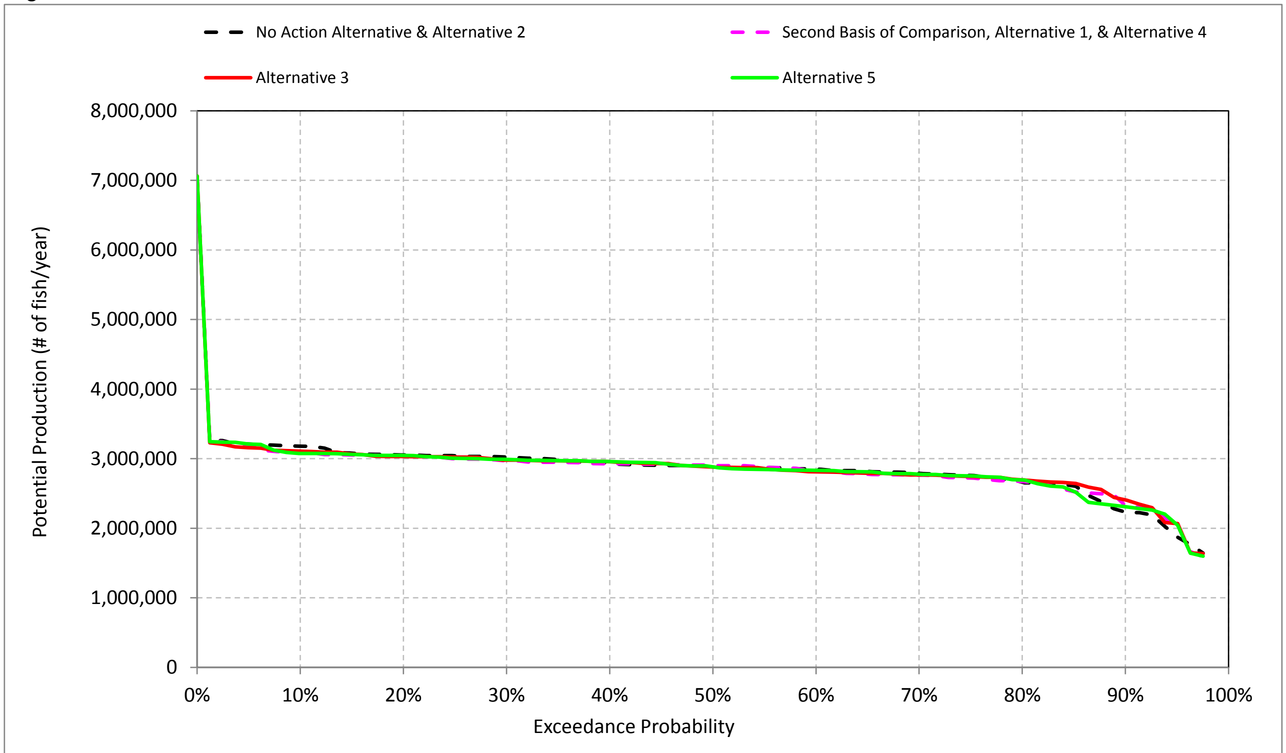
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

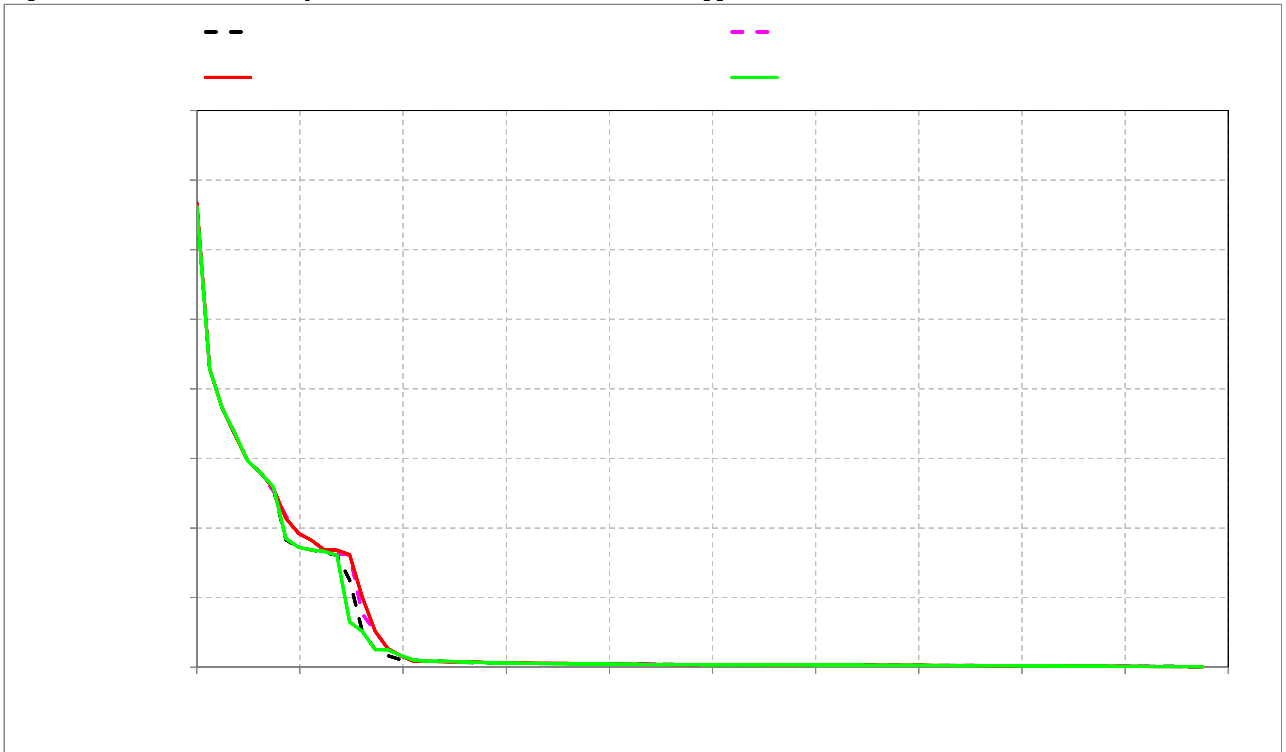
B.2. Late Fall-Run Chinook Salmon

Figure B-2-1. Annual Potential Production for Late Fall-Run Chinook Salmon



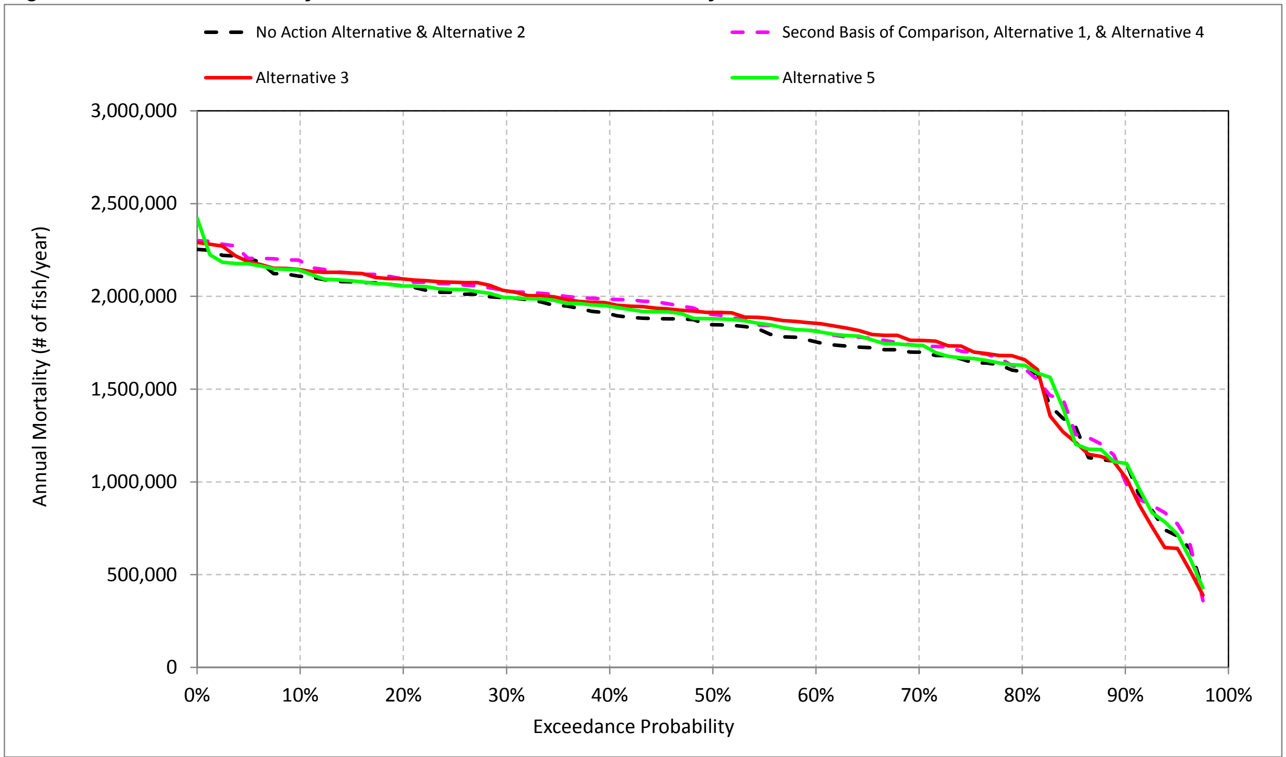
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-2. Annual Mortality for Late Fall-Run Chinook Salmon - Eggs



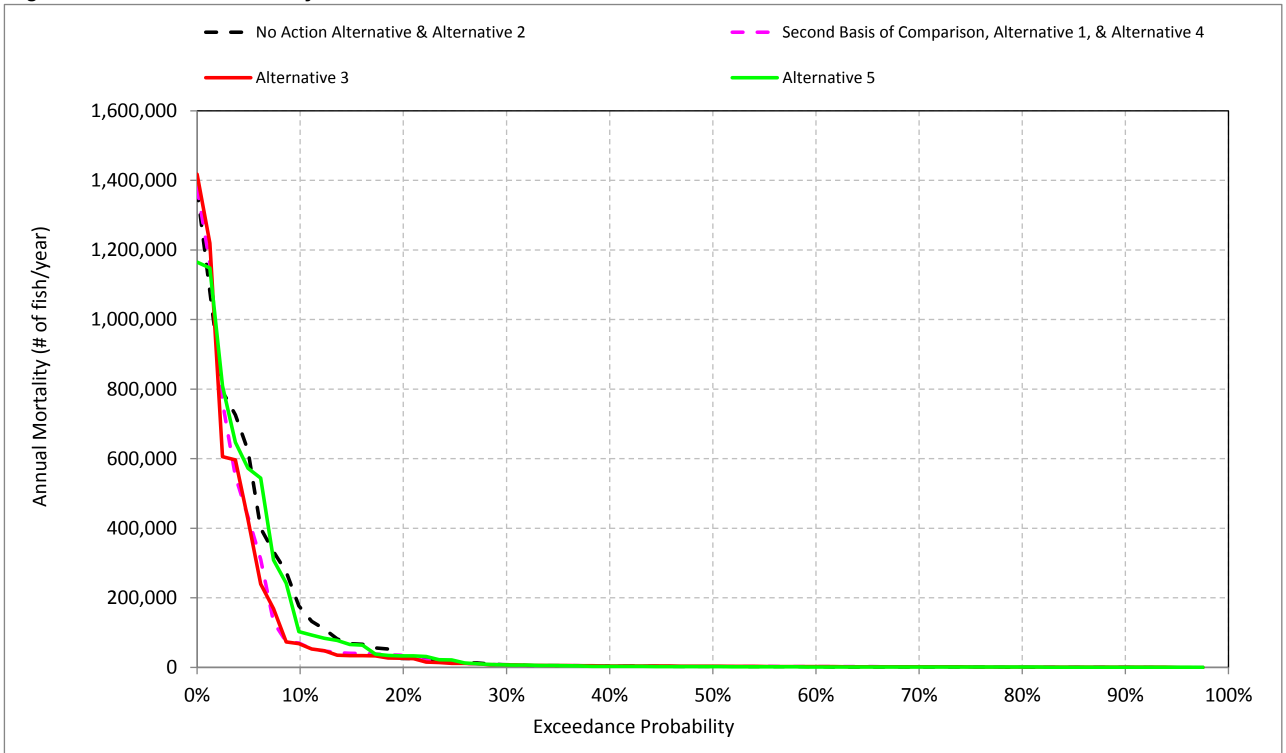
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-3. Annual Mortality for Late Fall-Run Chinook Salmon - Fry



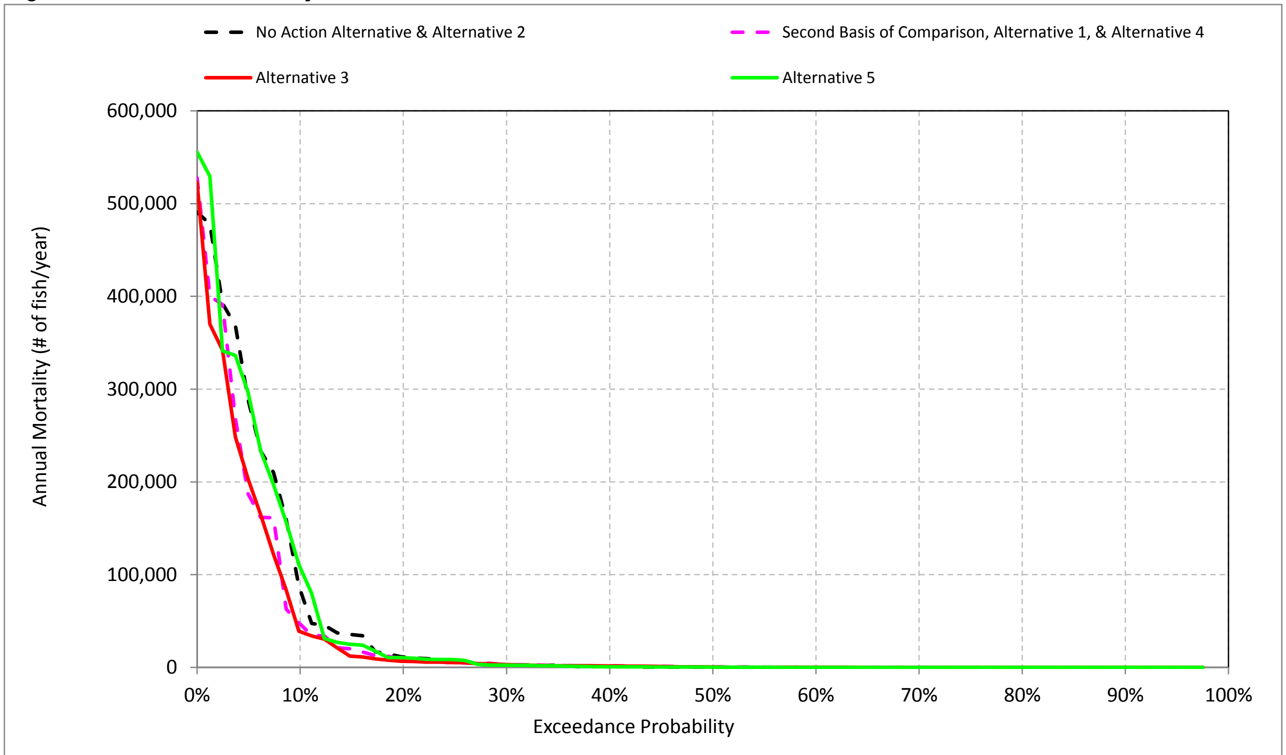
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-4. Annual Mortality for Late Fall-Run Chinook Salmon - Pre-Smolt



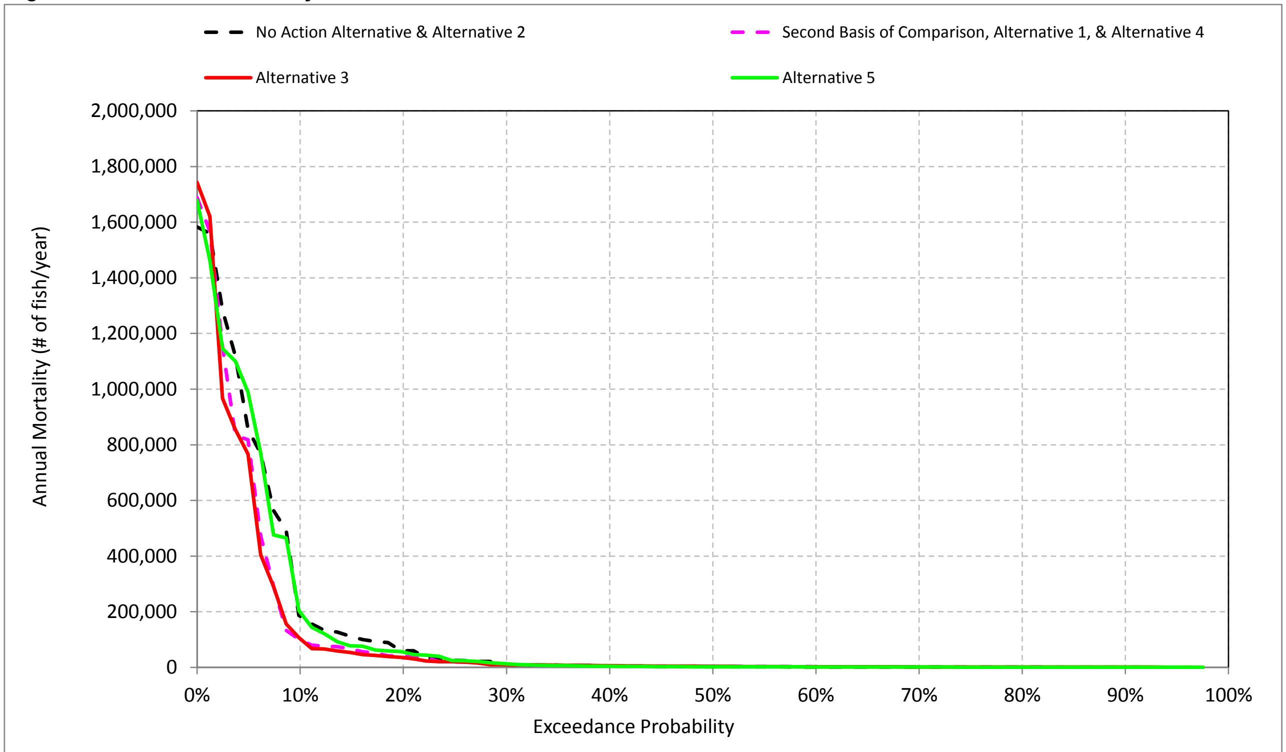
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-5. Annual Mortality for Late Fall-Run Chinook Salmon - Immature Smolt



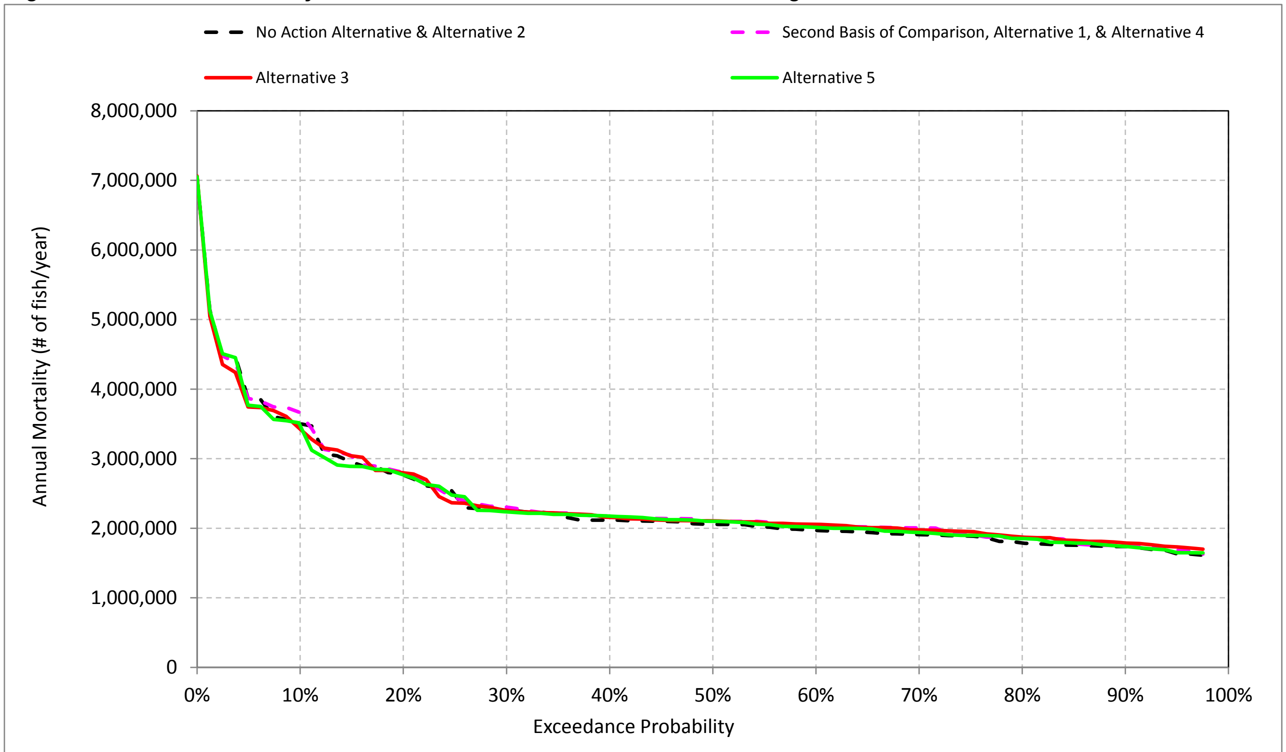
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-6. Annual Mortality for Late Fall-Run Chinook Salmon - Pre- & Immature Smolts



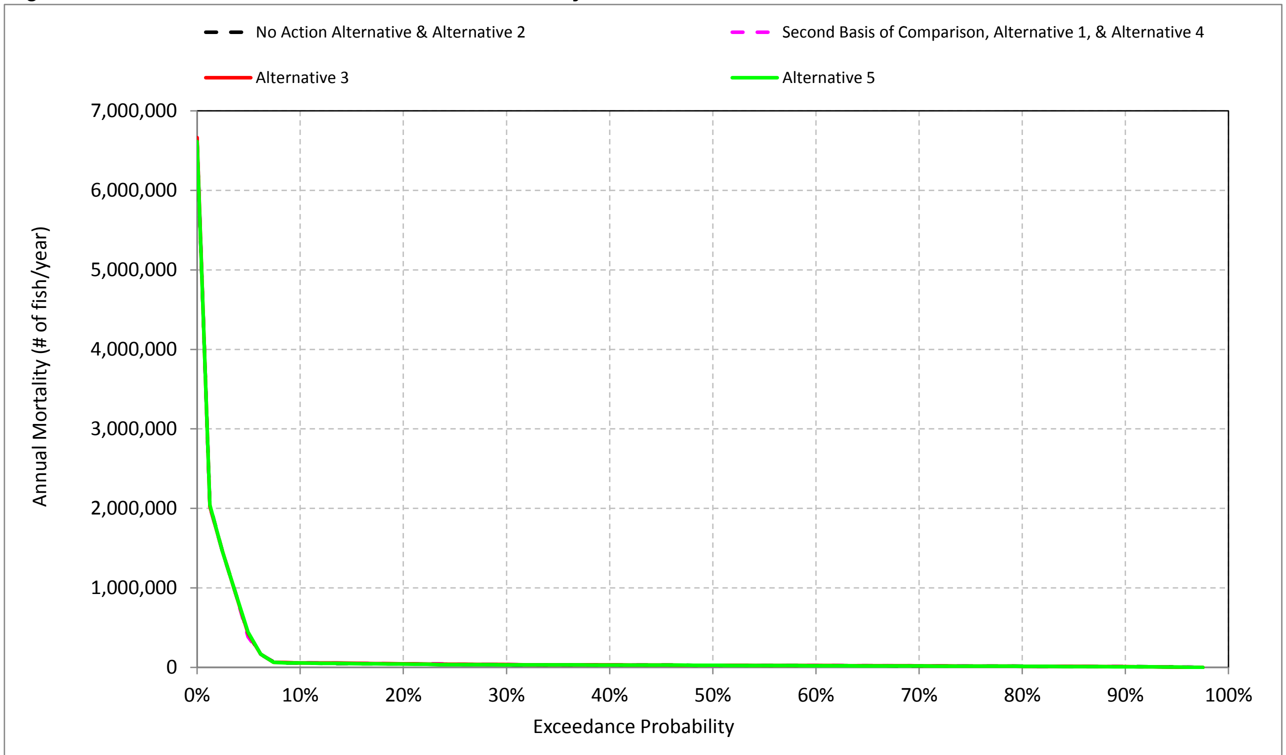
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-7. Annual Mortality for Late Fall-Run Chinook Salmon - All Lifestages



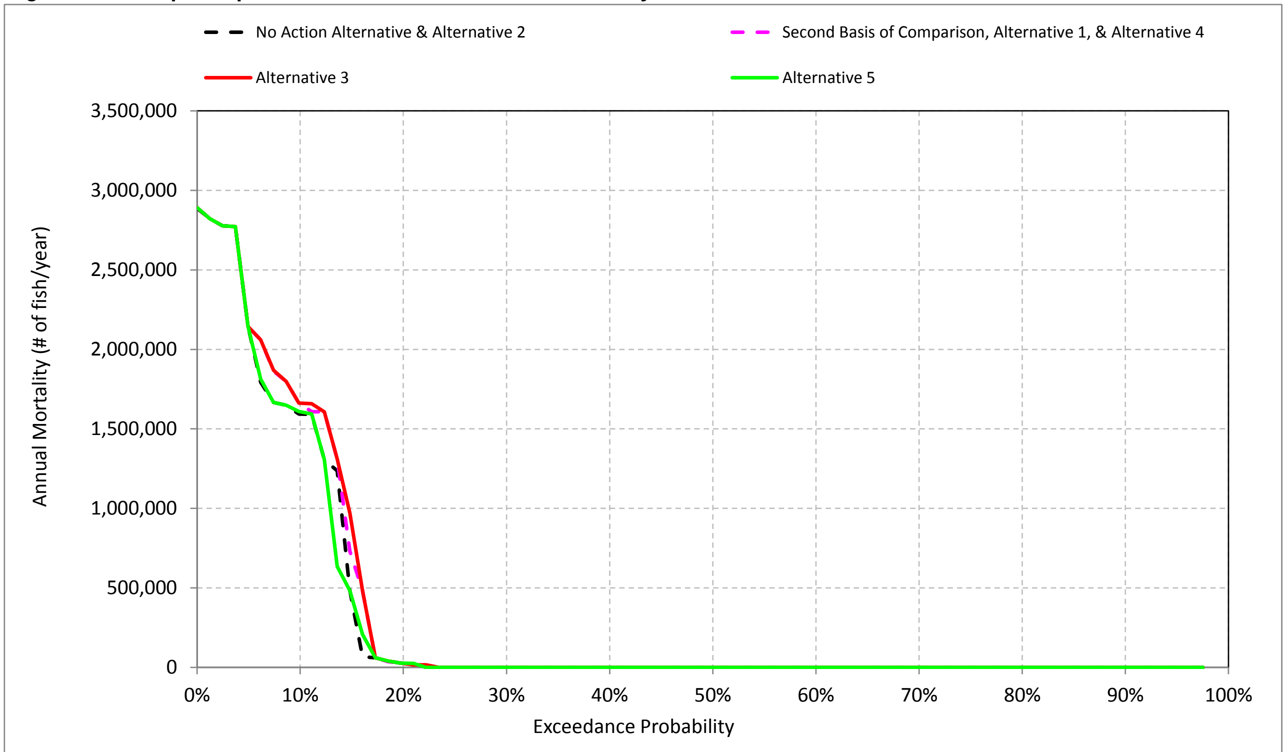
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-8. Incubation - Habitat based Annual Mortality for Late Fall-Run Chinook Salmon



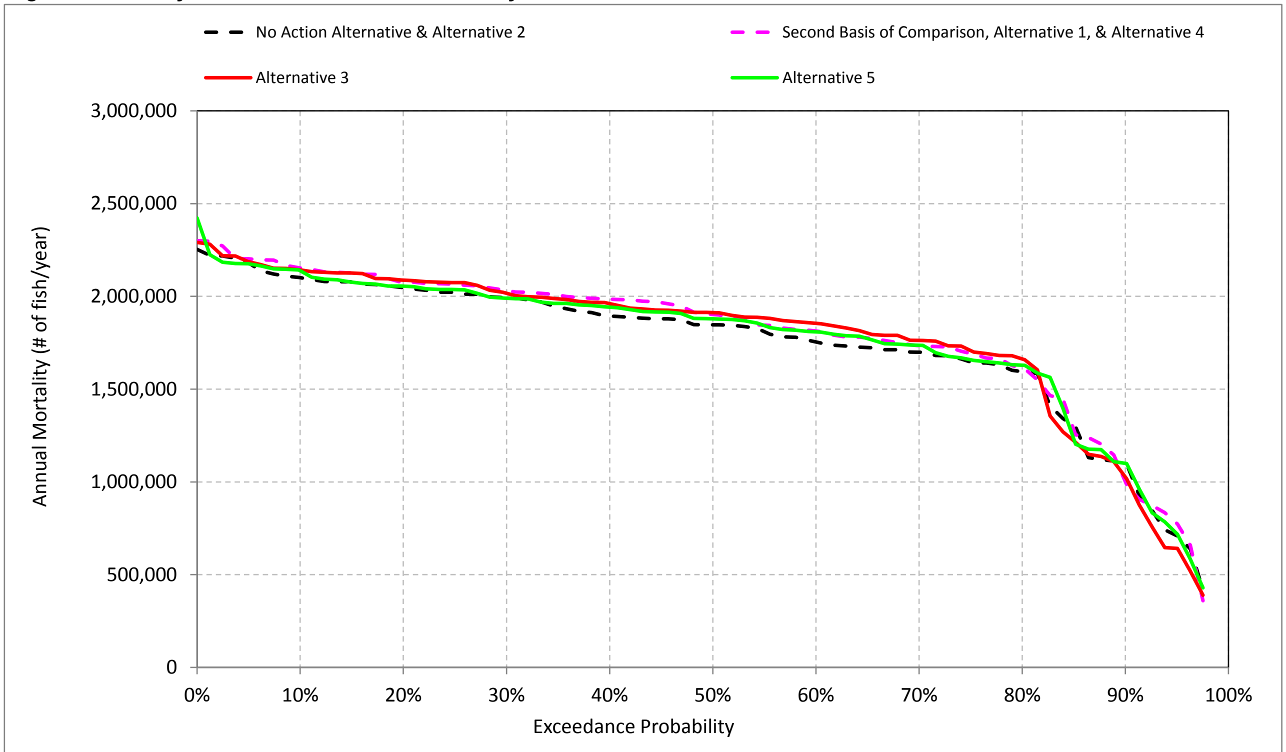
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-9. Super-imposition - Habitat based Annual Mortality for Late Fall-Run Chinook Salmon



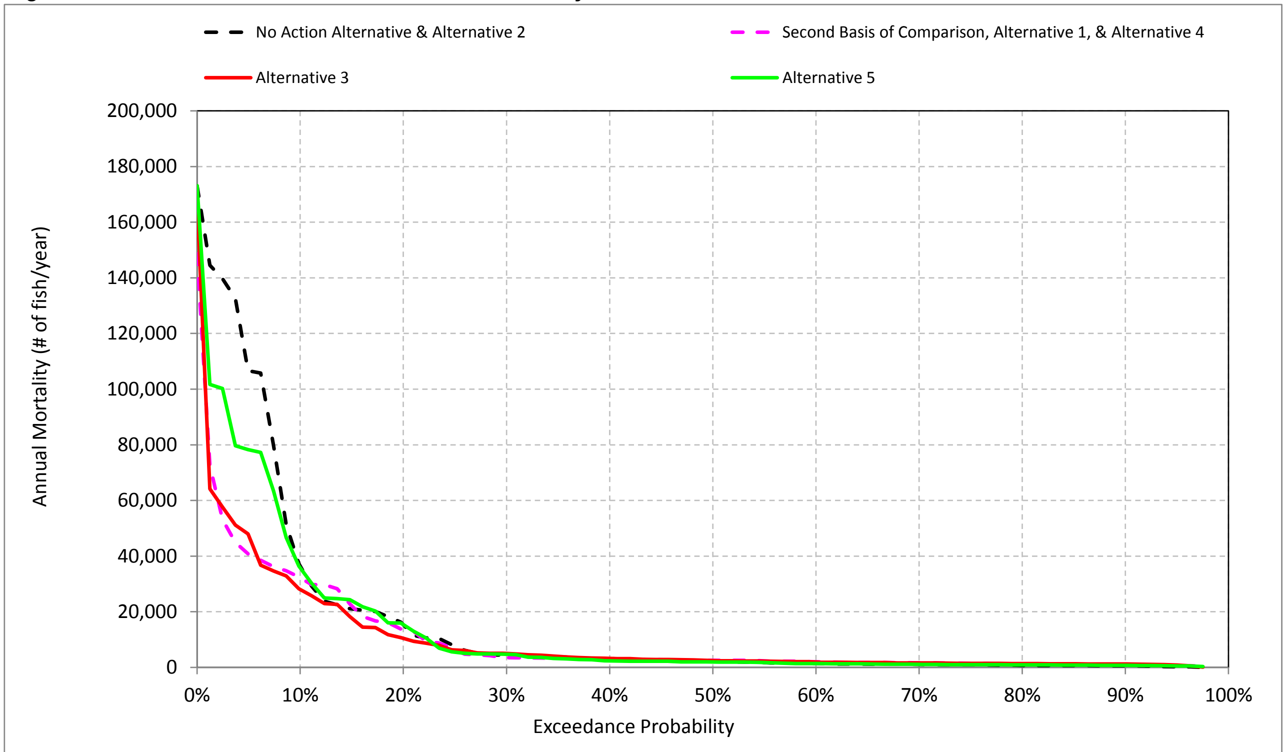
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-10. Fry - Habitat based Annual Mortality for Late Fall-Run Chinook Salmon



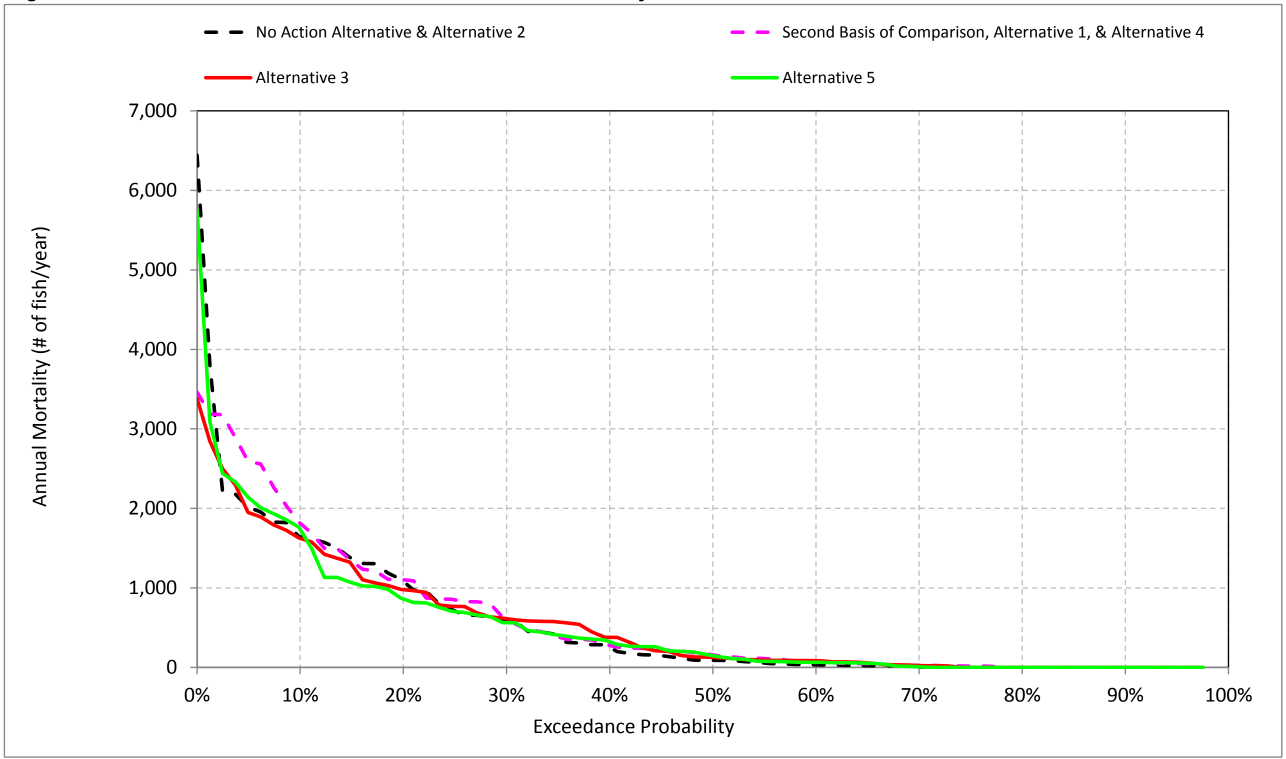
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-11. Pre-smolt - Habitat based Annual Mortality for Late Fall-Run Chinook Salmon



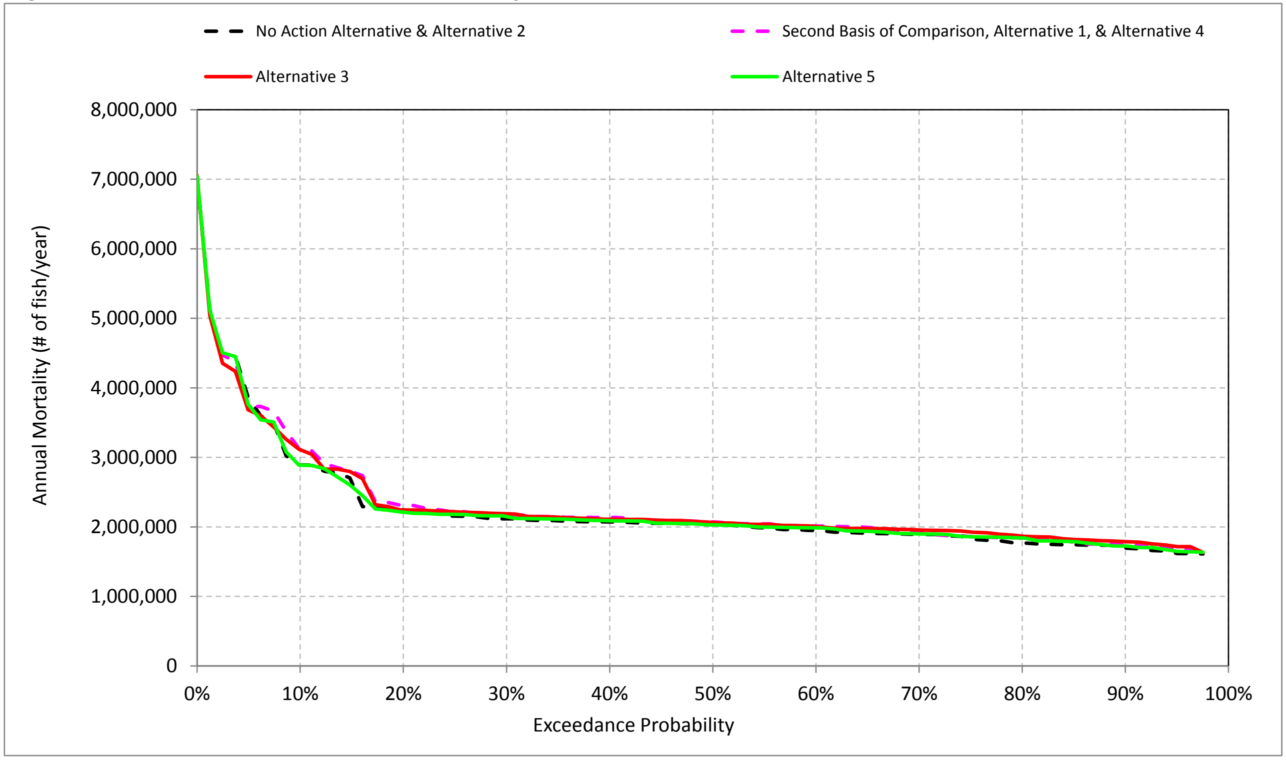
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-12. Immature Smolt - Habitat based Annual Mortality for Late Fall-Run Chinook Salmon



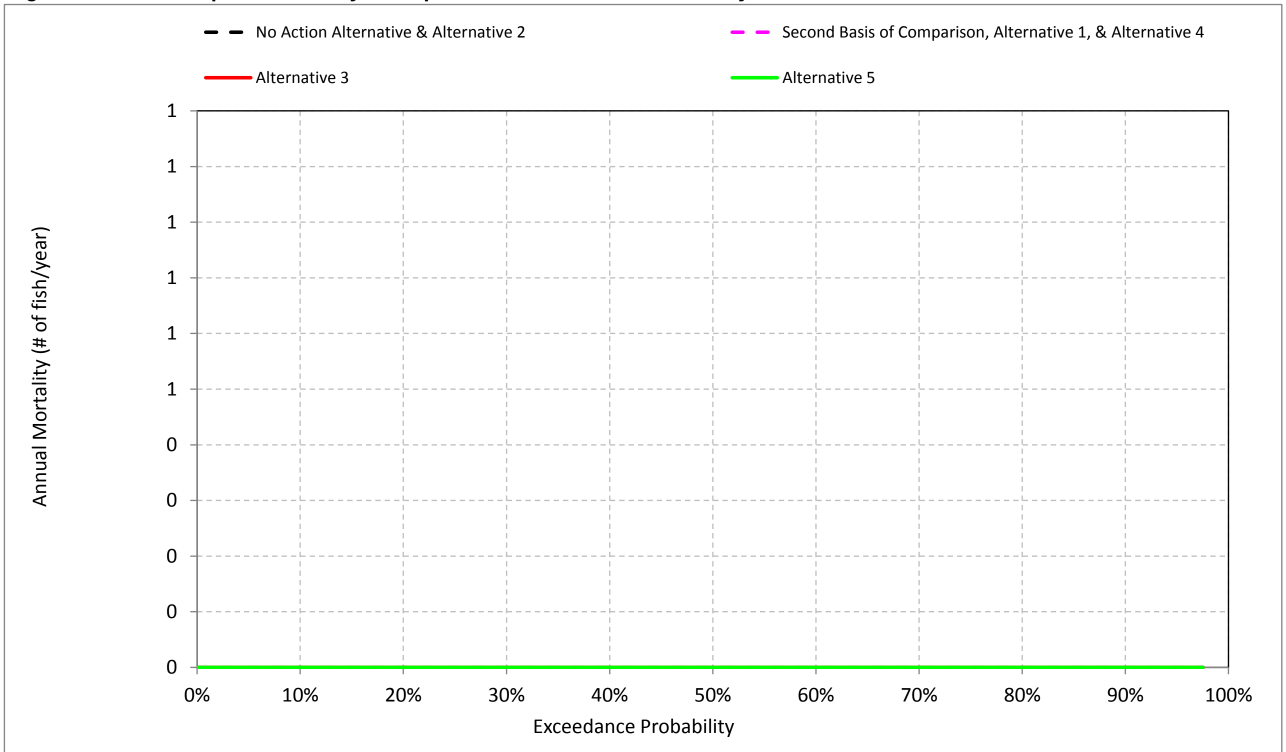
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-13. Total Habitat based Annual Mortality for Late Fall-Run Chinook Salmon



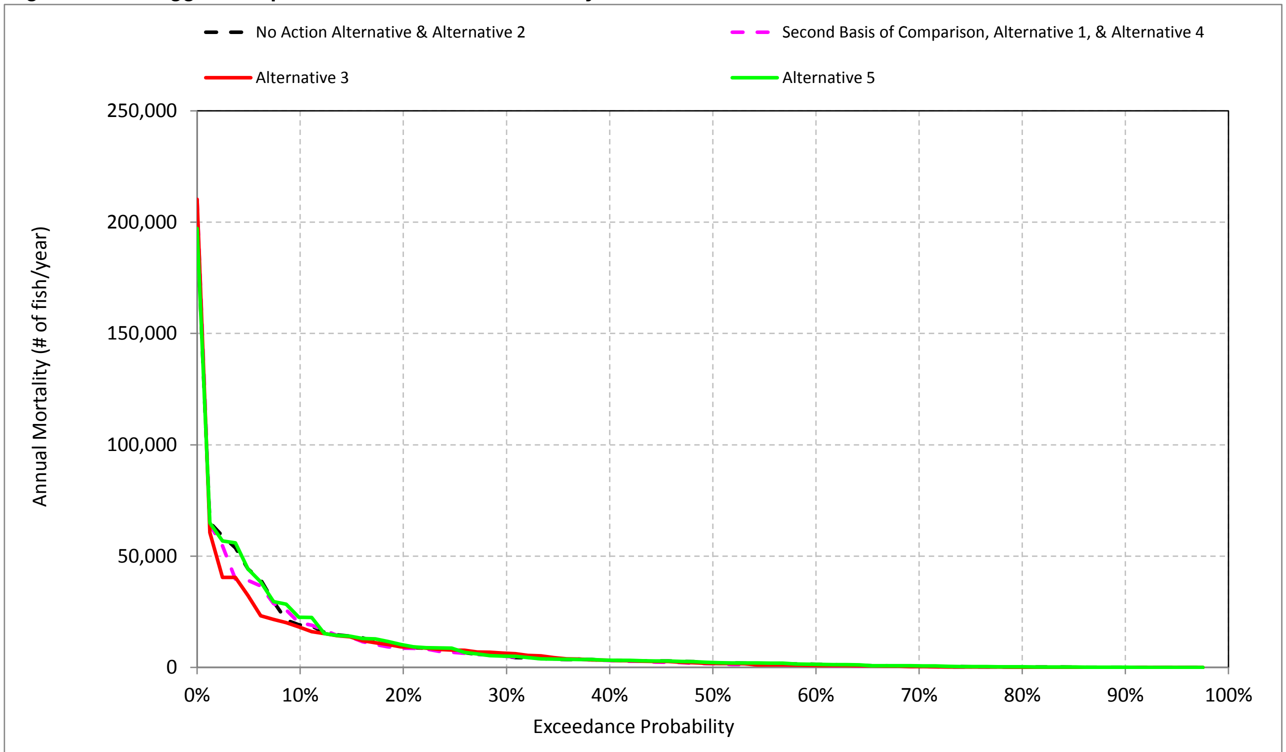
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-14. Pre-Spawn Mortality - Temperature based Annual Mortality for Late Fall-Run Chinook Salmon



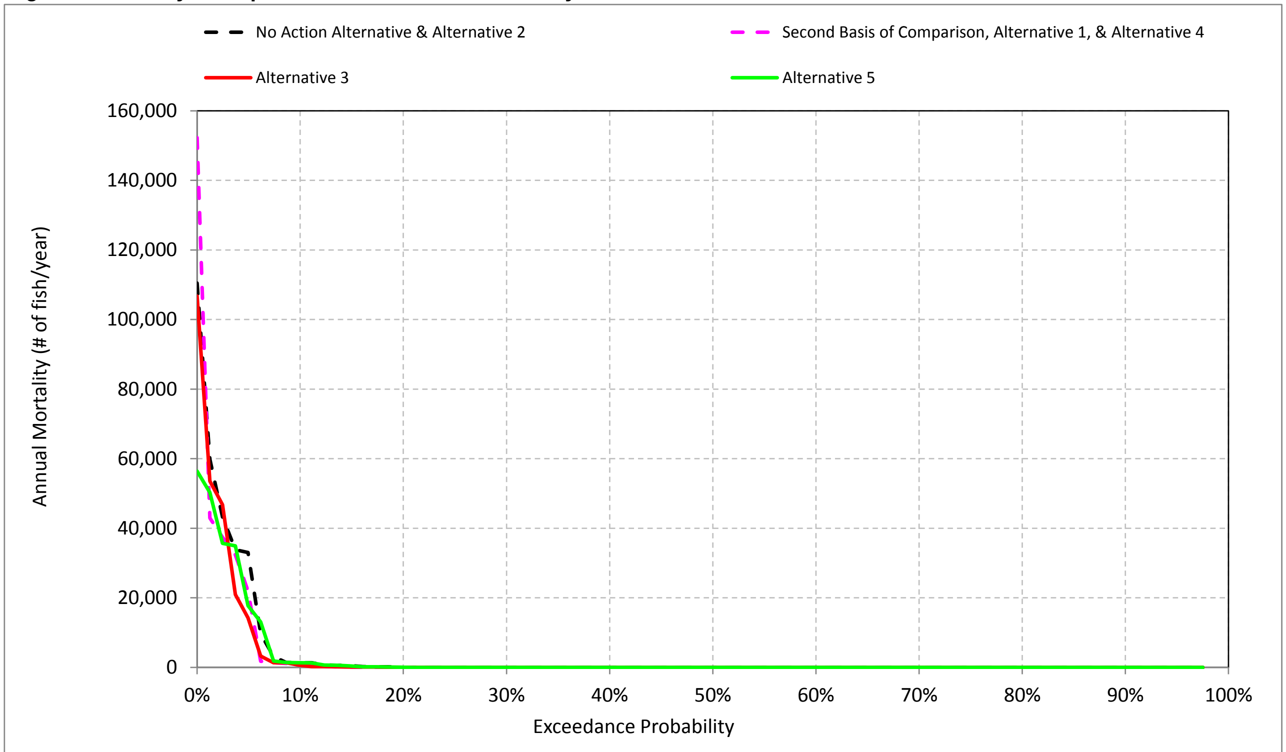
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-15. Eggs - Temperature based Annual Mortality for Late Fall-Run Chinook Salmon



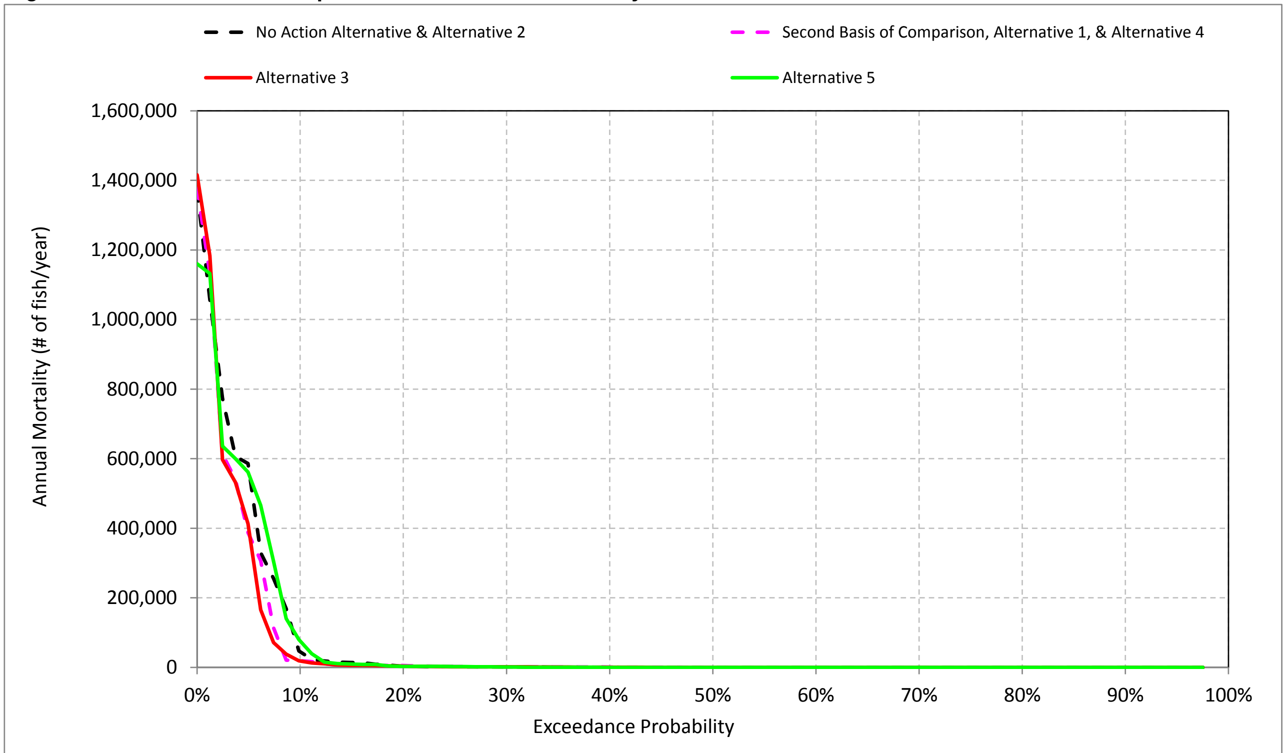
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-16. Fry - Temperature based Annual Mortality for Late Fall-Run Chinook Salmon



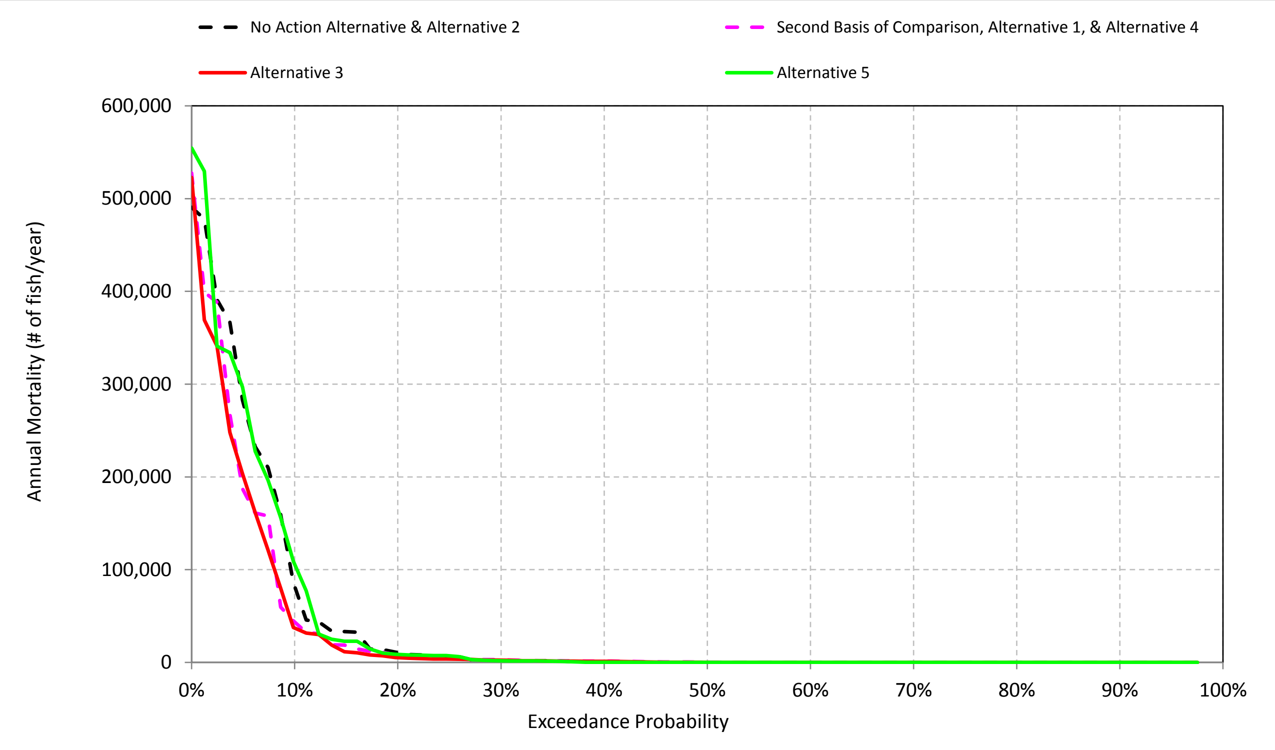
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-17. Pre-smolt - Temperature based Annual Mortality for Late Fall-Run Chinook Salmon



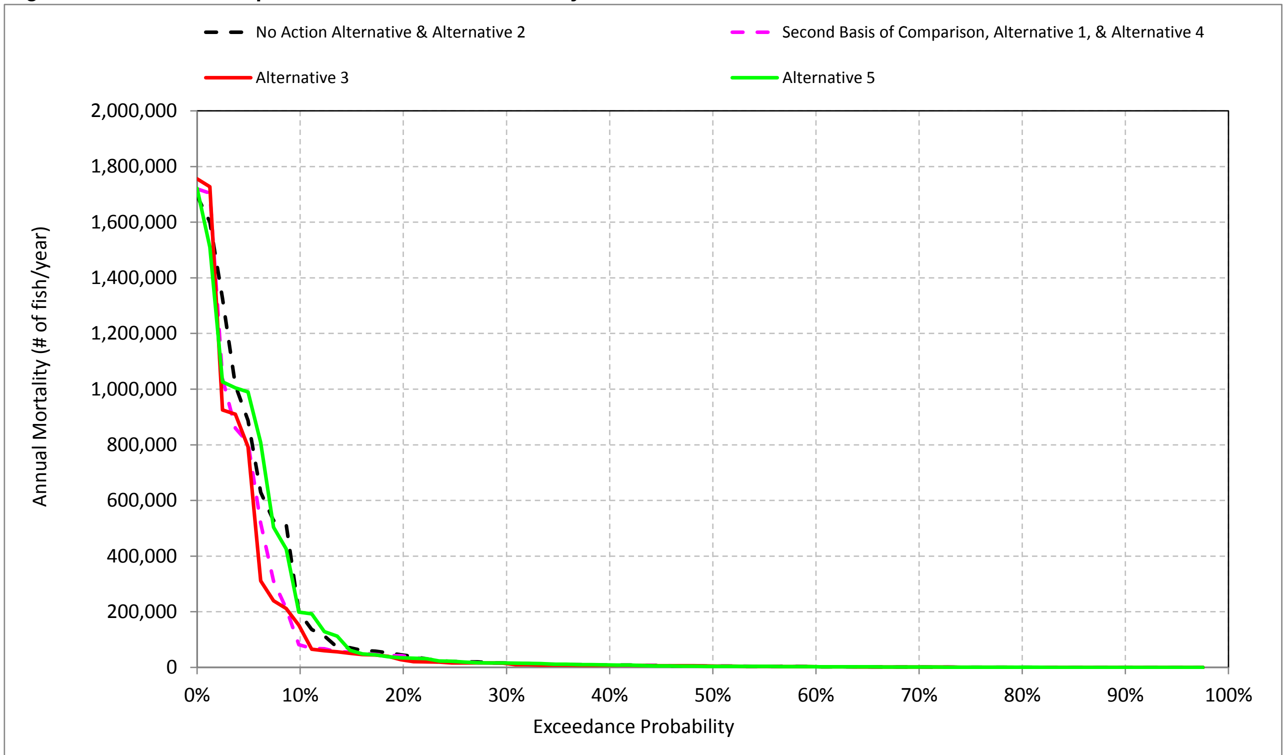
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-18. Immature Smolt - Temperature based Annual Mortality for Late Fall-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-19. Total Temperature based Annual Mortality for Late Fall-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-1. Annual Potential Production for Late Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	2,813,219
Alternative 1	2,800,061
Difference	-13,158
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	2,692,145
Alternative 1	2,691,035
Difference	-1,111
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	2,860,264
Alternative 1	2,802,912
Difference	-57,352
Percent Difference	-2
Below Normal (17.5%)	
No Action Alternative	2,982,412
Alternative 1	2,930,472
Difference	-51,940
Percent Difference	-2
Dry (22.5%)	
No Action Alternative	3,023,892
Alternative 1	2,976,338
Difference	-47,554
Percent Difference	-2
Critical (15%)	
No Action Alternative	2,522,939
Alternative 1	2,617,343
Difference	94,404
Percent Difference	4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-2-2. Annual Mortality by Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	492,142	1,757,035	82,787	37,844	120,631
Alternative 1	513,890	1,802,954	68,169	30,510	98,679
Difference	21,748	45,920	-14,618	-7,334	-21,952
Percent Difference[3]	4	3	-18	-19	-18
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	1,305,939	1,487,095	6,012	78	6,089
Alternative 1	1,331,500	1,479,904	4,935	609	5,544
Difference	25,561	-7,191	-1,076	531	-545
Percent Difference	2	0	-18	684	-9
Above Normal (12.5%)					
No Action Alternative	371,926	1,810,494	1,361	103	1,464
Alternative 1	482,073	1,869,446	2,387	187	2,573
Difference	110,146	58,952	1,025	84	1,109
Percent Difference	30	3	75	82	76
Below Normal (17.5%)					
No Action Alternative	38,722	1,885,067	14,022	4,588	18,610
Alternative 1	41,496	1,985,382	9,337	3,123	12,460
Difference	2,774	100,315	-4,685	-1,465	-6,150
Percent Difference	7	5	-33	-32	-33
Dry (22.5%)					
No Action Alternative	34,945	1,894,612	38,990	16,946	55,936
Alternative 1	34,962	1,979,833	29,461	15,809	45,270
Difference	17	85,221	-9,529	-1,137	-10,666
Percent Difference	0	4	-24	-7	-19
Critical (15%)					
No Action Alternative	43,879	1,941,615	462,907	221,268	684,174
Alternative 1	38,435	1,969,335	386,693	174,569	561,262
Difference	-5,445	27,720	-76,214	-46,699	-122,912
Percent Difference	-12	1	-16	-21	-18

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-2-3. Annual Mortality by Cause for Late Fall-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)		
Analysis Period	**Temperature**	**Flow**	**Total**
Long-term			
Full Simulation Period[1]			
No Action Alternative	117,312	2,252,495	2,369,807
Alternative 1	100,569	2,314,954	2,415,523
Difference	-16,743	62,459	45,716
Percent Difference[3]	-14	3	2
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	11,538	2,787,586	2,799,124
Alternative 1	13,087	2,803,861	2,816,949
Difference	1,549	16,276	17,825
Percent Difference	13	1	1
Above Normal (12.5%)			
No Action Alternative	9,419	2,174,466	2,183,885
Alternative 1	9,812	2,344,280	2,354,092
Difference	393	169,814	170,208
Percent Difference	4	8	8
Below Normal (17.5%)			
No Action Alternative	16,631	1,925,768	1,942,399
Alternative 1	15,158	2,024,180	2,039,338
Difference	-1,474	98,412	96,938
Percent Difference	-9	5	5
Dry (22.5%)			
No Action Alternative	44,530	1,940,964	1,985,493
Alternative 1	40,463	2,019,602	2,060,065
Difference	-4,067	78,638	74,572
Percent Difference	-9	4	4
Critical (15%)			
No Action Alternative	663,032	2,006,637	2,669,669
Alternative 1	555,549	2,013,483	2,569,032
Difference	-107,483	6,846	-100,637
Percent Difference	-16	0	-4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-4. Annual Mortality by Cause and Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	0	482,477	9,665	3,749	1,753,285	103,897	16,733	2,369,807
Alternative 1	0	504,586	9,304	3,662	1,799,292	87,603	11,076	2,415,523
Difference	0	22,110	-361	-87	46,006	-16,294	-5,657	45,716
Percent Difference[3]	0	5	-4	-2	3	-16	-34	2
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	0	1,294,487	11,452	61	1,487,035	26	6,063	2,799,124
Alternative 1	0	1,319,517	11,983	61	1,479,843	1,043	4,501	2,816,949
Difference	0	25,030	531	0	-7,192	1,018	-1,563	17,825
Percent Difference	0	2	5	1	0	3,925	-26	1
Above Normal (12.5%)								
No Action Alternative	0	362,747	9,179	167	1,810,328	73	1,392	2,183,885
Alternative 1	0	472,813	9,259	147	1,869,299	405	2,168	2,354,092
Difference	0	110,066	80	-19	58,971	333	776	170,208
Percent Difference	0	30	1	-12	3	459	56	8
Below Normal (17.5%)								
No Action Alternative	0	28,022	10,701	143	1,884,924	5,787	12,822	1,942,399
Alternative 1	0	30,282	11,214	62	1,985,320	3,882	8,578	2,039,338
Difference	0	2,261	513	-81	100,396	-1,906	-4,244	96,938
Percent Difference	0	8	5	-57	5	-33	-33	5
Dry (22.5%)								
No Action Alternative	0	28,946	5,999	570	1,894,042	37,961	17,975	1,985,493
Alternative 1	0	30,519	4,444	1,218	1,978,615	34,802	10,468	2,060,065
Difference	0	1,573	-1,556	648	84,573	-3,159	-7,508	74,572
Percent Difference	0	5	-26	114	4	-8	-42	4
Critical (15%)								
No Action Alternative	0	33,389	10,490	23,702	1,917,913	628,839	55,335	2,669,669
Alternative 1	0	29,837	8,597	22,262	1,947,073	524,689	36,573	2,569,032
Difference	0	-3,552	-1,893	-1,440	29,160	-104,150	-18,762	-100,637
Percent Difference	0	-11	-18	-6	2	-17	-34	-4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-5. Annual Mortality by All Factors for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	0	170,688	311,789	9,665	3,749	1,753,285	66,626	16,161	37,272	572	2,369,807
Alternative 1	0	171,160	333,426	9,304	3,662	1,799,292	57,690	10,479	29,913	597	2,415,523
Difference	0	472	21,637	-361	-87	46,006	-8,936	-5,682	-7,359	25	45,716
Percent Difference[3]	0	0	7	-4	-2	3	-13	-35	-20	4	2
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	0	465,305	829,182	11,452	61	1,487,035	19	5,993	7	71	2,799,124
Alternative 1	0	464,856	854,662	11,983	61	1,479,843	549	4,386	494	114	2,816,949
Difference	0	-449	25,479	531	0	-7,192	530	-1,606	488	43	17,825
Percent Difference	0	0	3	5	1	0	2,784	-27	7,082	61	1
Above Normal (12.5%)											
No Action Alternative	0	24,311	338,436	9,179	167	1,810,328	54	1,307	18	84	2,183,885
Alternative 1	0	27,524	445,289	9,259	147	1,869,299	297	2,089	108	79	2,354,092
Difference	0	3,213	106,853	80	-19	58,971	243	782	90	-6	170,208
Percent Difference	0	13	32	1	-12	3	448	60	491	-7	8
Below Normal (17.5%)											
No Action Alternative	0	28,022	0	10,701	143	1,884,924	1,766	12,256	4,022	566	1,942,399
Alternative 1	0	30,282	0	11,214	62	1,985,320	1,247	8,090	2,635	488	2,039,338
Difference	0	2,261	0	513	-81	100,396	-519	-4,166	-1,386	-79	96,938
Percent Difference	0	8	0	5	-57	5	-29	-34	-34	-14	5
Dry (22.5%)											
No Action Alternative	0	28,946	0	5,999	570	1,894,042	21,850	17,140	16,111	835	1,985,493
Alternative 1	0	30,519	0	4,444	1,218	1,978,615	19,975	9,486	14,827	982	2,060,065
Difference	0	1,573	0	-1,556	648	84,573	-1,875	-7,654	-1,284	147	74,572
Percent Difference	0	5	0	-26	114	4	-9	-45	-8	18	4
Critical (15%)											
No Action Alternative	0	33,389	0	10,490	23,702	1,917,913	409,251	53,656	219,588	1,679	2,669,669
Alternative 1	0	29,837	0	8,597	22,262	1,947,073	351,747	34,946	172,942	1,627	2,569,032
Difference	0	-3,552	0	-1,893	-1,440	29,160	-57,504	-18,710	-46,646	-52	-100,637
Percent Difference	0	-11	0	-18	-6	2	-14	-35	-21	-3	-4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-6. Annual Potential Production for Late Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	2,813,219
Alternative 3	2,812,234
Difference	-985
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	2,692,145
Alternative 3	2,691,402
Difference	-743
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	2,860,264
Alternative 3	2,810,515
Difference	-49,749
Percent Difference	-2
Below Normal (17.5%)	
No Action Alternative	2,982,412
Alternative 3	2,961,353
Difference	-21,059
Percent Difference	-1
Dry (22.5%)	
No Action Alternative	3,023,892
Alternative 3	3,012,660
Difference	-11,233
Percent Difference	0
Critical (15%)	
No Action Alternative	2,522,939
Alternative 3	2,600,856
Difference	77,917
Percent Difference	3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-2-7. Annual Mortality by Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	492,142	1,757,035	82,787	37,844	120,631
Alternative 3	517,818	1,792,455	66,941	28,700	95,641
Difference	25,677	35,421	-15,845	-9,144	-24,990
Percent Difference[3]	5	2	-19	-24	-21
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	1,305,939	1,487,095	6,012	78	6,089
Alternative 3	1,334,935	1,484,912	3,275	536	3,812
Difference	28,996	-2,184	-2,736	459	-2,278
Percent Difference	2	0	-46	590	-37
Above Normal (12.5%)					
No Action Alternative	371,926	1,810,494	1,361	103	1,464
Alternative 3	504,894	1,838,570	2,383	216	2,598
Difference	132,968	28,076	1,021	113	1,134
Percent Difference	36	2	75	110	77
Below Normal (17.5%)					
No Action Alternative	38,722	1,885,067	14,022	4,588	18,610
Alternative 3	39,609	1,946,219	10,333	2,164	12,497
Difference	887	61,152	-3,689	-2,424	-6,113
Percent Difference	2	3	-26	-53	-33
Dry (22.5%)					
No Action Alternative	34,945	1,894,612	38,990	16,946	55,936
Alternative 3	34,674	1,958,252	19,261	12,124	31,385
Difference	-271	63,640	-19,729	-4,822	-24,551
Percent Difference	-1	3	-51	-28	-44
Critical (15%)					
No Action Alternative	43,879	1,941,615	462,907	221,268	684,174
Alternative 3	40,798	1,992,284	396,247	169,277	565,524
Difference	-3,082	50,669	-66,660	-51,990	-118,650
Percent Difference	-7	3	-14	-23	-17

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-2-8. Annual Mortality by Cause for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	117,312	2,252,495	2,369,807
Alternative 3	96,645	2,309,269	2,405,915
Difference	-20,666	56,774	36,108
Percent Difference[3]	-18	3	2
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	11,538	2,787,586	2,799,124
Alternative 3	13,133	2,810,525	2,823,658
Difference	1,595	22,940	24,535
Percent Difference	14	1	1
Above Normal (12.5%)			
No Action Alternative	9,419	2,174,466	2,183,885
Alternative 3	6,036	2,340,026	2,346,062
Difference	-3,382	165,560	162,178
Percent Difference	-36	8	7
Below Normal (17.5%)			
No Action Alternative	16,631	1,925,768	1,942,399
Alternative 3	13,519	1,984,806	1,998,326
Difference	-3,112	59,038	55,926
Percent Difference	-19	3	3
Dry (22.5%)			
No Action Alternative	44,530	1,940,964	1,985,493
Alternative 3	27,396	1,996,915	2,024,311
Difference	-17,134	55,952	38,818
Percent Difference	-38	3	2
Critical (15%)			
No Action Alternative	663,032	2,006,637	2,669,669
Alternative 3	553,950	2,044,656	2,598,606
Difference	-109,082	38,019	-71,063
Percent Difference	-16	2	-3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-9. Annual Mortality by Cause and Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
	Annual Mortality[4] (# of Fish/year)							
Long-term								
Full Simulation Period[1]								
No Action Alternative	0	482,477	9,665	3,749	1,753,285	103,897	16,733	2,369,807
Alternative 3	0	509,000	8,818	3,126	1,789,329	84,700	10,941	2,405,915
Difference	0	26,523	-847	-623	36,043	-19,197	-5,793	36,108
Percent Difference[3]	0	5	-9	-17	2	-18	-35	2
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	0	1,294,487	11,452	61	1,487,035	26	6,063	2,799,124
Alternative 3	0	1,322,789	12,146	61	1,484,851	927	2,885	2,823,658
Difference	0	28,302	694	0	-2,184	901	-3,178	24,535
Percent Difference	0	2	6	0	0	3,475	-52	1
Above Normal (12.5%)								
No Action Alternative	0	362,747	9,179	167	1,810,328	73	1,392	2,183,885
Alternative 3	0	499,275	5,619	31	1,838,539	386	2,212	2,346,062
Difference	0	136,528	-3,560	-136	28,212	314	821	162,178
Percent Difference	0	38	-39	-82	2	433	59	7
Below Normal (17.5%)								
No Action Alternative	0	28,022	10,701	143	1,884,924	5,787	12,822	1,942,399
Alternative 3	0	28,753	10,857	75	1,946,144	2,588	9,910	1,998,326
Difference	0	731	156	-68	61,220	-3,200	-2,913	55,926
Percent Difference	0	3	1	-47	3	-55	-23	3
Dry (22.5%)								
No Action Alternative	0	28,946	5,999	570	1,894,042	37,961	17,975	1,985,493
Alternative 3	0	30,082	4,592	188	1,958,065	22,616	8,769	2,024,311
Difference	0	1,136	-1,407	-382	64,022	-15,345	-9,206	38,818
Percent Difference	0	4	-23	-67	3	-40	-51	2
Critical (15%)								
No Action Alternative	0	33,389	10,490	23,702	1,917,913	628,839	55,335	2,669,669
Alternative 3	0	32,561	8,237	20,317	1,971,967	525,396	40,128	2,598,606
Difference	0	-829	-2,253	-3,386	54,055	-103,443	-15,207	-71,063
Percent Difference	0	-2	-21	-14	3	-16	-27	-3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-10. Annual Mortality by All Factors for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year)										
	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	0	170,688	311,789	9,665	3,749	1,753,285	66,626	16,161	37,272	572	2,369,807
Alternative 3	0	171,685	337,315	8,818	3,126	1,789,329	56,543	10,398	28,158	542	2,405,915
Difference	0	997	25,526	-847	-623	36,043	-10,083	-5,762	-9,114	-30	36,108
Percent Difference[3]	0	1	8	-9	-17	2	-15	-36	-24	-5	2
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	0	465,305	829,182	11,452	61	1,487,035	19	5,993	7	71	2,799,124
Alternative 3	0	466,004	856,785	12,146	61	1,484,851	516	2,759	411	126	2,823,658
Difference	0	699	27,603	694	0	-2,184	497	-3,233	404	55	24,535
Percent Difference	0	0	3	6	0	0	2,610	-54	5,866	77	1
Above Normal (12.5%)											
No Action Alternative	0	24,311	338,436	9,179	167	1,810,328	54	1,307	18	84	2,183,885
Alternative 3	0	28,397	470,878	5,619	31	1,838,539	296	2,087	90	125	2,346,062
Difference	0	4,086	132,442	-3,560	-136	28,212	242	779	72	41	162,178
Percent Difference	0	17	39	-39	-82	2	446	60	392	49	7
Below Normal (17.5%)											
No Action Alternative	0	28,022	0	10,701	143	1,884,924	1,766	12,256	4,022	566	1,942,399
Alternative 3	0	28,753	0	10,857	75	1,946,144	823	9,510	1,765	400	1,998,326
Difference	0	731	0	156	-68	61,220	-943	-2,746	-2,257	-167	55,926
Percent Difference	0	3	0	1	-47	3	-53	-22	-56	-29	3
Dry (22.5%)											
No Action Alternative	0	28,946	0	5,999	570	1,894,042	21,850	17,140	16,111	835	1,985,493
Alternative 3	0	30,082	0	4,592	188	1,958,065	11,401	7,860	11,215	909	2,024,311
Difference	0	1,136	0	-1,407	-382	64,022	-10,449	-9,280	-4,896	74	38,818
Percent Difference	0	4	0	-23	-67	3	-48	-54	-30	9	2
Critical (15%)											
No Action Alternative	0	33,389	0	10,490	23,702	1,917,913	409,251	53,656	219,588	1,679	2,669,669
Alternative 3	0	32,561	0	8,237	20,317	1,971,967	357,527	38,720	167,870	1,408	2,598,606
Difference	0	-829	0	-2,253	-3,386	54,055	-51,725	-14,935	-51,719	-272	-71,063
Percent Difference	0	-2	0	-21	-14	3	-13	-28	-24	-16	-3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-11. Annual Potential Production for Late Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	2,813,219
Alternative 5	2,805,566
Difference	-7,653
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	2,692,145
Alternative 5	2,700,194
Difference	8,049
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	2,860,264
Alternative 5	2,829,088
Difference	-31,176
Percent Difference	-1
Below Normal (17.5%)	
No Action Alternative	2,982,412
Alternative 5	2,951,992
Difference	-30,420
Percent Difference	-1
Dry (22.5%)	
No Action Alternative	3,023,892
Alternative 5	3,004,835
Difference	-19,057
Percent Difference	-1
Critical (15%)	
No Action Alternative	2,522,939
Alternative 5	2,544,537
Difference	21,598
Percent Difference	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-2-12. Annual Mortality by Life Stage for Late Fall-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)				
Analysis Period	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	492,142	1,757,035	82,787	37,844	120,631
Alternative 5	486,679	1,779,342	78,549	38,177	116,726
Difference	-5,463	22,307	-4,237	333	-3,904
Percent Difference[3]	-1	1	-5	1	-3
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	1,305,939	1,487,095	6,012	78	6,089
Alternative 5	1,284,631	1,490,907	4,027	74	4,101
Difference	-21,308	3,812	-1,985	-4	-1,989
Percent Difference	-2	0	-33	-5	-33
Above Normal (12.5%)					
No Action Alternative	371,926	1,810,494	1,361	103	1,464
Alternative 5	385,985	1,859,656	1,357	82	1,439
Difference	14,059	49,162	-5	-21	-25
Percent Difference	4	3	0	-20	-2
Below Normal (17.5%)					
No Action Alternative	38,722	1,885,067	14,022	4,588	18,610
Alternative 5	39,141	1,943,539	13,998	4,481	18,480
Difference	419	58,471	-23	-107	-130
Percent Difference	1	3	0	-2	-1
Dry (22.5%)					
No Action Alternative	34,945	1,894,612	38,990	16,946	55,936
Alternative 5	34,298	1,930,739	31,905	14,697	46,602
Difference	-647	36,127	-7,085	-2,249	-9,334
Percent Difference	-2	2	-18	-13	-17
Critical (15%)					
No Action Alternative	43,879	1,941,615	462,907	221,268	684,174
Alternative 5	42,394	1,918,694	449,617	227,011	676,628
Difference	-1,485	-22,921	-13,290	5,743	-7,547
Percent Difference	-3	-1	-3	3	-1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-2-13. Annual Mortality by Cause for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	117,312	2,252,495	2,369,807
Alternative 5	115,323	2,267,424	2,382,747
Difference	-1,989	14,929	12,940
Percent Difference[3]	-2	1	1
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	11,538	2,787,586	2,799,124
Alternative 5	11,470	2,768,169	2,779,639
Difference	-68	-19,417	-19,485
Percent Difference	-1	-1	-1
Above Normal (12.5%)			
No Action Alternative	9,419	2,174,466	2,183,885
Alternative 5	9,777	2,237,304	2,247,081
Difference	359	62,838	63,196
Percent Difference	4	3	3
Below Normal (17.5%)			
No Action Alternative	16,631	1,925,768	1,942,399
Alternative 5	16,938	1,984,222	2,001,160
Difference	307	58,454	58,760
Percent Difference	2	3	3
Dry (22.5%)			
No Action Alternative	44,530	1,940,964	1,985,493
Alternative 5	40,257	1,971,382	2,011,639
Difference	-4,273	30,419	26,146
Percent Difference	-10	2	1
Critical (15%)			
No Action Alternative	663,032	2,006,637	2,669,669
Alternative 5	655,672	1,982,044	2,637,716
Difference	-7,360	-24,593	-31,953
Percent Difference	-1	-1	-1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-14. Annual Mortality by Cause and Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	0	482,477	9,665	3,749	1,753,285	103,897	16,733	2,369,807
Alternative 5	0	476,778	9,902	2,705	1,776,637	102,717	14,010	2,382,747
Difference	0	-5,699	236	-1,044	23,351	-1,181	-2,724	12,940
Percent Difference[3]	0	-1	2	-28	1	-1	-16	1
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	0	1,294,487	11,452	61	1,487,035	26	6,063	2,799,124
Alternative 5	0	1,273,245	11,386	61	1,490,847	24	4,077	2,779,639
Difference	0	-21,242	-66	0	3,812	-2	-1,987	-19,485
Percent Difference	0	-2	-1	0	0	-8	-33	-1
Above Normal (12.5%)								
No Action Alternative	0	362,747	9,179	167	1,810,328	73	1,392	2,183,885
Alternative 5	0	376,400	9,586	142	1,859,515	50	1,389	2,247,081
Difference	0	13,653	406	-25	49,187	-23	-2	63,196
Percent Difference	0	4	4	-15	3	-31	0	3
Below Normal (17.5%)								
No Action Alternative	0	28,022	10,701	143	1,884,924	5,787	12,822	1,942,399
Alternative 5	0	28,128	11,014	147	1,943,392	5,777	12,702	2,001,160
Difference	0	106	313	4	58,468	-10	-120	58,760
Percent Difference	0	0	3	3	3	0	-1	3
Dry (22.5%)								
No Action Alternative	0	28,946	5,999	570	1,894,042	37,961	17,975	1,985,493
Alternative 5	0	28,043	6,255	761	1,929,979	33,241	13,361	2,011,639
Difference	0	-903	256	191	35,936	-4,720	-4,614	26,146
Percent Difference	0	-3	4	34	2	-12	-26	1
Critical (15%)								
No Action Alternative	0	33,389	10,490	23,702	1,917,913	628,839	55,335	2,669,669
Alternative 5	0	31,273	11,121	16,469	1,902,225	628,081	48,546	2,637,716
Difference	0	-2,116	631	-7,233	-15,688	-758	-6,789	-31,953
Percent Difference	0	-6	6	-31	-1	0	-12	-1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-15. Annual Mortality by All Factors for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year)										
	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	0	170,688	311,789	9,665	3,749	1,753,285	66,626	16,161	37,272	572	2,369,807
Alternative 5	0	170,227	306,551	9,902	2,705	1,776,637	65,089	13,460	37,628	549	2,382,747
Difference	0	-461	-5,238	236	-1,044	23,351	-1,537	-2,700	356	-23	12,940
Percent Difference[3]	0	0	-2	2	-28	1	-2	-17	1	-4	1
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	0	465,305	829,182	11,452	61	1,487,035	19	5,993	7	71	2,799,124
Alternative 5	0	465,569	807,677	11,386	61	1,490,847	18	4,009	6	68	2,779,639
Difference	0	264	-21,506	-66	0	3,812	-1	-1,984	-1	-3	-19,485
Percent Difference	0	0	-3	-1	0	0	-3	-33	-20	-4	-1
Above Normal (12.5%)											
No Action Alternative	0	24,311	338,436	9,179	167	1,810,328	54	1,307	18	84	2,183,885
Alternative 5	0	23,955	352,445	9,586	142	1,859,515	32	1,325	18	64	2,247,081
Difference	0	-356	14,009	406	-25	49,187	-22	18	-1	-20	63,196
Percent Difference	0	-1	4	4	-15	3	-41	1	-3	-24	3
Below Normal (17.5%)											
No Action Alternative	0	28,022	0	10,701	143	1,884,924	1,766	12,256	4,022	566	1,942,399
Alternative 5	0	28,128	0	11,014	147	1,943,392	1,852	12,147	3,925	556	2,001,160
Difference	0	106	0	313	4	58,468	86	-110	-96	-11	58,760
Percent Difference	0	0	0	3	3	3	5	-1	-2	-2	3
Dry (22.5%)											
No Action Alternative	0	28,946	0	5,999	570	1,894,042	21,850	17,140	16,111	835	1,985,493
Alternative 5	0	28,043	0	6,255	761	1,929,979	19,310	12,595	13,932	766	2,011,639
Difference	0	-903	0	256	191	35,936	-2,540	-4,545	-2,179	-70	26,146
Percent Difference	0	-3	0	4	34	2	-12	-27	-14	-8	1
Critical (15%)											
No Action Alternative	0	33,389	0	10,490	23,702	1,917,913	409,251	53,656	219,588	1,679	2,669,669
Alternative 5	0	31,273	0	11,121	16,469	1,902,225	402,734	46,883	225,348	1,663	2,637,716
Difference	0	-2,116	0	631	-7,233	-15,688	-6,517	-6,773	5,759	-16	-31,953
Percent Difference	0	-6	0	6	-31	-1	-2	-13	3	-1	-1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table C-2-16. Annual Potential Production for Late Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	2,800,061
No Action Alternative	2,813,219
Difference	13,158
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	2,691,035
No Action Alternative	2,692,145
Difference	1,111
Percent Difference	0
Above Normal (12.5%)	
Second Basis of Comparison	2,802,912
No Action Alternative	2,860,264
Difference	57,352
Percent Difference	2
Below Normal (17.5%)	
Second Basis of Comparison	2,930,472
No Action Alternative	2,982,412
Difference	51,940
Percent Difference	2
Dry (22.5%)	
Second Basis of Comparison	2,976,338
No Action Alternative	3,023,892
Difference	47,554
Percent Difference	2
Critical (15%)	
Second Basis of Comparison	2,617,343
No Action Alternative	2,522,939
Difference	-94,404
Percent Difference	-4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table C-2-17. Annual Mortality by Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	513,890	1,802,954	68,169	30,510	98,679
No Action Alternative	492,142	1,757,035	82,787	37,844	120,631
Difference	-21,748	-45,920	14,618	7,334	21,952
Percent Difference[3]	-4	-3	21	24	22
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	1,331,500	1,479,904	4,935	609	5,544
No Action Alternative	1,305,939	1,487,095	6,012	78	6,089
Difference	-25,561	7,191	1,076	-531	545
Percent Difference	-2	0	22	-87	10
Above Normal (12.5%)					
Second Basis of Comparison	482,073	1,869,446	2,387	187	2,573
No Action Alternative	371,926	1,810,494	1,361	103	1,464
Difference	-110,146	-58,952	-1,025	-84	-1,109
Percent Difference	-23	-3	-43	-45	-43
Below Normal (17.5%)					
Second Basis of Comparison	41,496	1,985,382	9,337	3,123	12,460
No Action Alternative	38,722	1,885,067	14,022	4,588	18,610
Difference	-2,774	-100,315	4,685	1,465	6,150
Percent Difference	-7	-5	50	47	49
Dry (22.5%)					
Second Basis of Comparison	34,962	1,979,833	29,461	15,809	45,270
No Action Alternative	34,945	1,894,612	38,990	16,946	55,936
Difference	-17	-85,221	9,529	1,137	10,666
Percent Difference	0	-4	32	7	24
Critical (15%)					
Second Basis of Comparison	38,435	1,969,335	386,693	174,569	561,262
No Action Alternative	43,879	1,941,615	462,907	221,268	684,174
Difference	5,445	-27,720	76,214	46,699	122,912
Percent Difference	14	-1	20	27	22

1 Based on the 80-year simulation period
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.
3 Relative difference of the Annual average
4 Mortality values do not include base mortality
5 Eggs mortality includes pre-spawn mortality

Table C-2-18. Annual Mortality by Cause for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	100,569	2,314,954	2,415,523
No Action Alternative	117,312	2,252,495	2,369,807
Difference	16,743	-62,459	-45,716
Percent Difference[3]	17	-3	-2
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	13,087	2,803,861	2,816,949
No Action Alternative	11,538	2,787,586	2,799,124
Difference	-1,549	-16,276	-17,825
Percent Difference	-12	-1	-1
Above Normal (12.5%)			
Second Basis of Comparison	9,812	2,344,280	2,354,092
No Action Alternative	9,419	2,174,466	2,183,885
Difference	-393	-169,814	-170,208
Percent Difference	-4	-7	-7
Below Normal (17.5%)			
Second Basis of Comparison	15,158	2,024,180	2,039,338
No Action Alternative	16,631	1,925,768	1,942,399
Difference	1,474	-98,412	-96,938
Percent Difference	10	-5	-5
Dry (22.5%)			
Second Basis of Comparison	40,463	2,019,602	2,060,065
No Action Alternative	44,530	1,940,964	1,985,493
Difference	4,067	-78,638	-74,572
Percent Difference	10	-4	-4
Critical (15%)			
Second Basis of Comparison	555,549	2,013,483	2,569,032
No Action Alternative	663,032	2,006,637	2,669,669
Difference	107,483	-6,846	100,637
Percent Difference	19	0	4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table C-2-19. Annual Mortality by Cause and Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	0	504,586	9,304	3,662	1,799,292	87,603	11,076	2,415,523
No Action Alternative	0	482,477	9,665	3,749	1,753,285	103,897	16,733	2,369,807
Difference	0	-22,110	361	87	-46,006	16,294	5,657	-45,716
Percent Difference[3]	0	-4	4	2	-3	19	51	-2
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	0	1,319,517	11,983	61	1,479,843	1,043	4,501	2,816,949
No Action Alternative	0	1,294,487	11,452	61	1,487,035	26	6,063	2,799,124
Difference	0	-25,030	-531	0	7,192	-1,018	1,563	-17,825
Percent Difference	0	-2	-4	-1	0	-98	35	-1
Above Normal (12.5%)								
Second Basis of Comparison	0	472,813	9,259	147	1,869,299	405	2,168	2,354,092
No Action Alternative	0	362,747	9,179	167	1,810,328	73	1,392	2,183,885
Difference	0	-110,066	-80	19	-58,971	-333	-776	-170,208
Percent Difference	0	-23	-1	13	-3	-82	-36	-7
Below Normal (17.5%)								
Second Basis of Comparison	0	30,282	11,214	62	1,985,320	3,882	8,578	2,039,338
No Action Alternative	0	28,022	10,701	143	1,884,924	5,787	12,822	1,942,399
Difference	0	-2,261	-513	81	-100,396	1,906	4,244	-96,938
Percent Difference	0	-7	-5	131	-5	49	49	-5
Dry (22.5%)								
Second Basis of Comparison	0	30,519	4,444	1,218	1,978,615	34,802	10,468	2,060,065
No Action Alternative	0	28,946	5,999	570	1,894,042	37,961	17,975	1,985,493
Difference	0	-1,573	1,556	-648	-84,573	3,159	7,508	-74,572
Percent Difference	0	-5	35	-53	-4	9	72	-4
Critical (15%)								
Second Basis of Comparison	0	29,837	8,597	22,262	1,947,073	524,689	36,573	2,569,032
No Action Alternative	0	33,389	10,490	23,702	1,917,913	628,839	55,335	2,669,669
Difference	0	3,552	1,893	1,440	-29,160	104,150	18,762	100,637
Percent Difference	0	12	22	6	-1	20	51	4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table C-2-20. Annual Mortality by All Factors for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	0	171,160	333,426	9,304	3,662	1,799,292	57,690	10,479	29,913	597	2,415,523
No Action Alternative	0	170,688	311,789	9,665	3,749	1,753,285	66,626	16,161	37,272	572	2,369,807
Difference	0	-472	-21,637	361	87	-46,006	8,936	5,682	7,359	-25	-45,716
Percent Difference[3]	0	0	-6	4	2	-3	15	54	25	-4	-2
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	0	464,856	854,662	11,983	61	1,479,843	549	4,386	494	114	2,816,949
No Action Alternative	0	465,305	829,182	11,452	61	1,487,035	19	5,993	7	71	2,799,124
Difference	0	449	-25,479	-531	0	7,192	-530	1,606	-488	-43	-17,825
Percent Difference	0	0	-3	-4	-1	0	-97	37	-99	-38	-1
Above Normal (12.5%)											
Second Basis of Comparison	0	27,524	445,289	9,259	147	1,869,299	297	2,089	108	79	2,354,092
No Action Alternative	0	24,311	338,436	9,179	167	1,810,328	54	1,307	18	84	2,183,885
Difference	0	-3,213	-106,853	-80	19	-58,971	-243	-782	-90	6	-170,208
Percent Difference	0	-12	-24	-1	13	-3	-82	-37	-83	7	-7
Below Normal (17.5%)											
Second Basis of Comparison	0	30,282	0	11,214	62	1,985,320	1,247	8,090	2,635	488	2,039,338
No Action Alternative	0	28,022	0	10,701	143	1,884,924	1,766	12,256	4,022	566	1,942,399
Difference	0	-2,261	0	-513	81	-100,396	519	4,166	1,386	79	-96,938
Percent Difference	0	-7	0	-5	131	-5	42	51	53	16	-5
Dry (22.5%)											
Second Basis of Comparison	0	30,519	0	4,444	1,218	1,978,615	19,975	9,486	14,827	982	2,060,065
No Action Alternative	0	28,946	0	5,999	570	1,894,042	21,850	17,140	16,111	835	1,985,493
Difference	0	-1,573	0	1,556	-648	-84,573	1,875	7,654	1,284	-147	-74,572
Percent Difference	0	-5	0	35	-53	-4	9	81	9	-15	-4
Critical (15%)											
Second Basis of Comparison	0	29,837	0	8,597	22,262	1,947,073	351,747	34,946	172,942	1,627	2,569,032
No Action Alternative	0	33,389	0	10,490	23,702	1,917,913	409,251	53,656	219,588	1,679	2,669,669
Difference	0	3,552	0	1,893	1,440	-29,160	57,504	18,710	46,646	52	100,637
Percent Difference	0	12	0	22	6	-1	16	54	27	3	4

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-21. Annual Potential Production for Late Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	2,800,061
Alternative 3	2,812,234
Difference	12,173
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	2,691,035
Alternative 3	2,691,402
Difference	367
Percent Difference	0
Above Normal (12.5%)	
Second Basis of Comparison	2,802,912
Alternative 3	2,810,515
Difference	7,603
Percent Difference	0
Below Normal (17.5%)	
Second Basis of Comparison	2,930,472
Alternative 3	2,961,353
Difference	30,881
Percent Difference	1
Dry (22.5%)	
Second Basis of Comparison	2,976,338
Alternative 3	3,012,660
Difference	36,322
Percent Difference	1
Critical (15%)	
Second Basis of Comparison	2,617,343
Alternative 3	2,600,856
Difference	-16,487
Percent Difference	-1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-2-22. Annual Mortality by Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	513,890	1,802,954	68,169	30,510	98,679
Alternative 3	517,818	1,792,455	66,941	28,700	95,641
Difference	3,928	-10,499	-1,228	-1,811	-3,038
Percent Difference[3]	1	-1	-2	-6	-3
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	1,331,500	1,479,904	4,935	609	5,544
Alternative 3	1,334,935	1,484,912	3,275	536	3,812
Difference	3,434	5,008	-1,660	-72	-1,732
Percent Difference	0	0	-34	-12	-31
Above Normal (12.5%)					
Second Basis of Comparison	482,073	1,869,446	2,387	187	2,573
Alternative 3	504,894	1,838,570	2,383	216	2,598
Difference	22,822	-30,877	-4	29	25
Percent Difference	5	-2	0	15	1
Below Normal (17.5%)					
Second Basis of Comparison	41,496	1,985,382	9,337	3,123	12,460
Alternative 3	39,609	1,946,219	10,333	2,164	12,497
Difference	-1,887	-39,163	996	-959	37
Percent Difference	-5	-2	11	-31	0
Dry (22.5%)					
Second Basis of Comparison	34,962	1,979,833	29,461	15,809	45,270
Alternative 3	34,674	1,958,252	19,261	12,124	31,385
Difference	-288	-21,580	-10,200	-3,685	-13,885
Percent Difference	-1	-1	-35	-23	-31
Critical (15%)					
Second Basis of Comparison	38,435	1,969,335	386,693	174,569	561,262
Alternative 3	40,798	1,992,284	396,247	169,277	565,524
Difference	2,363	22,949	9,554	-5,292	4,262
Percent Difference	6	1	2	-3	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-2-23. Annual Mortality by Cause for Late Fall-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)		
Analysis Period	Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	100,569	2,314,954	2,415,523
Alternative 3	96,645	2,309,269	2,405,915
Difference	-3,924	-5,685	-9,609
Percent Difference[3]	-4	0	0
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	13,087	2,803,861	2,816,949
Alternative 3	13,133	2,810,525	2,823,658
Difference	45	6,664	6,710
Percent Difference	0	0	0
Above Normal (12.5%)			
Second Basis of Comparison	9,812	2,344,280	2,354,092
Alternative 3	6,036	2,340,026	2,346,062
Difference	-3,776	-4,254	-8,030
Percent Difference	-38	0	0
Below Normal (17.5%)			
Second Basis of Comparison	15,158	2,024,180	2,039,338
Alternative 3	13,519	1,984,806	1,998,326
Difference	-1,638	-39,374	-41,012
Percent Difference	-11	-2	-2
Dry (22.5%)			
Second Basis of Comparison	40,463	2,019,602	2,060,065
Alternative 3	27,396	1,996,915	2,024,311
Difference	-13,067	-22,686	-35,754
Percent Difference	-32	-1	-2
Critical (15%)			
Second Basis of Comparison	555,549	2,013,483	2,569,032
Alternative 3	553,950	2,044,656	2,598,606
Difference	-1,599	31,172	29,574
Percent Difference	0	2	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-24. Annual Mortality by Cause and Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	0	504,586	9,304	3,662	1,799,292	87,603	11,076	2,415,523
Alternative 3	0	509,000	8,818	3,126	1,789,329	84,700	10,941	2,405,915
Difference	0	4,414	-485	-536	-9,963	-2,903	-136	-9,609
Percent Difference[3]	0	1	-5	-15	-1	-3	-1	0
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	0	1,319,517	11,983	61	1,479,843	1,043	4,501	2,816,949
Alternative 3	0	1,322,789	12,146	61	1,484,851	927	2,885	2,823,658
Difference	0	3,272	162	0	5,008	-117	-1,616	6,710
Percent Difference	0	0	1	0	0	-11	-36	0
Above Normal (12.5%)								
Second Basis of Comparison	0	472,813	9,259	147	1,869,299	405	2,168	2,354,092
Alternative 3	0	499,275	5,619	31	1,838,539	386	2,212	2,346,062
Difference	0	26,462	-3,640	-117	-30,760	-19	44	-8,030
Percent Difference	0	6	-39	-79	-2	-5	2	0
Below Normal (17.5%)								
Second Basis of Comparison	0	30,282	11,214	62	1,985,320	3,882	8,578	2,039,338
Alternative 3	0	28,753	10,857	75	1,946,144	2,588	9,910	1,998,326
Difference	0	-1,530	-357	13	-39,176	-1,294	1,332	-41,012
Percent Difference	0	-5	-3	21	-2	-33	16	-2
Dry (22.5%)								
Second Basis of Comparison	0	30,519	4,444	1,218	1,978,615	34,802	10,468	2,060,065
Alternative 3	0	30,082	4,592	188	1,958,065	22,616	8,769	2,024,311
Difference	0	-437	149	-1,030	-20,551	-12,186	-1,699	-35,754
Percent Difference	0	-1	3	-85	-1	-35	-16	-2
Critical (15%)								
Second Basis of Comparison	0	29,837	8,597	22,262	1,947,073	524,689	36,573	2,569,032
Alternative 3	0	32,561	8,237	20,317	1,971,967	525,396	40,128	2,598,606
Difference	0	2,723	-360	-1,946	24,894	707	3,555	29,574
Percent Difference	0	9	-4	-9	1	0	10	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-25. Annual Mortality by All Factors for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	0	171,160	333,426	9,304	3,662	1,799,292	57,690	10,479	29,913	597	2,415,523
Alternative 3	0	171,685	337,315	8,818	3,126	1,789,329	56,543	10,398	28,158	542	2,405,915
Difference	0	525	3,889	-485	-536	-9,963	-1,147	-80	-1,755	-55	-9,609
Percent Difference[3]	0	0	1	-5	-15	-1	-2	-1	-6	-9	0
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	0	464,856	854,662	11,983	61	1,479,843	549	4,386	494	114	2,816,949
Alternative 3	0	466,004	856,785	12,146	61	1,484,851	516	2,759	411	126	2,823,658
Difference	0	1,149	2,123	162	0	5,008	-33	-1,627	-84	11	6,710
Percent Difference	0	0	0	1	0	0	-6	-37	-17	10	0
Above Normal (12.5%)											
Second Basis of Comparison	0	27,524	445,289	9,259	147	1,869,299	297	2,089	108	79	2,354,092
Alternative 3	0	28,397	470,878	5,619	31	1,838,539	296	2,087	90	125	2,346,062
Difference	0	873	25,589	-3,640	-117	-30,760	-1	-3	-18	47	-8,030
Percent Difference	0	3	6	-39	-79	-2	0	0	-17	60	0
Below Normal (17.5%)											
Second Basis of Comparison	0	30,282	0	11,214	62	1,985,320	1,247	8,090	2,635	488	2,039,338
Alternative 3	0	28,753	0	10,857	75	1,946,144	823	9,510	1,765	400	1,998,326
Difference	0	-1,530	0	-357	13	-39,176	-424	1,420	-871	-88	-41,012
Percent Difference	0	-5	0	-3	21	-2	-34	18	-33	-18	-2
Dry (22.5%)											
Second Basis of Comparison	0	30,519	0	4,444	1,218	1,978,615	19,975	9,486	14,827	982	2,060,065
Alternative 3	0	30,082	0	4,592	188	1,958,065	11,401	7,860	11,215	909	2,024,311
Difference	0	-437	0	149	-1,030	-20,551	-8,574	-1,626	-3,612	-73	-35,754
Percent Difference	0	-1	0	3	-85	-1	-43	-17	-24	-7	-2
Critical (15%)											
Second Basis of Comparison	0	29,837	0	8,597	22,262	1,947,073	351,747	34,946	172,942	1,627	2,569,032
Alternative 3	0	32,561	0	8,237	20,317	1,971,967	357,527	38,720	167,870	1,408	2,598,606
Difference	0	2,723	0	-360	-1,946	24,894	5,780	3,774	-5,072	-219	29,574
Percent Difference	0	9	0	-4	-9	1	2	11	-3	-13	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-26. Annual Potential Production for Late Fall-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	2,800,061
Alternative 5	2,805,566
Difference	5,506
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	2,691,035
Alternative 5	2,700,194
Difference	9,159
Percent Difference	0
Above Normal (12.5%)	
Second Basis of Comparison	2,802,912
Alternative 5	2,829,088
Difference	26,176
Percent Difference	1
Below Normal (17.5%)	
Second Basis of Comparison	2,930,472
Alternative 5	2,951,992
Difference	21,520
Percent Difference	1
Dry (22.5%)	
Second Basis of Comparison	2,976,338
Alternative 5	3,004,835
Difference	28,497
Percent Difference	1
Critical (15%)	
Second Basis of Comparison	2,617,343
Alternative 5	2,544,537
Difference	-72,807
Percent Difference	-3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-2-27. Annual Mortality by Life Stage for Late Fall-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)				
Analysis Period	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	513,890	1,802,954	68,169	30,510	98,679
Alternative 5	486,679	1,779,342	78,549	38,177	116,726
Difference	-27,211	-23,612	10,380	7,667	18,047
Percent Difference[3]	-5	-1	15	25	18
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	1,331,500	1,479,904	4,935	609	5,544
Alternative 5	1,284,631	1,490,907	4,027	74	4,101
Difference	-46,869	11,003	-909	-535	-1,443
Percent Difference	-4	1	-18	-88	-26
Above Normal (12.5%)					
Second Basis of Comparison	482,073	1,869,446	2,387	187	2,573
Alternative 5	385,985	1,859,656	1,357	82	1,439
Difference	-96,087	-9,790	-1,030	-105	-1,134
Percent Difference	-20	-1	-43	-56	-44
Below Normal (17.5%)					
Second Basis of Comparison	41,496	1,985,382	9,337	3,123	12,460
Alternative 5	39,141	1,943,539	13,998	4,481	18,480
Difference	-2,355	-41,843	4,662	1,358	6,020
Percent Difference	-6	-2	50	43	48
Dry (22.5%)					
Second Basis of Comparison	34,962	1,979,833	29,461	15,809	45,270
Alternative 5	34,298	1,930,739	31,905	14,697	46,602
Difference	-664	-49,093	2,444	-1,112	1,332
Percent Difference	-2	-2	8	-7	3
Critical (15%)					
Second Basis of Comparison	38,435	1,969,335	386,693	174,569	561,262
Alternative 5	42,394	1,918,694	449,617	227,011	676,628
Difference	3,960	-50,641	62,924	52,442	115,365
Percent Difference	10	-3	16	30	21

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-2-28. Annual Mortality by Cause for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	100,569	2,314,954	2,415,523
Alternative 5	115,323	2,267,424	2,382,747
Difference	14,754	-47,530	-32,776
Percent Difference[3]	15	-2	-1
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	13,087	2,803,861	2,816,949
Alternative 5	11,470	2,768,169	2,779,639
Difference	-1,617	-35,692	-37,310
Percent Difference	-12	-1	-1
Above Normal (12.5%)			
Second Basis of Comparison	9,812	2,344,280	2,354,092
Alternative 5	9,777	2,237,304	2,247,081
Difference	-35	-106,977	-107,012
Percent Difference	0	-5	-5
Below Normal (17.5%)			
Second Basis of Comparison	15,158	2,024,180	2,039,338
Alternative 5	16,938	1,984,222	2,001,160
Difference	1,780	-39,958	-38,178
Percent Difference	12	-2	-2
Dry (22.5%)			
Second Basis of Comparison	40,463	2,019,602	2,060,065
Alternative 5	40,257	1,971,382	2,011,639
Difference	-206	-48,219	-48,426
Percent Difference	-1	-2	-2
Critical (15%)			
Second Basis of Comparison	555,549	2,013,483	2,569,032
Alternative 5	655,672	1,982,044	2,637,716
Difference	100,123	-31,439	68,684
Percent Difference	18	-2	3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-29. Annual Mortality by Cause and Life Stage for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	0	504,586	9,304	3,662	1,799,292	87,603	11,076	2,415,523
Alternative 5	0	476,778	9,902	2,705	1,776,637	102,717	14,010	2,382,747
Difference	0	-27,809	598	-958	-22,655	15,114	2,934	-32,776
Percent Difference[3]	0	-6	6	-26	-1	17	26	-1
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	0	1,319,517	11,983	61	1,479,843	1,043	4,501	2,816,949
Alternative 5	0	1,273,245	11,386	61	1,490,847	24	4,077	2,779,639
Difference	0	-46,272	-597	0	11,003	-1,020	-424	-37,310
Percent Difference	0	-4	-5	-1	1	-98	-9	-1
Above Normal (12.5%)								
Second Basis of Comparison	0	472,813	9,259	147	1,869,299	405	2,168	2,354,092
Alternative 5	0	376,400	9,586	142	1,859,515	50	1,389	2,247,081
Difference	0	-96,413	326	-6	-9,784	-355	-779	-107,012
Percent Difference	0	-20	4	-4	-1	-88	-36	-5
Below Normal (17.5%)								
Second Basis of Comparison	0	30,282	11,214	62	1,985,320	3,882	8,578	2,039,338
Alternative 5	0	28,128	11,014	147	1,943,392	5,777	12,702	2,001,160
Difference	0	-2,155	-200	85	-41,928	1,896	4,124	-38,178
Percent Difference	0	-7	-2	137	-2	49	48	-2
Dry (22.5%)								
Second Basis of Comparison	0	30,519	4,444	1,218	1,978,615	34,802	10,468	2,060,065
Alternative 5	0	28,043	6,255	761	1,929,979	33,241	13,361	2,011,639
Difference	0	-2,476	1,812	-457	-48,637	-1,561	2,893	-48,426
Percent Difference	0	-8	41	-38	-2	-4	28	-2
Critical (15%)								
Second Basis of Comparison	0	29,837	8,597	22,262	1,947,073	524,689	36,573	2,569,032
Alternative 5	0	31,273	11,121	16,469	1,902,225	628,081	48,546	2,637,716
Difference	0	1,436	2,524	-5,793	-44,848	103,392	11,973	68,684
Percent Difference	0	5	29	-26	-2	20	33	3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-2-30. Annual Mortality by All Factors for Late Fall-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	0	171,160	333,426	9,304	3,662	1,799,292	57,690	10,479	29,913	597	2,415,523
Alternative 5	0	170,227	306,551	9,902	2,705	1,776,637	65,089	13,460	37,628	549	2,382,747
Difference	0	-933	-26,876	598	-958	-22,655	7,399	2,982	7,715	-48	-32,776
Percent Difference[3]	0	-1	-8	6	-26	-1	13	28	26	-8	-1
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	0	464,856	854,662	11,983	61	1,479,843	549	4,386	494	114	2,816,949
Alternative 5	0	465,569	807,677	11,386	61	1,490,847	18	4,009	6	68	2,779,639
Difference	0	713	-46,985	-597	0	11,003	-531	-378	-489	-46	-37,310
Percent Difference	0	0	-5	-5	-1	1	-97	-9	-99	-40	-1
Above Normal (12.5%)											
Second Basis of Comparison	0	27,524	445,289	9,259	147	1,869,299	297	2,089	108	79	2,354,092
Alternative 5	0	23,955	352,445	9,586	142	1,859,515	32	1,325	18	64	2,247,081
Difference	0	-3,569	-92,844	326	-6	-9,784	-265	-765	-90	-14	-107,012
Percent Difference	0	-13	-21	4	-4	-1	-89	-37	-84	-18	-5
Below Normal (17.5%)											
Second Basis of Comparison	0	30,282	0	11,214	62	1,985,320	1,247	8,090	2,635	488	2,039,338
Alternative 5	0	28,128	0	11,014	147	1,943,392	1,852	12,147	3,925	556	2,001,160
Difference	0	-2,155	0	-200	85	-41,928	605	4,056	1,290	68	-38,178
Percent Difference	0	-7	0	-2	137	-2	49	50	49	14	-2
Dry (22.5%)											
Second Basis of Comparison	0	30,519	0	4,444	1,218	1,978,615	19,975	9,486	14,827	982	2,060,065
Alternative 5	0	28,043	0	6,255	761	1,929,979	19,310	12,595	13,932	766	2,011,639
Difference	0	-2,476	0	1,812	-457	-48,637	-665	3,109	-896	-216	-48,426
Percent Difference	0	-8	0	41	-38	-2	-3	33	-6	-22	-2
Critical (15%)											
Second Basis of Comparison	0	29,837	0	8,597	22,262	1,947,073	351,747	34,946	172,942	1,627	2,569,032
Alternative 5	0	31,273	0	11,121	16,469	1,902,225	402,734	46,883	225,348	1,663	2,637,716
Difference	0	1,436	0	2,524	-5,793	-44,848	50,987	11,937	52,405	36	68,684
Percent Difference	0	5	0	29	-26	-2	14	34	30	2	3

1 Based on the 80-year simulation period

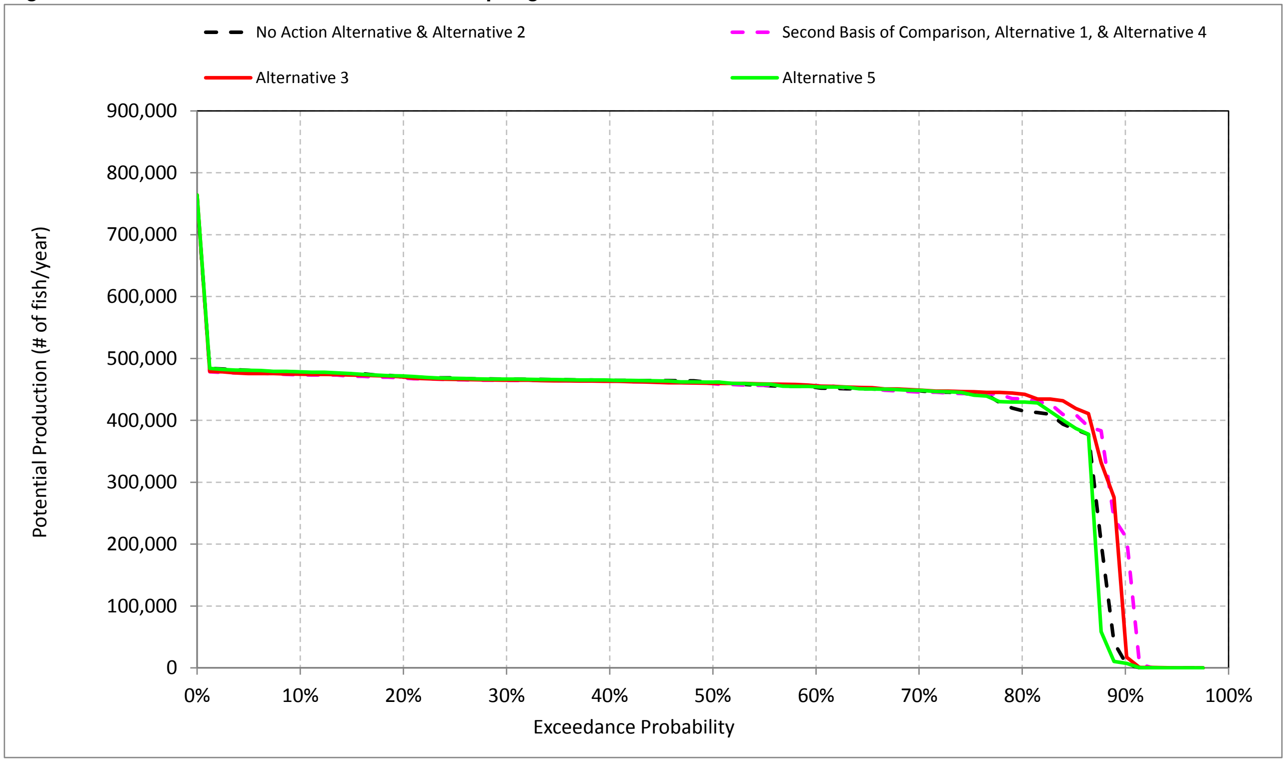
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

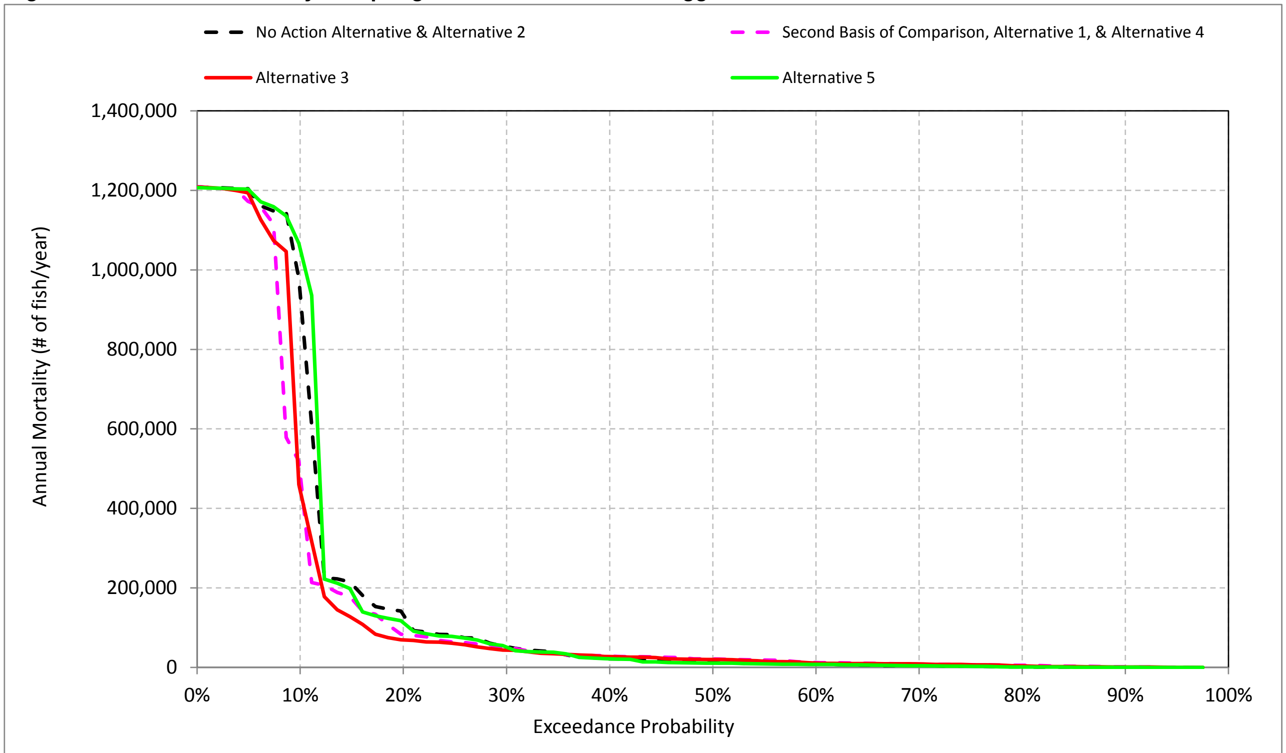
B.3. Spring-Run Chinook Salmon

Figure B-3-1. Annual Potential Production for Spring-Run Chinook Salmon



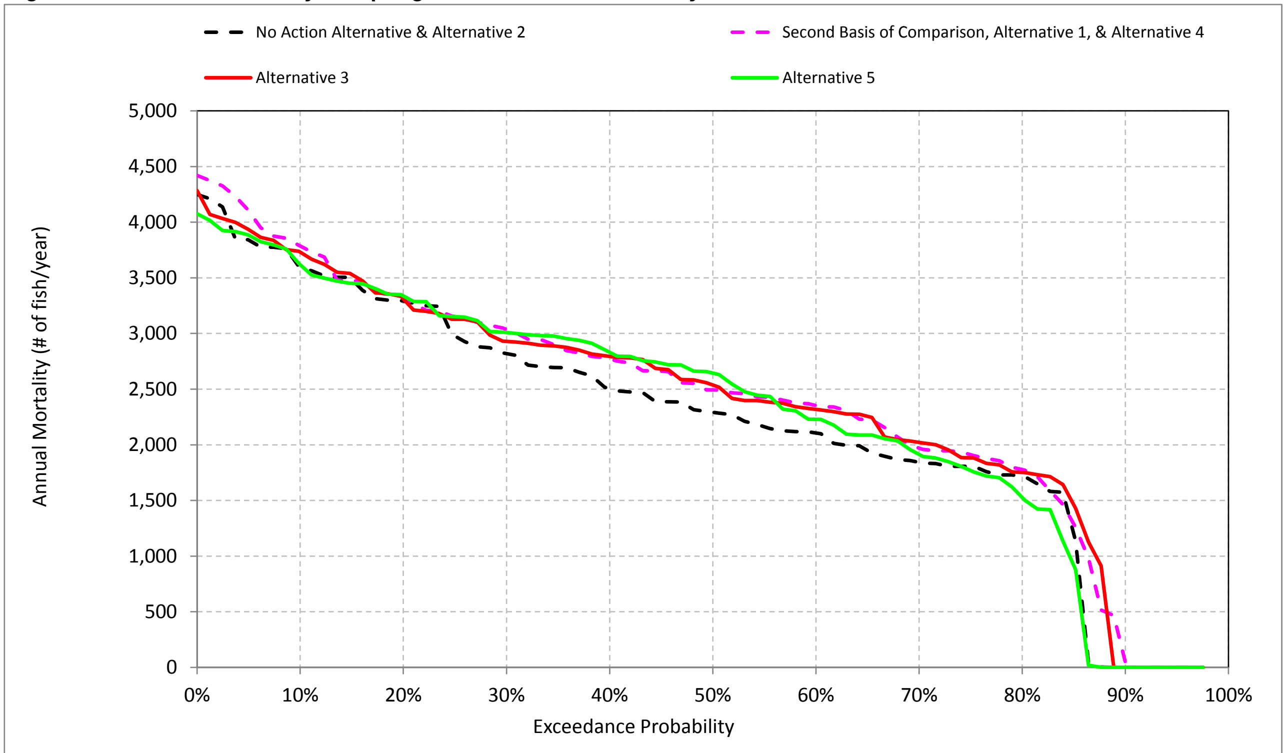
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-2. Annual Mortality for Spring-Run Chinook Salmon - Eggs



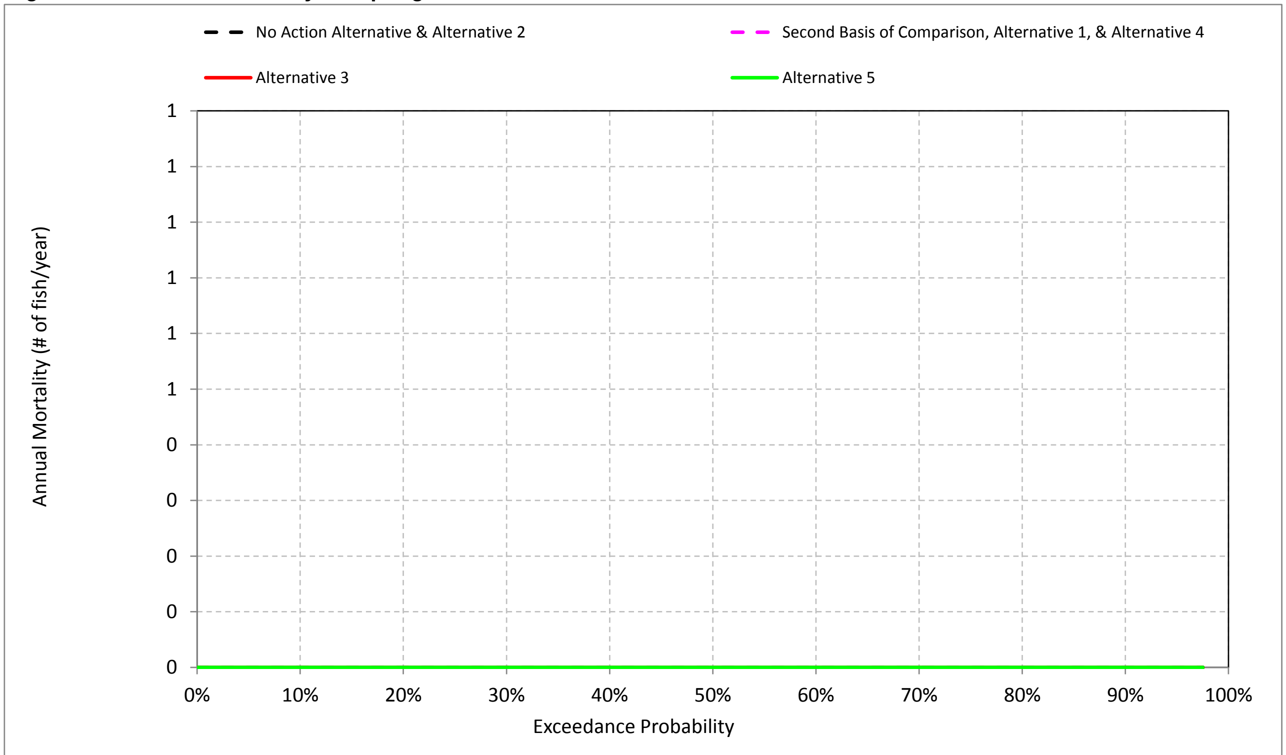
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-3. Annual Mortality for Spring-Run Chinook Salmon - Fry



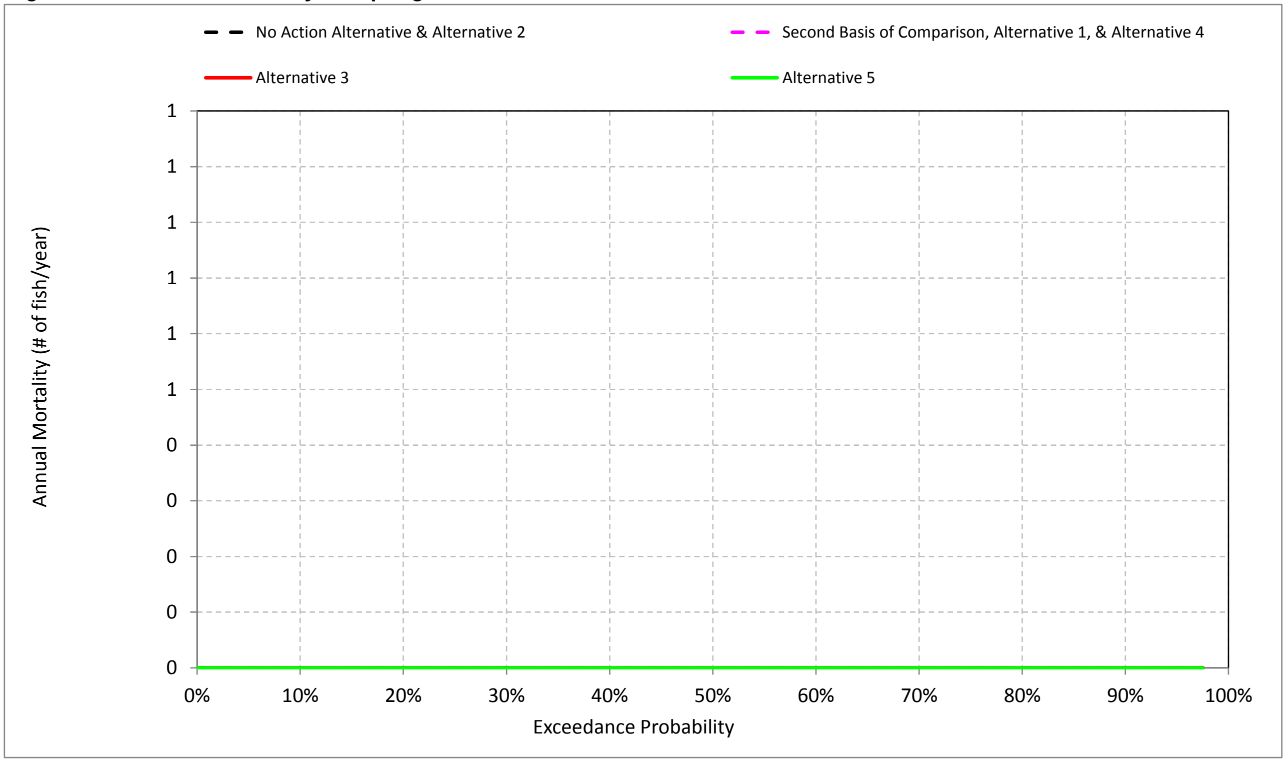
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-4. Annual Mortality for Spring-Run Chinook Salmon - Pre-Smolt



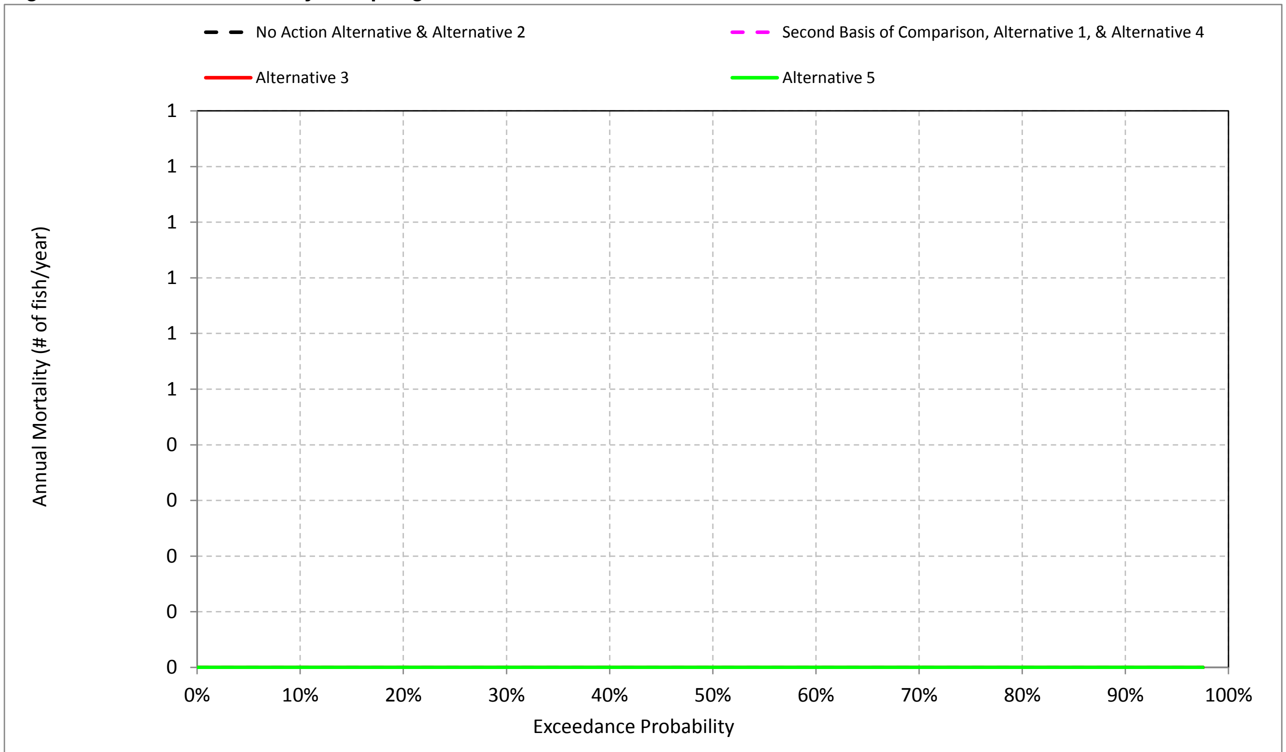
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-5. Annual Mortality for Spring-Run Chinook Salmon - Immature Smolt



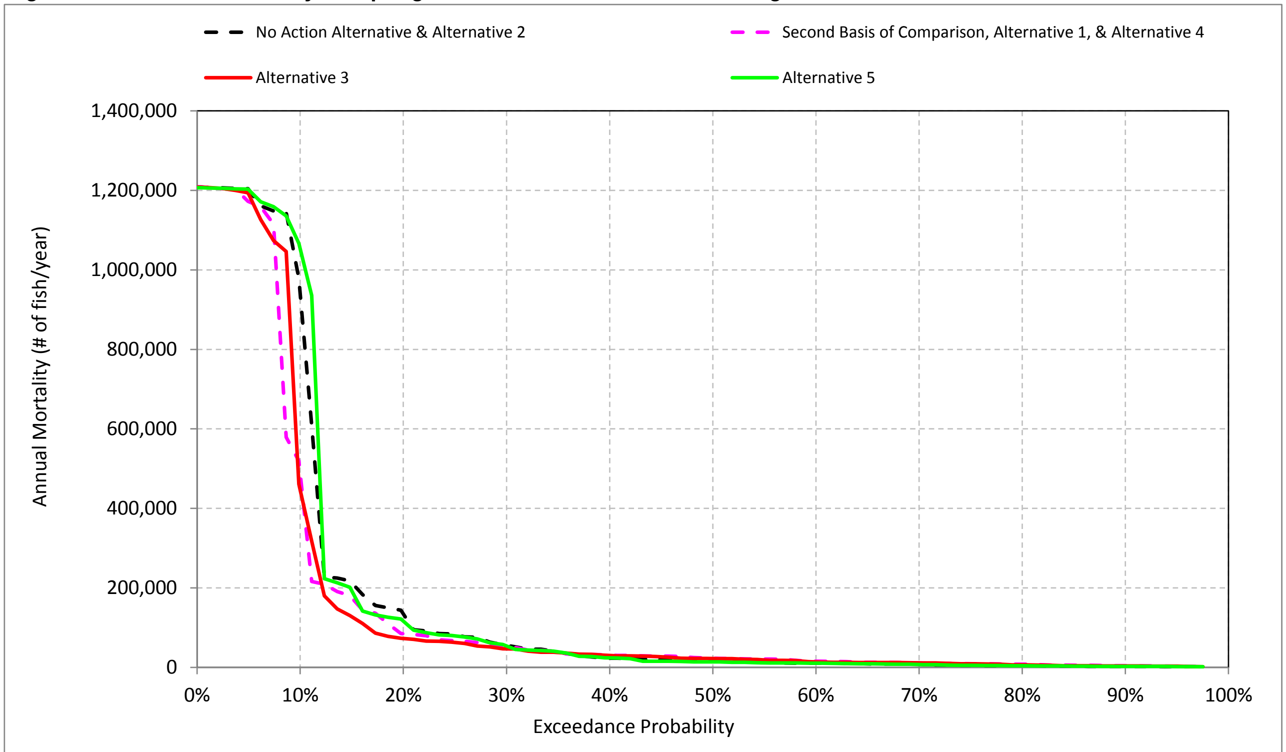
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-6. Annual Mortality for Spring-Run Chinook Salmon - Pre- & Immature Smolts



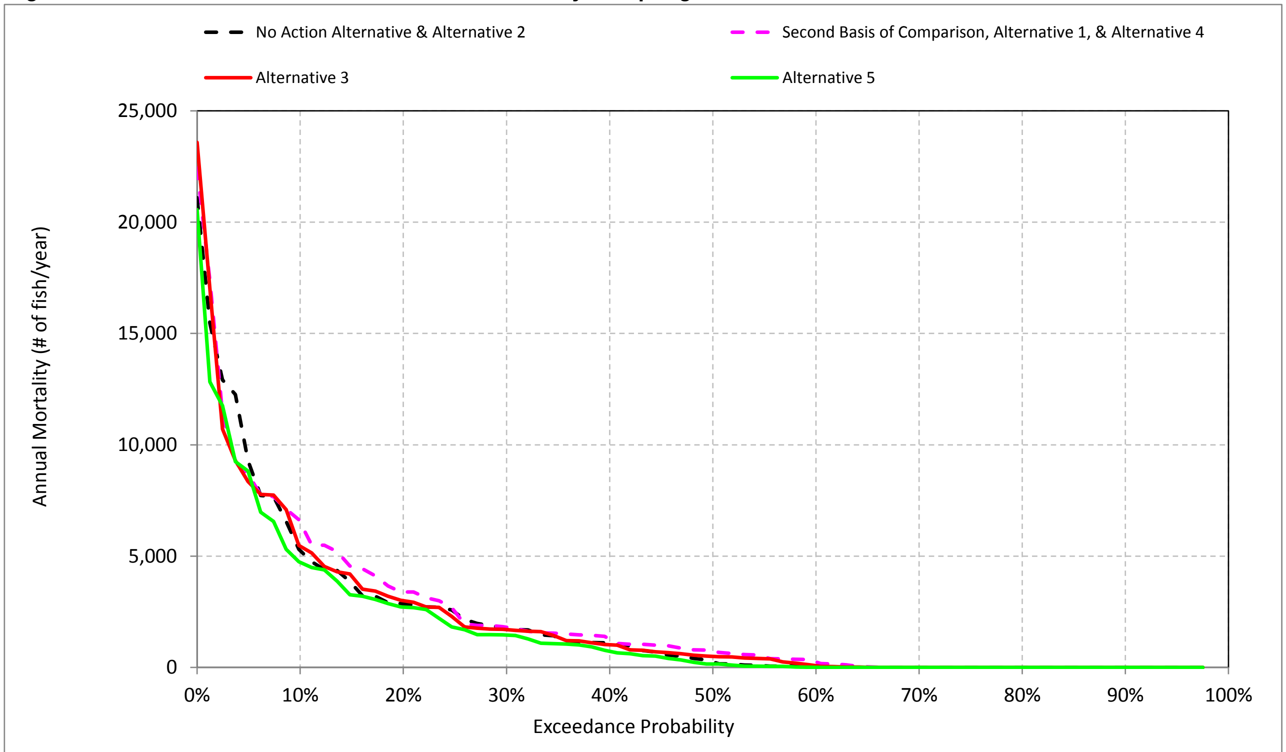
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-7. Annual Mortality for Spring-Run Chinook Salmon - All Lifestages



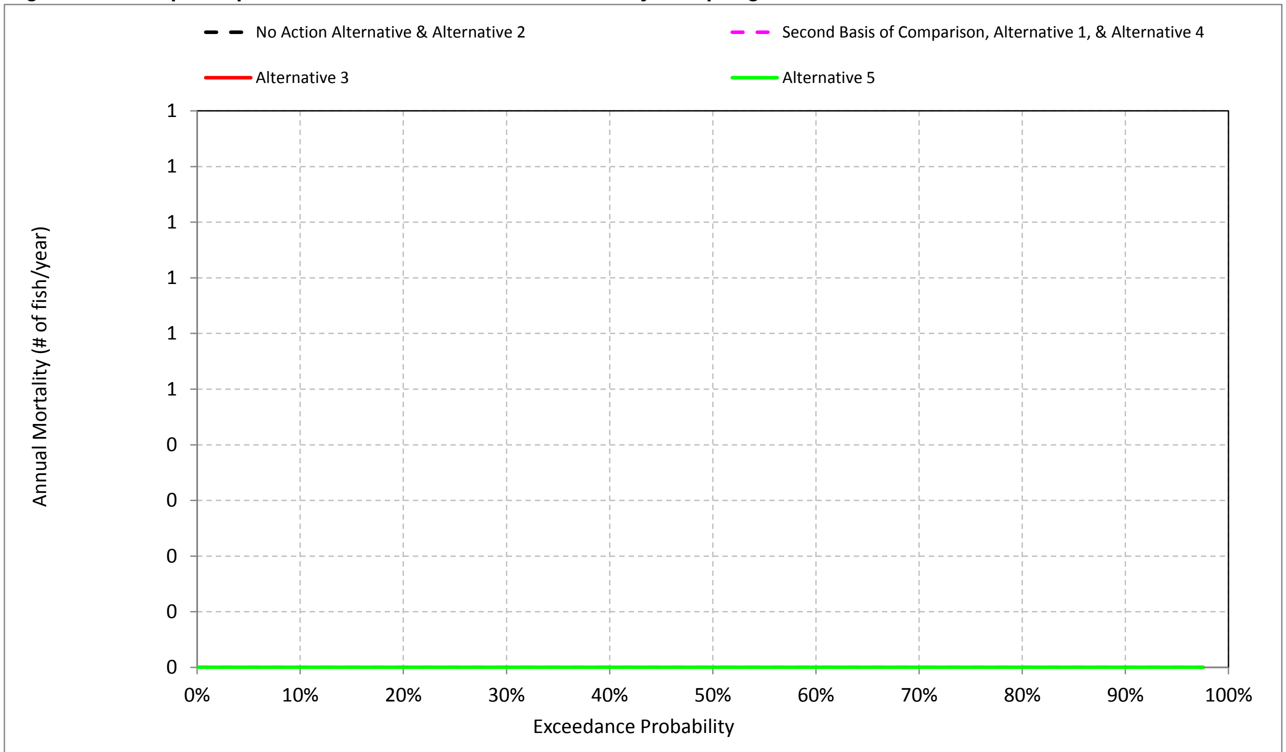
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-8. Incubation - Habitat based Annual Mortality for Spring-Run Chinook Salmon



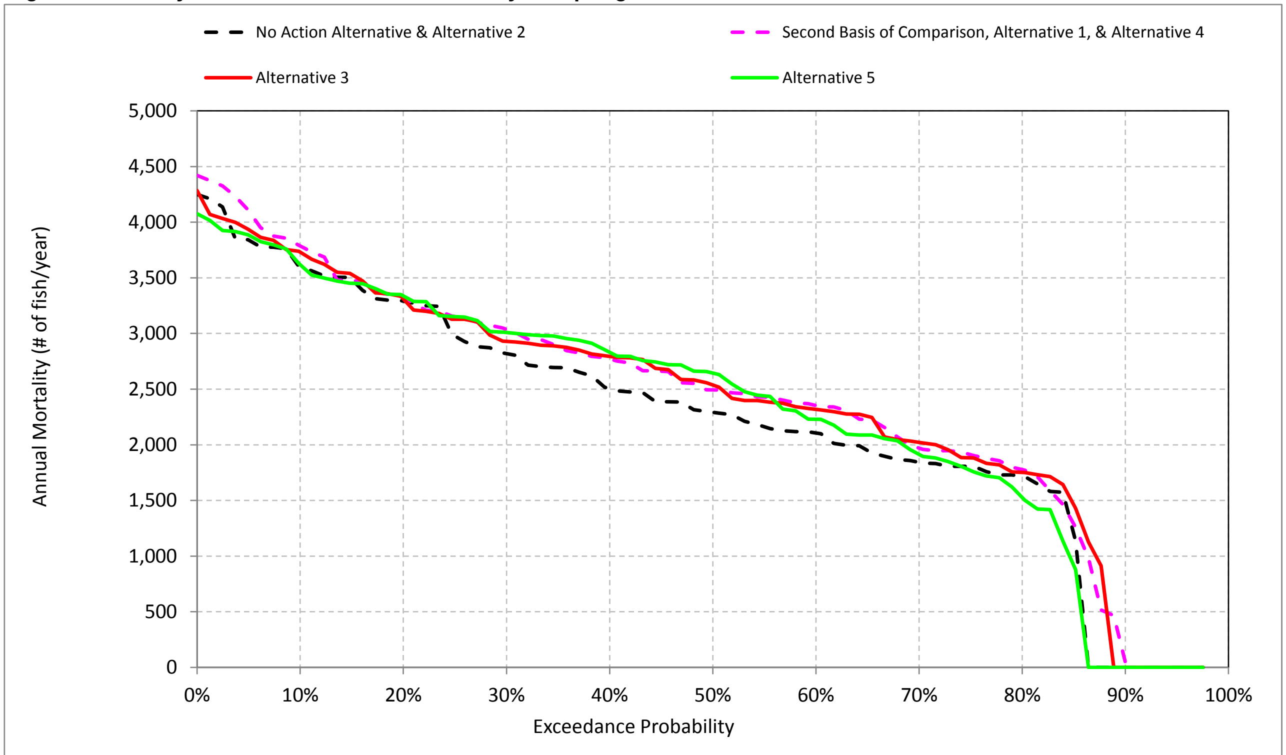
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-9. Super-imposition - Habitat based Annual Mortality for Spring-Run Chinook Salmon



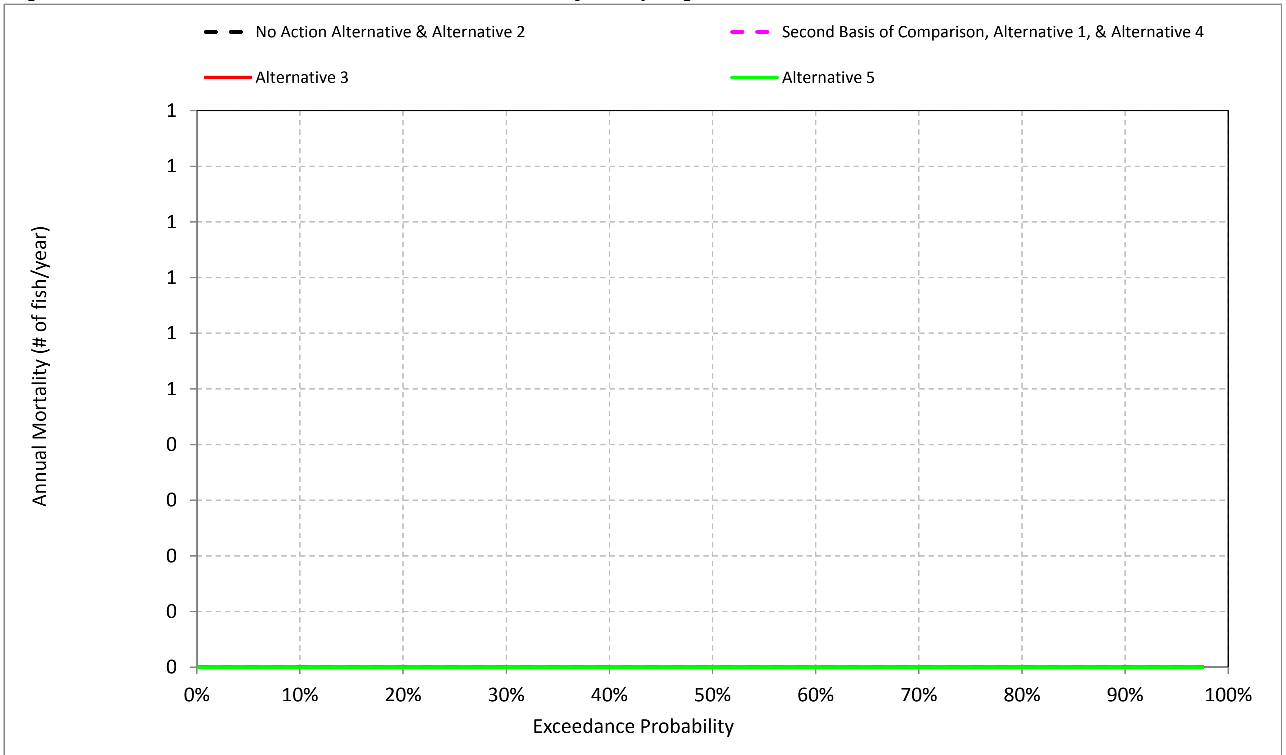
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-10. Fry - Habitat based Annual Mortality for Spring-Run Chinook Salmon



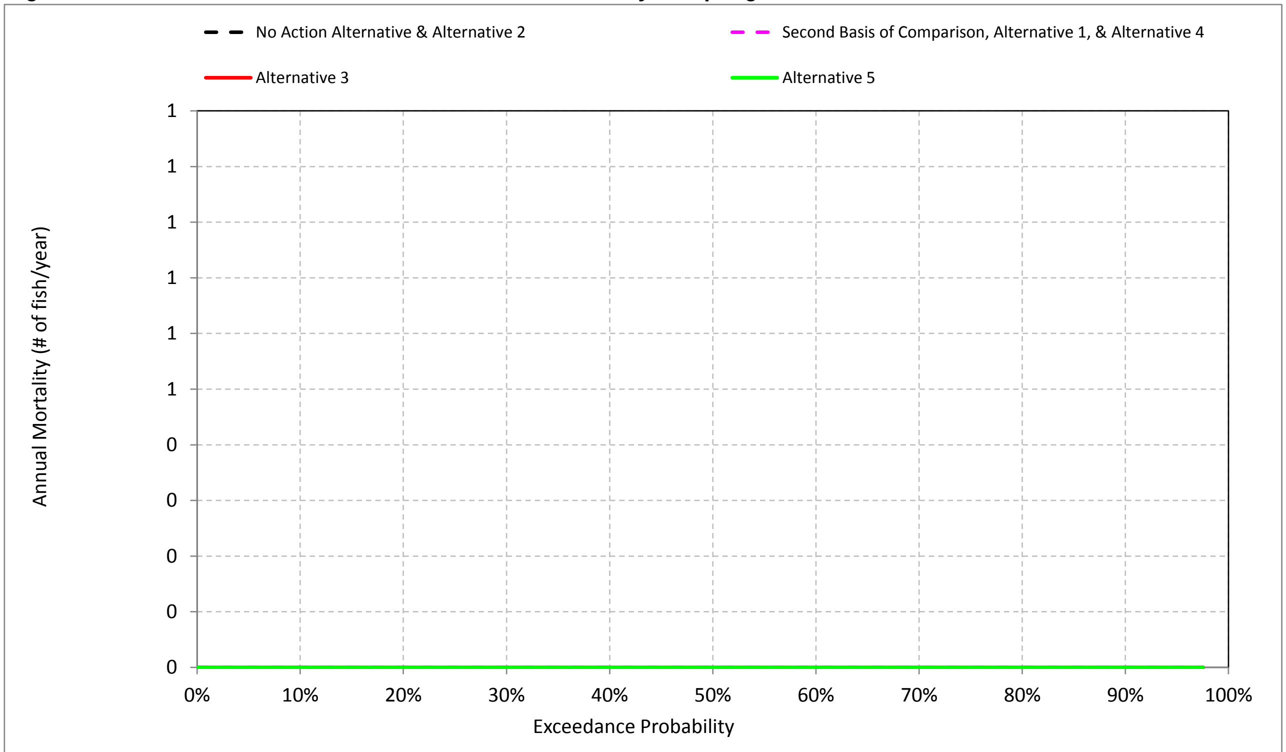
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-11. Pre-smolt - Habitat based Annual Mortality for Spring-Run Chinook Salmon



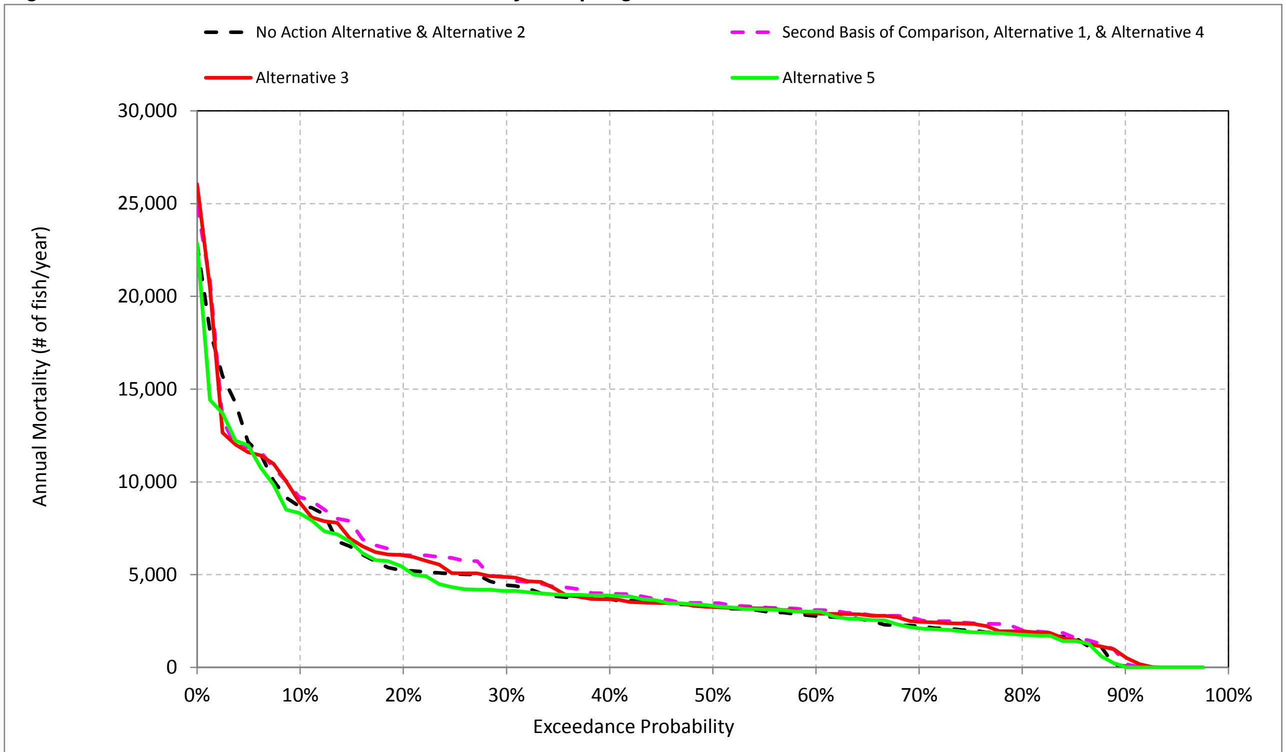
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-12. Immature Smolt - Habitat based Annual Mortality for Spring-Run Chinook Salmon



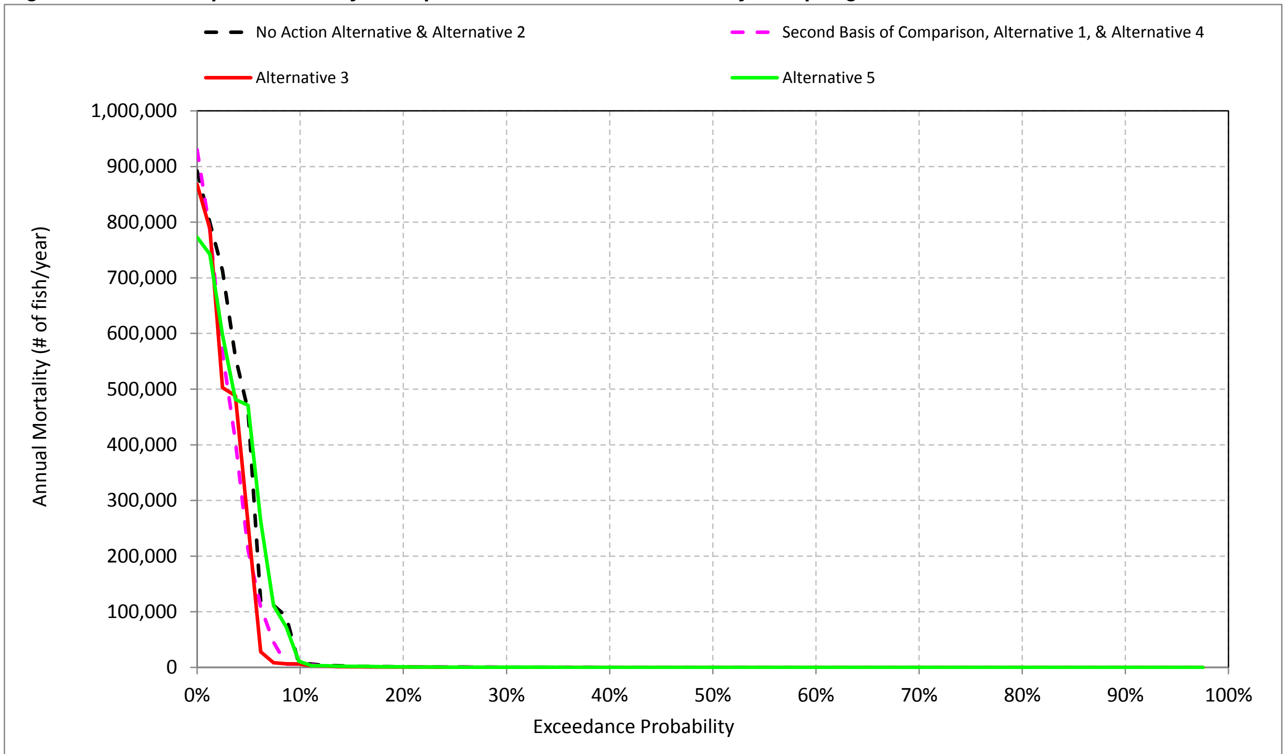
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-13. Total Habitat based Annual Mortality for Spring-Run Chinook Salmon



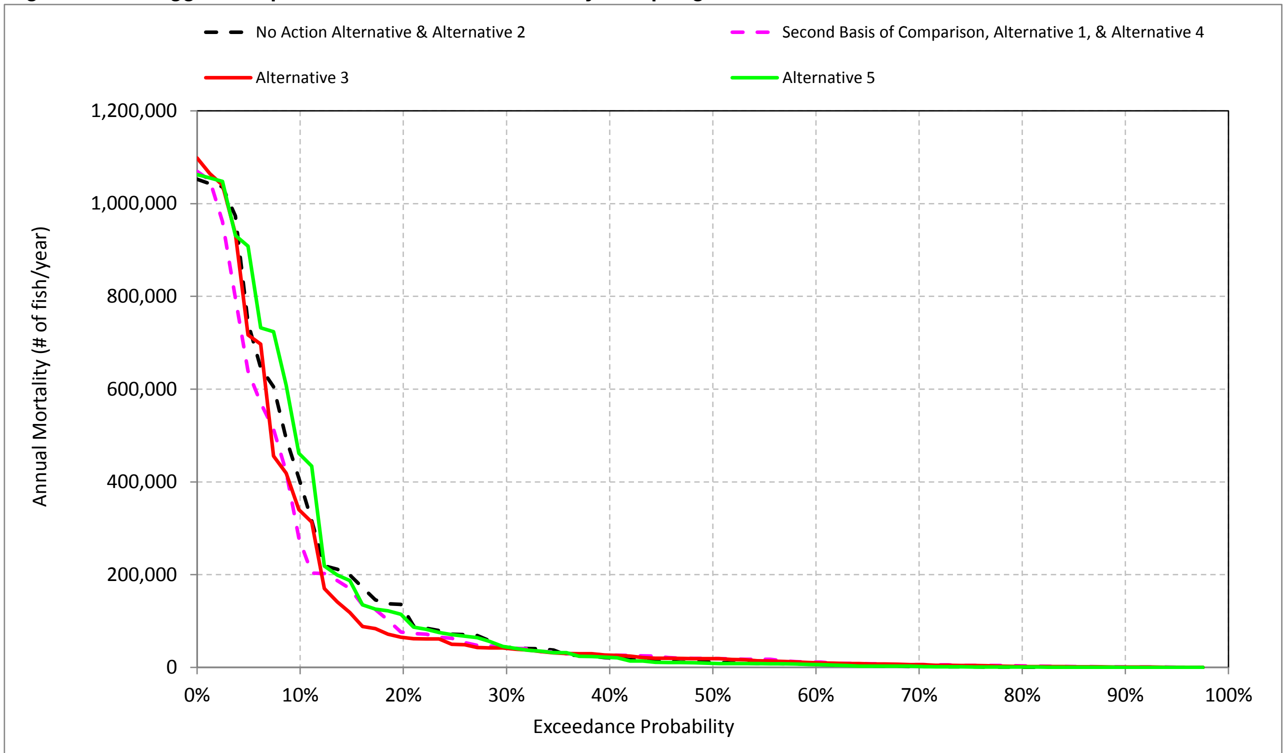
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-14. Pre-Spawn Mortality - Temperature based Annual Mortality for Spring-Run Chinook Salmon



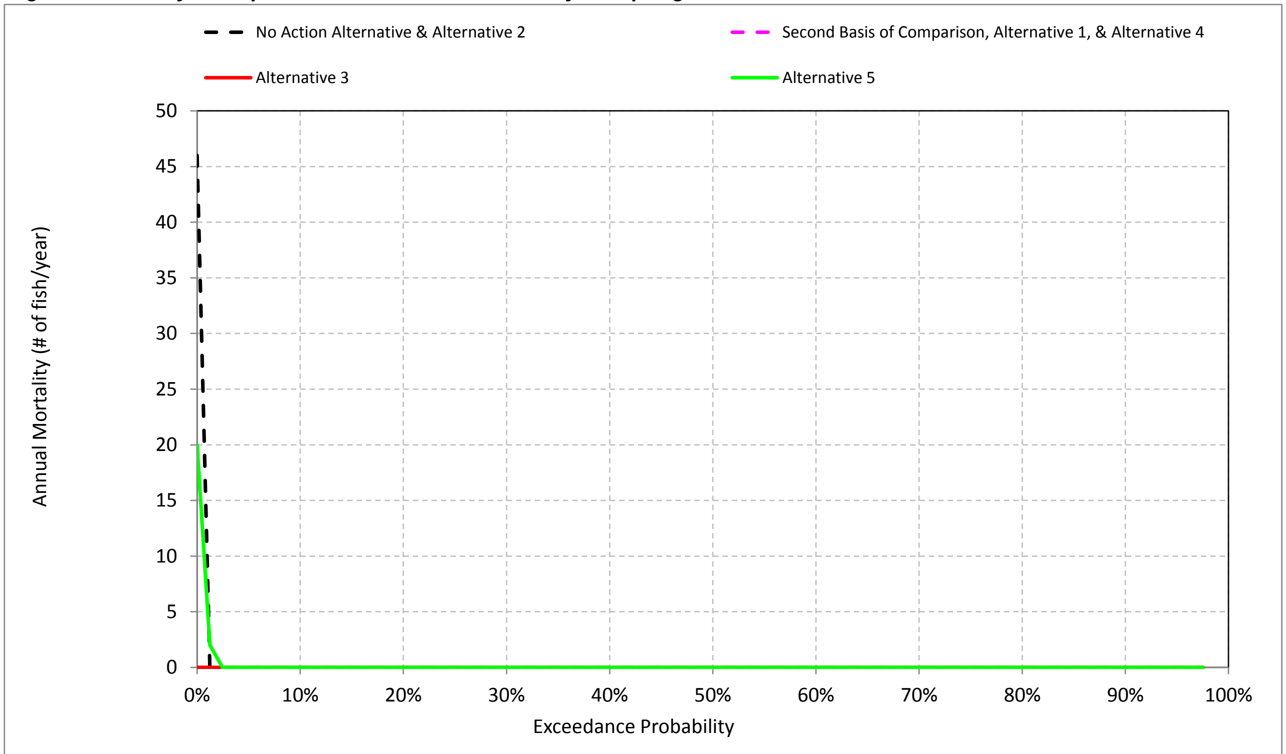
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-15. Eggs - Temperature based Annual Mortality for Spring-Run Chinook Salmon



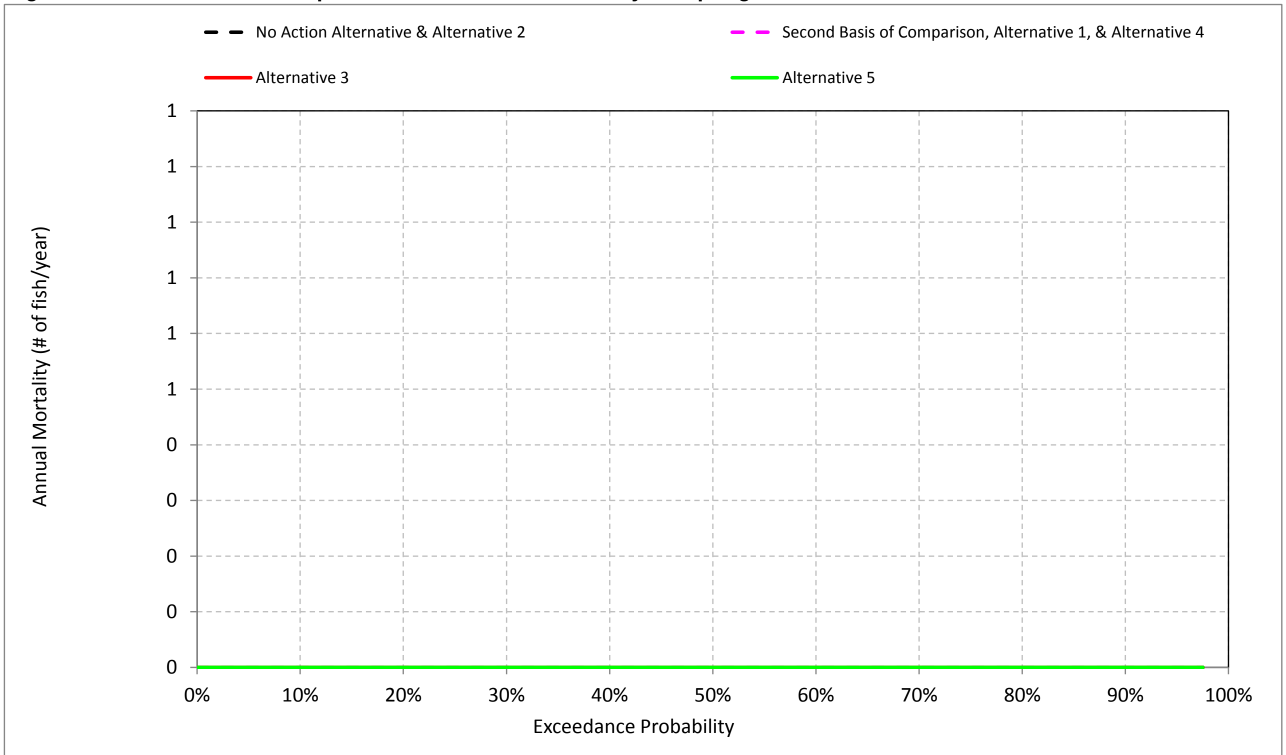
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-16. Fry - Temperature based Annual Mortality for Spring-Run Chinook Salmon



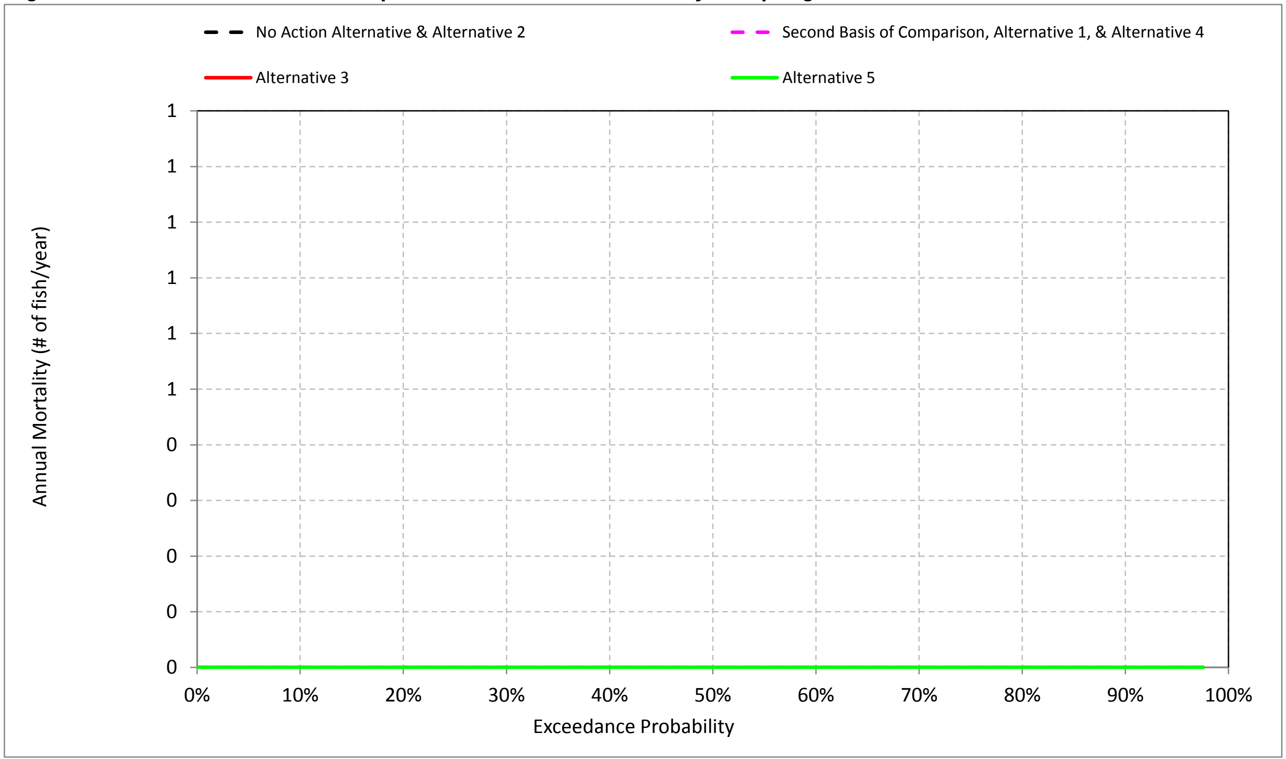
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-17. Pre-smolt - Temperature based Annual Mortality for Spring-Run Chinook Salmon



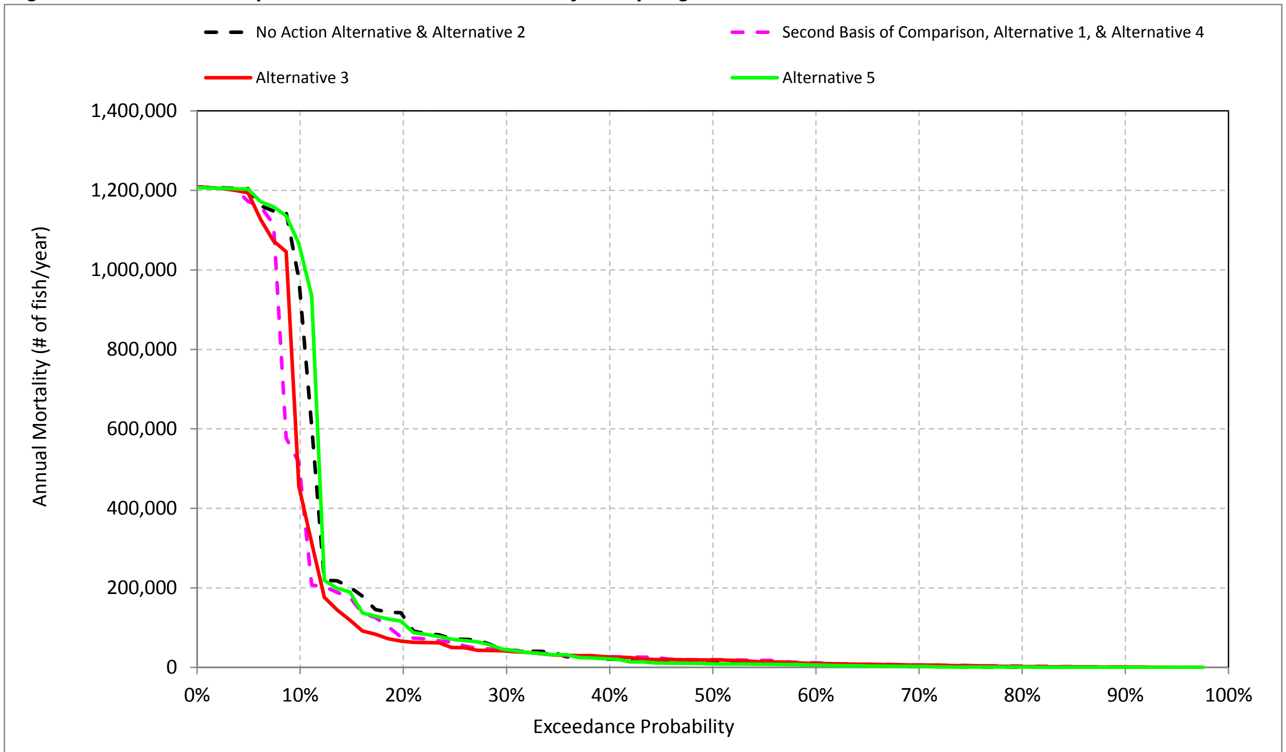
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-18. Immature Smolt - Temperature based Annual Mortality for Spring-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-19. Total Temperature based Annual Mortality for Spring-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-1. Annual Potential Production for Spring-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	402,980
Alternative 1	410,722
Difference	7,742
Percent Difference[3]	2
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	442,676
Alternative 1	449,832
Difference	7,156
Percent Difference	2
Above Normal (12.5%)	
No Action Alternative	362,537
Alternative 1	367,591
Difference	5,054
Percent Difference	1
Below Normal (17.5%)	
No Action Alternative	428,569
Alternative 1	426,491
Difference	-2,078
Percent Difference	0
Dry (22.5%)	
No Action Alternative	405,967
Alternative 1	403,012
Difference	-2,955
Percent Difference	-1
Critical (15%)	
No Action Alternative	316,344
Alternative 1	355,097
Difference	38,753
Percent Difference	12

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-3-2. Annual Mortality by Life Stage for Spring-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)				
Analysis Period	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	169,230	2,282	0	0	0
Alternative 1	149,155	2,453	0	0	0
Difference	-20,075	171	0	0	0
Percent Difference[3]	-12	7	0	0	0
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	54,929	2,217	0	0	0
Alternative 1	38,874	2,303	0	0	0
Difference	-16,055	86	0	0	0
Percent Difference	-29	4	0	0	0
Above Normal (12.5%)					
No Action Alternative	275,059	1,955	0	0	0
Alternative 1	256,999	2,360	0	0	0
Difference	-18,059	406	0	0	0
Percent Difference	-7	21	0	0	0
Below Normal (17.5%)					
No Action Alternative	108,811	2,619	0	0	0
Alternative 1	110,617	2,763	0	0	0
Difference	1,806	144	0	0	0
Percent Difference	2	5	0	0	0
Dry (22.5%)					
No Action Alternative	170,290	2,608	0	0	0
Alternative 1	175,971	2,682	0	0	0
Difference	5,681	73	0	0	0
Percent Difference	3	3	0	0	0
Critical (15%)					
No Action Alternative	397,589	1,814	0	0	0
Alternative 1	302,962	2,151	0	0	0
Difference	-94,627	337	0	0	0
Percent Difference	-24	19	0	0	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-3-3. Annual Mortality by Cause for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	167,192	4,321	171,512
Alternative 1	146,922	4,686	151,608
Difference	-20,270	366	-19,904
Percent Difference[3]	-12	8	-12
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	53,038	4,108	57,146
Alternative 1	36,709	4,468	41,178
Difference	-16,329	360	-15,969
Percent Difference	-31	9	-28
Above Normal (12.5%)			
No Action Alternative	274,408	2,606	277,013
Alternative 1	256,534	2,826	259,360
Difference	-17,874	221	-17,653
Percent Difference	-7	8	-6
Below Normal (17.5%)			
No Action Alternative	107,177	4,253	111,431
Alternative 1	108,800	4,580	113,380
Difference	1,623	327	1,949
Percent Difference	2	8	2
Dry (22.5%)			
No Action Alternative	167,873	5,025	172,898
Alternative 1	173,420	5,232	178,652
Difference	5,547	207	5,754
Percent Difference	3	4	3
Critical (15%)			
No Action Alternative	394,171	5,232	399,403
Alternative 1	299,101	6,012	305,113
Difference	-95,070	780	-94,290
Percent Difference	-24	15	-24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-4. Annual Mortality by Cause and Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	47,267	2,039	119,924	1	2,282	0	0	171,512
Alternative 1	38,621	2,233	108,301	0	2,453	0	0	151,608
Difference	-8,646	194	-11,623	-1	172	0	0	-19,904
Percent Difference[3]	-18	10	-10	-100	8	0	0	-12
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	340	1,893	52,697	2	2,215	0	0	57,146
Alternative 1	260	2,165	36,450	0	2,303	0	0	41,178
Difference	-80	272	-16,247	-2	88	0	0	-15,969
Percent Difference	-24	14	-31	-100	4	0	0	-28
Above Normal (12.5%)								
No Action Alternative	151,449	651	122,959	0	1,955	0	0	277,013
Alternative 1	99,868	466	156,666	0	2,360	0	0	259,360
Difference	-51,581	-185	33,707	0	406	0	0	-17,653
Percent Difference	-34	-28	27	0	21	0	0	-6
Below Normal (17.5%)								
No Action Alternative	63,840	1,634	43,337	0	2,619	0	0	111,431
Alternative 1	66,585	1,818	42,215	0	2,763	0	0	113,380
Difference	2,744	183	-1,122	0	144	0	0	1,949
Percent Difference	4	11	-3	0	5	0	0	2
Dry (22.5%)								
No Action Alternative	37,718	2,417	130,155	0	2,608	0	0	172,898
Alternative 1	34,417	2,551	139,003	0	2,682	0	0	178,652
Difference	-3,301	134	8,847	0	73	0	0	5,754
Percent Difference	-9	6	7	0	3	0	0	3
Critical (15%)								
No Action Alternative	57,112	3,419	337,059	0	1,814	0	0	399,403
Alternative 1	44,378	3,862	254,723	0	2,151	0	0	305,113
Difference	-12,734	443	-82,336	0	337	0	0	-94,290
Percent Difference	-22	13	-24	0	19	0	0	-24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-5. Annual Mortality by All Factors for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	47,267	2,039	0	119,924	1	2,282	0	0	0	0	171,512
Alternative 1	38,621	2,233	0	108,301	0	2,453	0	0	0	0	151,608
Difference	-8,646	194	0	-11,623	-1	172	0	0	0	0	-19,904
Percent Difference[3]	-18	10	0	-10	-100	8	0	0	0	0	-12
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	340	1,893	0	52,697	2	2,215	0	0	0	0	57,146
Alternative 1	260	2,165	0	36,450	0	2,303	0	0	0	0	41,178
Difference	-80	272	0	-16,247	-2	88	0	0	0	0	-15,969
Percent Difference	-24	14	0	-31	-100	4	0	0	0	0	-28
Above Normal (12.5%)											
No Action Alternative	151,449	651	0	122,959	0	1,955	0	0	0	0	277,013
Alternative 1	99,868	466	0	156,666	0	2,360	0	0	0	0	259,360
Difference	-51,581	-185	0	33,707	0	406	0	0	0	0	-17,653
Percent Difference	-34	-28	0	27	0	21	0	0	0	0	-6
Below Normal (17.5%)											
No Action Alternative	63,840	1,634	0	43,337	0	2,619	0	0	0	0	111,431
Alternative 1	66,585	1,818	0	42,215	0	2,763	0	0	0	0	113,380
Difference	2,744	183	0	-1,122	0	144	0	0	0	0	1,949
Percent Difference	4	11	0	-3	0	5	0	0	0	0	2
Dry (22.5%)											
No Action Alternative	37,718	2,417	0	130,155	0	2,608	0	0	0	0	172,898
Alternative 1	34,417	2,551	0	139,003	0	2,682	0	0	0	0	178,652
Difference	-3,301	134	0	8,847	0	73	0	0	0	0	5,754
Percent Difference	-9	6	0	7	0	3	0	0	0	0	3
Critical (15%)											
No Action Alternative	57,112	3,419	0	337,059	0	1,814	0	0	0	0	399,403
Alternative 1	44,378	3,862	0	254,723	0	2,151	0	0	0	0	305,113
Difference	-12,734	443	0	-82,336	0	337	0	0	0	0	-94,290
Percent Difference	-22	13	0	-24	0	19	0	0	0	0	-24

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-6. Annual Potential Production for Spring-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	402,980
Alternative 3	409,813
Difference	6,832
Percent Difference[3]	2
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	442,676
Alternative 3	453,743
Difference	11,067
Percent Difference	2
Above Normal (12.5%)	
No Action Alternative	362,537
Alternative 3	368,403
Difference	5,866
Percent Difference	2
Below Normal (17.5%)	
No Action Alternative	428,569
Alternative 3	427,631
Difference	-938
Percent Difference	0
Dry (22.5%)	
No Action Alternative	405,967
Alternative 3	410,542
Difference	4,575
Percent Difference	1
Critical (15%)	
No Action Alternative	316,344
Alternative 3	327,260
Difference	10,915
Percent Difference	3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-3-7. Annual Mortality by Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	169,230	2,282	0	0	0
Alternative 3	150,290	2,435	0	0	0
Difference	-18,940	153	0	0	0
Percent Difference[3]	-11	7	0	0	0
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	54,929	2,217	0	0	0
Alternative 3	29,787	2,271	0	0	0
Difference	-25,142	54	0	0	0
Percent Difference	-46	2	0	0	0
Above Normal (12.5%)					
No Action Alternative	275,059	1,955	0	0	0
Alternative 3	257,573	2,190	0	0	0
Difference	-17,485	236	0	0	0
Percent Difference	-6	12	0	0	0
Below Normal (17.5%)					
No Action Alternative	108,811	2,619	0	0	0
Alternative 3	107,671	2,858	0	0	0
Difference	-1,140	239	0	0	0
Percent Difference	-1	9	0	0	0
Dry (22.5%)					
No Action Alternative	170,290	2,608	0	0	0
Alternative 3	156,331	2,731	0	0	0
Difference	-13,959	123	0	0	0
Percent Difference	-8	5	0	0	0
Critical (15%)					
No Action Alternative	397,589	1,814	0	0	0
Alternative 3	362,639	2,060	0	0	0
Difference	-34,950	247	0	0	0
Percent Difference	-9	14	0	0	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-3-8. Annual Mortality by Cause for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	167,192	4,321	171,512
Alternative 3	148,223	4,502	152,726
Difference	-18,968	182	-18,786
Percent Difference[3]	-11	4	-11
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	53,038	4,108	57,146
Alternative 3	27,591	4,467	32,057
Difference	-25,448	359	-25,089
Percent Difference	-48	9	-44
Above Normal (12.5%)			
No Action Alternative	274,408	2,606	277,013
Alternative 3	257,166	2,597	259,763
Difference	-17,242	-8	-17,250
Percent Difference	-6	0	-6
Below Normal (17.5%)			
No Action Alternative	107,177	4,253	111,431
Alternative 3	105,832	4,697	110,529
Difference	-1,345	444	-901
Percent Difference	-1	10	-1
Dry (22.5%)			
No Action Alternative	167,873	5,025	172,898
Alternative 3	154,048	5,014	159,062
Difference	-13,825	-11	-13,836
Percent Difference	-8	0	-8
Critical (15%)			
No Action Alternative	394,171	5,232	399,403
Alternative 3	359,528	5,172	364,700
Difference	-34,643	-60	-34,703
Percent Difference	-9	-1	-9

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-9. Annual Mortality by Cause and Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	47,267	2,039	119,924	1	2,282	0	0	171,512
Alternative 3	37,164	2,067	111,060	0	2,435	0	0	152,726
Difference	-10,103	28	-8,864	-1	154	0	0	-18,786
Percent Difference[3]	-21	1	-7	-100	7	0	0	-11
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	340	1,893	52,697	2	2,215	0	0	57,146
Alternative 3	189	2,196	27,402	0	2,271	0	0	32,057
Difference	-151	303	-25,295	-2	56	0	0	-25,089
Percent Difference	-44	16	-48	-100	3	0	0	-44
Above Normal (12.5%)								
No Action Alternative	151,449	651	122,959	0	1,955	0	0	277,013
Alternative 3	104,829	407	152,337	0	2,190	0	0	259,763
Difference	-46,620	-244	29,379	0	236	0	0	-17,250
Percent Difference	-31	-37	24	0	12	0	0	-6
Below Normal (17.5%)								
No Action Alternative	63,840	1,634	43,337	0	2,619	0	0	111,431
Alternative 3	62,085	1,839	43,747	0	2,858	0	0	110,529
Difference	-1,755	205	410	0	239	0	0	-901
Percent Difference	-3	13	1	0	9	0	0	-1
Dry (22.5%)								
No Action Alternative	37,718	2,417	130,155	0	2,608	0	0	172,898
Alternative 3	28,700	2,282	125,348	0	2,731	0	0	159,062
Difference	-9,018	-134	-4,807	0	123	0	0	-13,836
Percent Difference	-24	-6	-4	0	5	0	0	-8
Critical (15%)								
No Action Alternative	57,112	3,419	337,059	0	1,814	0	0	399,403
Alternative 3	44,510	3,112	315,018	0	2,060	0	0	364,700
Difference	-12,602	-307	-22,041	0	247	0	0	-34,703
Percent Difference	-22	-9	-7	0	14	0	0	-9

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-10. Annual Mortality by All Factors for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	47,267	2,039	0	119,924	1	2,282	0	0	0	0	171,512
Alternative 3	37,164	2,067	0	111,060	0	2,435	0	0	0	0	152,726
Difference	-10,103	28	0	-8,864	-1	154	0	0	0	0	-18,786
Percent Difference[3]	-21	1	0	-7	-100	7	0	0	0	0	-11
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	340	1,893	0	52,697	2	2,215	0	0	0	0	57,146
Alternative 3	189	2,196	0	27,402	0	2,271	0	0	0	0	32,057
Difference	-151	303	0	-25,295	-2	56	0	0	0	0	-25,089
Percent Difference	-44	16	0	-48	-100	3	0	0	0	0	-44
Above Normal (12.5%)											
No Action Alternative	151,449	651	0	122,959	0	1,955	0	0	0	0	277,013
Alternative 3	104,829	407	0	152,337	0	2,190	0	0	0	0	259,763
Difference	-46,620	-244	0	29,379	0	236	0	0	0	0	-17,250
Percent Difference	-31	-37	0	24	0	12	0	0	0	0	-6
Below Normal (17.5%)											
No Action Alternative	63,840	1,634	0	43,337	0	2,619	0	0	0	0	111,431
Alternative 3	62,085	1,839	0	43,747	0	2,858	0	0	0	0	110,529
Difference	-1,755	205	0	410	0	239	0	0	0	0	-901
Percent Difference	-3	13	0	1	0	9	0	0	0	0	-1
Dry (22.5%)											
No Action Alternative	37,718	2,417	0	130,155	0	2,608	0	0	0	0	172,898
Alternative 3	28,700	2,282	0	125,348	0	2,731	0	0	0	0	159,062
Difference	-9,018	-134	0	-4,807	0	123	0	0	0	0	-13,836
Percent Difference	-24	-6	0	-4	0	5	0	0	0	0	-8
Critical (15%)											
No Action Alternative	57,112	3,419	0	337,059	0	1,814	0	0	0	0	399,403
Alternative 3	44,510	3,112	0	315,018	0	2,060	0	0	0	0	364,700
Difference	-12,602	-307	0	-22,041	0	247	0	0	0	0	-34,703
Percent Difference	-22	-9	0	-7	0	14	0	0	0	0	-9

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-11. Annual Potential Production for Spring-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	402,980
Alternative 5	401,678
Difference	-1,302
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	442,676
Alternative 5	441,971
Difference	-705
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	362,537
Alternative 5	363,460
Difference	923
Percent Difference	0
Below Normal (17.5%)	
No Action Alternative	428,569
Alternative 5	428,206
Difference	-363
Percent Difference	0
Dry (22.5%)	
No Action Alternative	405,967
Alternative 5	407,290
Difference	1,323
Percent Difference	0
Critical (15%)	
No Action Alternative	316,344
Alternative 5	306,861
Difference	-9,484
Percent Difference	-3

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-3-12. Annual Mortality by Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	169,230	2,282	0	0	0
Alternative 5	171,978	2,371	0	0	0
Difference	2,748	89	0	0	0
Percent Difference[3]	2	4	0	0	0
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	54,929	2,217	0	0	0
Alternative 5	57,192	2,203	0	0	0
Difference	2,263	-14	0	0	0
Percent Difference	4	-1	0	0	0
Above Normal (12.5%)					
No Action Alternative	275,059	1,955	0	0	0
Alternative 5	271,916	1,980	0	0	0
Difference	-3,143	26	0	0	0
Percent Difference	-1	1	0	0	0
Below Normal (17.5%)					
No Action Alternative	108,811	2,619	0	0	0
Alternative 5	108,195	2,925	0	0	0
Difference	-616	306	0	0	0
Percent Difference	-1	12	0	0	0
Dry (22.5%)					
No Action Alternative	170,290	2,608	0	0	0
Alternative 5	166,496	2,666	0	0	0
Difference	-3,794	57	0	0	0
Percent Difference	-2	2	0	0	0
Critical (15%)					
No Action Alternative	397,589	1,814	0	0	0
Alternative 5	420,039	1,972	0	0	0
Difference	22,449	159	0	0	0
Percent Difference	6	9	0	0	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-3-13. Annual Mortality by Cause for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	167,192	4,321	171,512
Alternative 5	170,196	4,153	174,349
Difference	3,004	-167	2,837
Percent Difference[3]	2	-4	2
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	53,038	4,108	57,146
Alternative 5	55,390	4,005	59,395
Difference	2,351	-103	2,249
Percent Difference	4	-2	4
Above Normal (12.5%)			
No Action Alternative	274,408	2,606	277,013
Alternative 5	271,280	2,616	273,896
Difference	-3,128	11	-3,117
Percent Difference	-1	0	-1
Below Normal (17.5%)			
No Action Alternative	107,177	4,253	111,431
Alternative 5	106,681	4,439	111,120
Difference	-496	186	-310
Percent Difference	0	4	0
Dry (22.5%)			
No Action Alternative	167,873	5,025	172,898
Alternative 5	164,607	4,554	169,161
Difference	-3,266	-471	-3,737
Percent Difference	-2	-9	-2
Critical (15%)			
No Action Alternative	394,171	5,232	399,403
Alternative 5	417,191	4,820	422,011
Difference	23,020	-412	22,608
Percent Difference	6	-8	6

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-14. Annual Mortality by Cause and Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	47,267	2,039	119,924	1	2,282	0	0	171,512
Alternative 5	44,327	1,783	125,868	0	2,371	0	0	174,349
Difference	-2,940	-256	5,944	0	89	0	0	2,837
Percent Difference[3]	-6	-13	5	-52	4	0	0	2
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	340	1,893	52,697	2	2,215	0	0	57,146
Alternative 5	608	1,803	54,781	1	2,203	0	0	59,395
Difference	268	-90	2,084	-1	-13	0	0	2,249
Percent Difference	79	-5	4	-57	-1	0	0	4
Above Normal (12.5%)								
No Action Alternative	151,449	651	122,959	0	1,955	0	0	277,013
Alternative 5	125,685	636	145,595	0	1,980	0	0	273,896
Difference	-25,764	-15	22,636	0	26	0	0	-3,117
Percent Difference	-17	-2	18	0	1	0	0	-1
Below Normal (17.5%)								
No Action Alternative	63,840	1,634	43,337	0	2,619	0	0	111,431
Alternative 5	53,122	1,514	53,559	0	2,925	0	0	111,120
Difference	-10,718	-120	10,222	0	306	0	0	-310
Percent Difference	-17	-7	24	0	12	0	0	0
Dry (22.5%)								
No Action Alternative	37,718	2,417	130,155	0	2,608	0	0	172,898
Alternative 5	37,450	1,889	127,157	0	2,666	0	0	169,161
Difference	-268	-528	-2,998	0	57	0	0	-3,737
Percent Difference	-1	-22	-2	0	2	0	0	-2
Critical (15%)								
No Action Alternative	57,112	3,419	337,059	0	1,814	0	0	399,403
Alternative 5	71,310	2,848	345,881	0	1,972	0	0	422,011
Difference	14,198	-571	8,822	0	158	0	0	22,608
Percent Difference	25	-17	3	0	9	0	0	6

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-15. Annual Mortality by All Factors for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year)										
	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	47,267	2,039	0	119,924	1	2,282	0	0	0	0	171,512
Alternative 5	44,327	1,783	0	125,868	0	2,371	0	0	0	0	174,349
Difference	-2,940	-256	0	5,944	0	89	0	0	0	0	2,837
Percent Difference[3]	-6	-13	0	5	-52	4	0	0	0	0	2
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	340	1,893	0	52,697	2	2,215	0	0	0	0	57,146
Alternative 5	608	1,803	0	54,781	1	2,203	0	0	0	0	59,395
Difference	268	-90	0	2,084	-1	-13	0	0	0	0	2,249
Percent Difference	79	-5	0	4	-57	-1	0	0	0	0	4
Above Normal (12.5%)											
No Action Alternative	151,449	651	0	122,959	0	1,955	0	0	0	0	277,013
Alternative 5	125,685	636	0	145,595	0	1,980	0	0	0	0	273,896
Difference	-25,764	-15	0	22,636	0	26	0	0	0	0	-3,117
Percent Difference	-17	-2	0	18	0	1	0	0	0	0	-1
Below Normal (17.5%)											
No Action Alternative	63,840	1,634	0	43,337	0	2,619	0	0	0	0	111,431
Alternative 5	53,122	1,514	0	53,559	0	2,925	0	0	0	0	111,120
Difference	-10,718	-120	0	10,222	0	306	0	0	0	0	-310
Percent Difference	-17	-7	0	24	0	12	0	0	0	0	0
Dry (22.5%)											
No Action Alternative	37,718	2,417	0	130,155	0	2,608	0	0	0	0	172,898
Alternative 5	37,450	1,889	0	127,157	0	2,666	0	0	0	0	169,161
Difference	-268	-528	0	-2,998	0	57	0	0	0	0	-3,737
Percent Difference	-1	-22	0	-2	0	2	0	0	0	0	-2
Critical (15%)											
No Action Alternative	57,112	3,419	0	337,059	0	1,814	0	0	0	0	399,403
Alternative 5	71,310	2,848	0	345,881	0	1,972	0	0	0	0	422,011
Difference	14,198	-571	0	8,822	0	158	0	0	0	0	22,608
Percent Difference	25	-17	0	3	0	9	0	0	0	0	6

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-16. Annual Potential Production for Spring-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	410,722
No Action Alternative	402,980
Difference	-7,742
Percent Difference[3]	-2
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	449,832
No Action Alternative	442,676
Difference	-7,156
Percent Difference	-2
Above Normal (12.5%)	
Second Basis of Comparison	367,591
No Action Alternative	362,537
Difference	-5,054
Percent Difference	-1
Below Normal (17.5%)	
Second Basis of Comparison	426,491
No Action Alternative	428,569
Difference	2,078
Percent Difference	0
Dry (22.5%)	
Second Basis of Comparison	403,012
No Action Alternative	405,967
Difference	2,955
Percent Difference	1
Critical (15%)	
Second Basis of Comparison	355,097
No Action Alternative	316,344
Difference	-38,753
Percent Difference	-11

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-3-17. Annual Mortality by Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	149,155	2,453	0	0	0
No Action Alternative	169,230	2,282	0	0	0
Difference	20,075	-171	0	0	0
Percent Difference[3]	13	-7	0	0	0
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	38,874	2,303	0	0	0
No Action Alternative	54,929	2,217	0	0	0
Difference	16,055	-86	0	0	0
Percent Difference	41	-4	0	0	0
Above Normal (12.5%)					
Second Basis of Comparison	256,999	2,360	0	0	0
No Action Alternative	275,059	1,955	0	0	0
Difference	18,059	-406	0	0	0
Percent Difference	7	-17	0	0	0
Below Normal (17.5%)					
Second Basis of Comparison	110,617	2,763	0	0	0
No Action Alternative	108,811	2,619	0	0	0
Difference	-1,806	-144	0	0	0
Percent Difference	-2	-5	0	0	0
Dry (22.5%)					
Second Basis of Comparison	175,971	2,682	0	0	0
No Action Alternative	170,290	2,608	0	0	0
Difference	-5,681	-73	0	0	0
Percent Difference	-3	-3	0	0	0
Critical (15%)					
Second Basis of Comparison	302,962	2,151	0	0	0
No Action Alternative	397,589	1,814	0	0	0
Difference	94,627	-337	0	0	0
Percent Difference	31	-16	0	0	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-3-18. Annual Mortality by Cause for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	146,922	4,686	151,608
No Action Alternative	167,192	4,321	171,512
Difference	20,270	-366	19,904
Percent Difference[3]	14	-8	13
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	36,709	4,468	41,178
No Action Alternative	53,038	4,108	57,146
Difference	16,329	-360	15,969
Percent Difference	44	-8	39
Above Normal (12.5%)			
Second Basis of Comparison	256,534	2,826	259,360
No Action Alternative	274,408	2,606	277,013
Difference	17,874	-221	17,653
Percent Difference	7	-8	7
Below Normal (17.5%)			
Second Basis of Comparison	108,800	4,580	113,380
No Action Alternative	107,177	4,253	111,431
Difference	-1,623	-327	-1,949
Percent Difference	-1	-7	-2
Dry (22.5%)			
Second Basis of Comparison	173,420	5,232	178,652
No Action Alternative	167,873	5,025	172,898
Difference	-5,547	-207	-5,754
Percent Difference	-3	-4	-3
Critical (15%)			
Second Basis of Comparison	299,101	6,012	305,113
No Action Alternative	394,171	5,232	399,403
Difference	95,070	-780	94,290
Percent Difference	32	-13	31

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-19. Annual Mortality by Cause and Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	38,621	2,233	108,301	0	2,453	0	0	151,608
No Action Alternative	47,267	2,039	119,924	1	2,282	0	0	171,512
Difference	8,646	-194	11,623	1	-172	0	0	19,904
Percent Difference[3]	22	-9	11	0	-7	0	0	13
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	260	2,165	36,450	0	2,303	0	0	41,178
No Action Alternative	340	1,893	52,697	2	2,215	0	0	57,146
Difference	80	-272	16,247	2	-88	0	0	15,969
Percent Difference	31	-13	45	0	-4	0	0	39
Above Normal (12.5%)								
Second Basis of Comparison	99,868	466	156,666	0	2,360	0	0	259,360
No Action Alternative	151,449	651	122,959	0	1,955	0	0	277,013
Difference	51,581	185	-33,707	0	-406	0	0	17,653
Percent Difference	52	40	-22	0	-17	0	0	7
Below Normal (17.5%)								
Second Basis of Comparison	66,585	1,818	42,215	0	2,763	0	0	113,380
No Action Alternative	63,840	1,634	43,337	0	2,619	0	0	111,431
Difference	-2,744	-183	1,122	0	-144	0	0	-1,949
Percent Difference	-4	-10	3	0	-5	0	0	-2
Dry (22.5%)								
Second Basis of Comparison	34,417	2,551	139,003	0	2,682	0	0	178,652
No Action Alternative	37,718	2,417	130,155	0	2,608	0	0	172,898
Difference	3,301	-134	-8,847	0	-73	0	0	-5,754
Percent Difference	10	-5	-6	0	-3	0	0	-3
Critical (15%)								
Second Basis of Comparison	44,378	3,862	254,723	0	2,151	0	0	305,113
No Action Alternative	57,112	3,419	337,059	0	1,814	0	0	399,403
Difference	12,734	-443	82,336	0	-337	0	0	94,290
Percent Difference	29	-11	32	0	-16	0	0	31

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-20. Annual Mortality by All Factors for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	38,621	2,233	0	108,301	0	2,453	0	0	0	0	151,608
No Action Alternative	47,267	2,039	0	119,924	1	2,282	0	0	0	0	171,512
Difference	8,646	-194	0	11,623	1	-172	0	0	0	0	19,904
Percent Difference[3]	22	-9	0	11	0	-7	0	0	0	0	13
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	260	2,165	0	36,450	0	2,303	0	0	0	0	41,178
No Action Alternative	340	1,893	0	52,697	2	2,215	0	0	0	0	57,146
Difference	80	-272	0	16,247	2	-88	0	0	0	0	15,969
Percent Difference	31	-13	0	45	0	-4	0	0	0	0	39
Above Normal (12.5%)											
Second Basis of Comparison	99,868	466	0	156,666	0	2,360	0	0	0	0	259,360
No Action Alternative	151,449	651	0	122,959	0	1,955	0	0	0	0	277,013
Difference	51,581	185	0	-33,707	0	-406	0	0	0	0	17,653
Percent Difference	52	40	0	-22	0	-17	0	0	0	0	7
Below Normal (17.5%)											
Second Basis of Comparison	66,585	1,818	0	42,215	0	2,763	0	0	0	0	113,380
No Action Alternative	63,840	1,634	0	43,337	0	2,619	0	0	0	0	111,431
Difference	-2,744	-183	0	1,122	0	-144	0	0	0	0	-1,949
Percent Difference	-4	-10	0	3	0	-5	0	0	0	0	-2
Dry (22.5%)											
Second Basis of Comparison	34,417	2,551	0	139,003	0	2,682	0	0	0	0	178,652
No Action Alternative	37,718	2,417	0	130,155	0	2,608	0	0	0	0	172,898
Difference	3,301	-134	0	-8,847	0	-73	0	0	0	0	-5,754
Percent Difference	10	-5	0	-6	0	-3	0	0	0	0	-3
Critical (15%)											
Second Basis of Comparison	44,378	3,862	0	254,723	0	2,151	0	0	0	0	305,113
No Action Alternative	57,112	3,419	0	337,059	0	1,814	0	0	0	0	399,403
Difference	12,734	-443	0	82,336	0	-337	0	0	0	0	94,290
Percent Difference	29	-11	0	32	0	-16	0	0	0	0	31

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-21. Annual Potential Production for Spring-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	410,722
Alternative 3	409,813
Difference	-909
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	449,832
Alternative 3	453,743
Difference	3,911
Percent Difference	1
Above Normal (12.5%)	
Second Basis of Comparison	367,591
Alternative 3	368,403
Difference	812
Percent Difference	0
Below Normal (17.5%)	
Second Basis of Comparison	426,491
Alternative 3	427,631
Difference	1,140
Percent Difference	0
Dry (22.5%)	
Second Basis of Comparison	403,012
Alternative 3	410,542
Difference	7,530
Percent Difference	2
Critical (15%)	
Second Basis of Comparison	355,097
Alternative 3	327,260
Difference	-27,838
Percent Difference	-8

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-3-22. Annual Mortality by Life Stage for Spring-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)				
Analysis Period	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	149,155	2,453	0	0	0
Alternative 3	150,290	2,435	0	0	0
Difference	1,135	-18	0	0	0
Percent Difference[3]	1	-1	0	0	0
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	38,874	2,303	0	0	0
Alternative 3	29,787	2,271	0	0	0
Difference	-9,087	-33	0	0	0
Percent Difference	-23	-1	0	0	0
Above Normal (12.5%)					
Second Basis of Comparison	256,999	2,360	0	0	0
Alternative 3	257,573	2,190	0	0	0
Difference	574	-170	0	0	0
Percent Difference	0	-7	0	0	0
Below Normal (17.5%)					
Second Basis of Comparison	110,617	2,763	0	0	0
Alternative 3	107,671	2,858	0	0	0
Difference	-2,946	95	0	0	0
Percent Difference	-3	3	0	0	0
Dry (22.5%)					
Second Basis of Comparison	175,971	2,682	0	0	0
Alternative 3	156,331	2,731	0	0	0
Difference	-19,640	50	0	0	0
Percent Difference	-11	2	0	0	0
Critical (15%)					
Second Basis of Comparison	302,962	2,151	0	0	0
Alternative 3	362,639	2,060	0	0	0
Difference	59,677	-90	0	0	0
Percent Difference	20	-4	0	0	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-3-23. Annual Mortality by Cause for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	146,922	4,686	151,608
Alternative 3	148,223	4,502	152,726
Difference	1,302	-184	1,118
Percent Difference[3]	1	-4	1
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	36,709	4,468	41,178
Alternative 3	27,591	4,467	32,057
Difference	-9,119	-1	-9,120
Percent Difference	-25	0	-22
Above Normal (12.5%)			
Second Basis of Comparison	256,534	2,826	259,360
Alternative 3	257,166	2,597	259,763
Difference	632	-229	404
Percent Difference	0	-8	0
Below Normal (17.5%)			
Second Basis of Comparison	108,800	4,580	113,380
Alternative 3	105,832	4,697	110,529
Difference	-2,968	117	-2,851
Percent Difference	-3	3	-3
Dry (22.5%)			
Second Basis of Comparison	173,420	5,232	178,652
Alternative 3	154,048	5,014	159,062
Difference	-19,372	-219	-19,590
Percent Difference	-11	-4	-11
Critical (15%)			
Second Basis of Comparison	299,101	6,012	305,113
Alternative 3	359,528	5,172	364,700
Difference	60,427	-840	59,587
Percent Difference	20	-14	20

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-24. Annual Mortality by Cause and Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	38,621	2,233	108,301	0	2,453	0	0	151,608
Alternative 3	37,164	2,067	111,060	0	2,435	0	0	152,726
Difference	-1,457	-166	2,759	0	-18	0	0	1,118
Percent Difference[3]	-4	-7	3	0	-1	0	0	1
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	260	2,165	36,450	0	2,303	0	0	41,178
Alternative 3	189	2,196	27,402	0	2,271	0	0	32,057
Difference	-71	31	-9,047	0	-33	0	0	-9,120
Percent Difference	-27	1	-25	0	-1	0	0	-22
Above Normal (12.5%)								
Second Basis of Comparison	99,868	466	156,666	0	2,360	0	0	259,360
Alternative 3	104,829	407	152,337	0	2,190	0	0	259,763
Difference	4,961	-59	-4,329	0	-170	0	0	404
Percent Difference	5	-13	-3	0	-7	0	0	0
Below Normal (17.5%)								
Second Basis of Comparison	66,585	1,818	42,215	0	2,763	0	0	113,380
Alternative 3	62,085	1,839	43,747	0	2,858	0	0	110,529
Difference	-4,500	22	1,532	0	95	0	0	-2,851
Percent Difference	-7	1	4	0	3	0	0	-3
Dry (22.5%)								
Second Basis of Comparison	34,417	2,551	139,003	0	2,682	0	0	178,652
Alternative 3	28,700	2,282	125,348	0	2,731	0	0	159,062
Difference	-5,717	-269	-13,654	0	50	0	0	-19,590
Percent Difference	-17	-11	-10	0	2	0	0	-11
Critical (15%)								
Second Basis of Comparison	44,378	3,862	254,723	0	2,151	0	0	305,113
Alternative 3	44,510	3,112	315,018	0	2,060	0	0	364,700
Difference	132	-750	60,295	0	-90	0	0	59,587
Percent Difference	0	-19	24	0	-4	0	0	20

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-25. Annual Mortality by All Factors for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	38,621	2,233	0	108,301	0	2,453	0	0	0	0	151,608
Alternative 3	37,164	2,067	0	111,060	0	2,435	0	0	0	0	152,726
Difference	-1,457	-166	0	2,759	0	-18	0	0	0	0	1,118
Percent Difference[3]	-4	-7	0	3	0	-1	0	0	0	0	1
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	260	2,165	0	36,450	0	2,303	0	0	0	0	41,178
Alternative 3	189	2,196	0	27,402	0	2,271	0	0	0	0	32,057
Difference	-71	31	0	-9,047	0	-33	0	0	0	0	-9,120
Percent Difference	-27	1	0	-25	0	-1	0	0	0	0	-22
Above Normal (12.5%)											
Second Basis of Comparison	99,868	466	0	156,666	0	2,360	0	0	0	0	259,360
Alternative 3	104,829	407	0	152,337	0	2,190	0	0	0	0	259,763
Difference	4,961	-59	0	-4,329	0	-170	0	0	0	0	404
Percent Difference	5	-13	0	-3	0	-7	0	0	0	0	0
Below Normal (17.5%)											
Second Basis of Comparison	66,585	1,818	0	42,215	0	2,763	0	0	0	0	113,380
Alternative 3	62,085	1,839	0	43,747	0	2,858	0	0	0	0	110,529
Difference	-4,500	22	0	1,532	0	95	0	0	0	0	-2,851
Percent Difference	-7	1	0	4	0	3	0	0	0	0	-3
Dry (22.5%)											
Second Basis of Comparison	34,417	2,551	0	139,003	0	2,682	0	0	0	0	178,652
Alternative 3	28,700	2,282	0	125,348	0	2,731	0	0	0	0	159,062
Difference	-5,717	-269	0	-13,654	0	50	0	0	0	0	-19,590
Percent Difference	-17	-11	0	-10	0	2	0	0	0	0	-11
Critical (15%)											
Second Basis of Comparison	44,378	3,862	0	254,723	0	2,151	0	0	0	0	305,113
Alternative 3	44,510	3,112	0	315,018	0	2,060	0	0	0	0	364,700
Difference	132	-750	0	60,295	0	-90	0	0	0	0	59,587
Percent Difference	0	-19	0	24	0	-4	0	0	0	0	20

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-26. Annual Potential Production for Spring-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	410,722
Alternative 5	401,678
Difference	-9,044
Percent Difference[3]	-2
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	449,832
Alternative 5	441,971
Difference	-7,862
Percent Difference	-2
Above Normal (12.5%)	
Second Basis of Comparison	367,591
Alternative 5	363,460
Difference	-4,131
Percent Difference	-1
Below Normal (17.5%)	
Second Basis of Comparison	426,491
Alternative 5	428,206
Difference	1,716
Percent Difference	0
Dry (22.5%)	
Second Basis of Comparison	403,012
Alternative 5	407,290
Difference	4,278
Percent Difference	1
Critical (15%)	
Second Basis of Comparison	355,097
Alternative 5	306,861
Difference	-48,237
Percent Difference	-14

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-3-27. Annual Mortality by Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	149,155	2,453	0	0	0
Alternative 5	171,978	2,371	0	0	0
Difference	22,823	-82	0	0	0
Percent Difference[3]	15	-3	0	0	0
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	38,874	2,303	0	0	0
Alternative 5	57,192	2,203	0	0	0
Difference	18,318	-100	0	0	0
Percent Difference	47	-4	0	0	0
Above Normal (12.5%)					
Second Basis of Comparison	256,999	2,360	0	0	0
Alternative 5	271,916	1,980	0	0	0
Difference	14,917	-380	0	0	0
Percent Difference	6	-16	0	0	0
Below Normal (17.5%)					
Second Basis of Comparison	110,617	2,763	0	0	0
Alternative 5	108,195	2,925	0	0	0
Difference	-2,422	163	0	0	0
Percent Difference	-2	6	0	0	0
Dry (22.5%)					
Second Basis of Comparison	175,971	2,682	0	0	0
Alternative 5	166,496	2,666	0	0	0
Difference	-9,475	-16	0	0	0
Percent Difference	-5	-1	0	0	0
Critical (15%)					
Second Basis of Comparison	302,962	2,151	0	0	0
Alternative 5	420,039	1,972	0	0	0
Difference	117,076	-179	0	0	0
Percent Difference	39	-8	0	0	0

1 Based on the 80-year simulation period
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.
3 Relative difference of the Annual average
4 Mortality values do not include base mortality
5 Eggs mortality includes pre-spawn mortality

Table B-3-28. Annual Mortality by Cause for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	146,922	4,686	151,608
Alternative 5	170,196	4,153	174,349
Difference	23,274	-533	22,742
Percent Difference[3]	16	-11	15
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	36,709	4,468	41,178
Alternative 5	55,390	4,005	59,395
Difference	18,680	-463	18,217
Percent Difference	51	-10	44
Above Normal (12.5%)			
Second Basis of Comparison	256,534	2,826	259,360
Alternative 5	271,280	2,616	273,896
Difference	14,746	-210	14,536
Percent Difference	6	-7	6
Below Normal (17.5%)			
Second Basis of Comparison	108,800	4,580	113,380
Alternative 5	106,681	4,439	111,120
Difference	-2,119	-141	-2,260
Percent Difference	-2	-3	-2
Dry (22.5%)			
Second Basis of Comparison	173,420	5,232	178,652
Alternative 5	164,607	4,554	169,161
Difference	-8,813	-678	-9,491
Percent Difference	-5	-13	-5
Critical (15%)			
Second Basis of Comparison	299,101	6,012	305,113
Alternative 5	417,191	4,820	422,011
Difference	118,090	-1,192	116,898
Percent Difference	39	-20	38

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-29. Annual Mortality by Cause and Life Stage for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	38,621	2,233	108,301	0	2,453	0	0	151,608
Alternative 5	44,327	1,783	125,868	0	2,371	0	0	174,349
Difference	5,706	-450	17,567	0	-82	0	0	22,742
Percent Difference[3]	15	-20	16	0	-3	0	0	15
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	260	2,165	36,450	0	2,303	0	0	41,178
Alternative 5	608	1,803	54,781	1	2,203	0	0	59,395
Difference	348	-362	18,331	1	-101	0	0	18,217
Percent Difference	134	-17	50	0	-4	0	0	44
Above Normal (12.5%)								
Second Basis of Comparison	99,868	466	156,666	0	2,360	0	0	259,360
Alternative 5	125,685	636	145,595	0	1,980	0	0	273,896
Difference	25,817	171	-11,071	0	-380	0	0	14,536
Percent Difference	26	37	-7	0	-16	0	0	6
Below Normal (17.5%)								
Second Basis of Comparison	66,585	1,818	42,215	0	2,763	0	0	113,380
Alternative 5	53,122	1,514	53,559	0	2,925	0	0	111,120
Difference	-13,463	-303	11,344	0	163	0	0	-2,260
Percent Difference	-20	-17	27	0	6	0	0	-2
Dry (22.5%)								
Second Basis of Comparison	34,417	2,551	139,003	0	2,682	0	0	178,652
Alternative 5	37,450	1,889	127,157	0	2,666	0	0	169,161
Difference	3,033	-662	-11,845	0	-16	0	0	-9,491
Percent Difference	9	-26	-9	0	-1	0	0	-5
Critical (15%)								
Second Basis of Comparison	44,378	3,862	254,723	0	2,151	0	0	305,113
Alternative 5	71,310	2,848	345,881	0	1,972	0	0	422,011
Difference	26,932	-1,013	91,158	0	-179	0	0	116,898
Percent Difference	61	-26	36	0	-8	0	0	38

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-3-30. Annual Mortality by All Factors for Spring-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year)										
	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	38,621	2,233	0	108,301	0	2,453	0	0	0	0	151,608
Alternative 5	44,327	1,783	0	125,868	0	2,371	0	0	0	0	174,349
Difference	5,706	-450	0	17,567	0	-82	0	0	0	0	22,742
Percent Difference[3]	15	-20	0	16	0	-3	0	0	0	0	15
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	260	2,165	0	36,450	0	2,303	0	0	0	0	41,178
Alternative 5	608	1,803	0	54,781	1	2,203	0	0	0	0	59,395
Difference	348	-362	0	18,331	1	-101	0	0	0	0	18,217
Percent Difference	134	-17	0	50	0	-4	0	0	0	0	44
Above Normal (12.5%)											
Second Basis of Comparison	99,868	466	0	156,666	0	2,360	0	0	0	0	259,360
Alternative 5	125,685	636	0	145,595	0	1,980	0	0	0	0	273,896
Difference	25,817	171	0	-11,071	0	-380	0	0	0	0	14,536
Percent Difference	26	37	0	-7	0	-16	0	0	0	0	6
Below Normal (17.5%)											
Second Basis of Comparison	66,585	1,818	0	42,215	0	2,763	0	0	0	0	113,380
Alternative 5	53,122	1,514	0	53,559	0	2,925	0	0	0	0	111,120
Difference	-13,463	-303	0	11,344	0	163	0	0	0	0	-2,260
Percent Difference	-20	-17	0	27	0	6	0	0	0	0	-2
Dry (22.5%)											
Second Basis of Comparison	34,417	2,551	0	139,003	0	2,682	0	0	0	0	178,652
Alternative 5	37,450	1,889	0	127,157	0	2,666	0	0	0	0	169,161
Difference	3,033	-662	0	-11,845	0	-16	0	0	0	0	-9,491
Percent Difference	9	-26	0	-9	0	-1	0	0	0	0	-5
Critical (15%)											
Second Basis of Comparison	44,378	3,862	0	254,723	0	2,151	0	0	0	0	305,113
Alternative 5	71,310	2,848	0	345,881	0	1,972	0	0	0	0	422,011
Difference	26,932	-1,013	0	91,158	0	-179	0	0	0	0	116,898
Percent Difference	61	-26	0	36	0	-8	0	0	0	0	38

1 Based on the 80-year simulation period

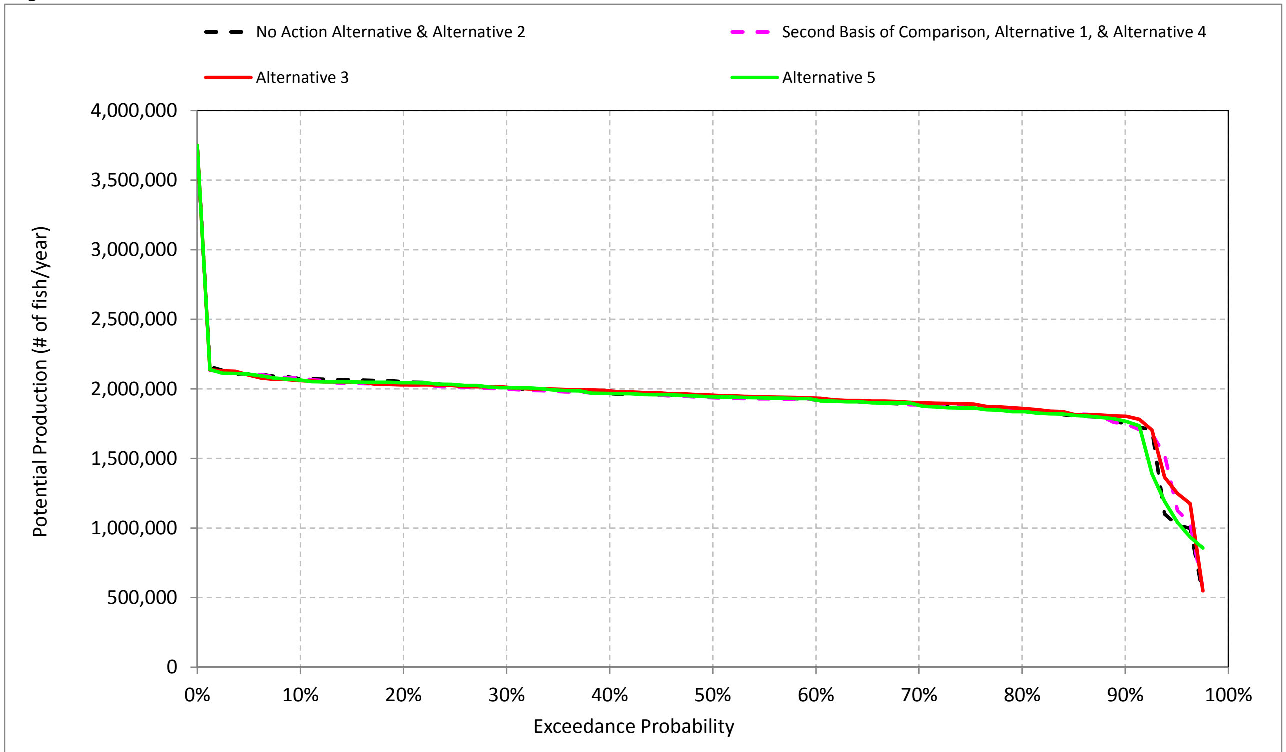
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

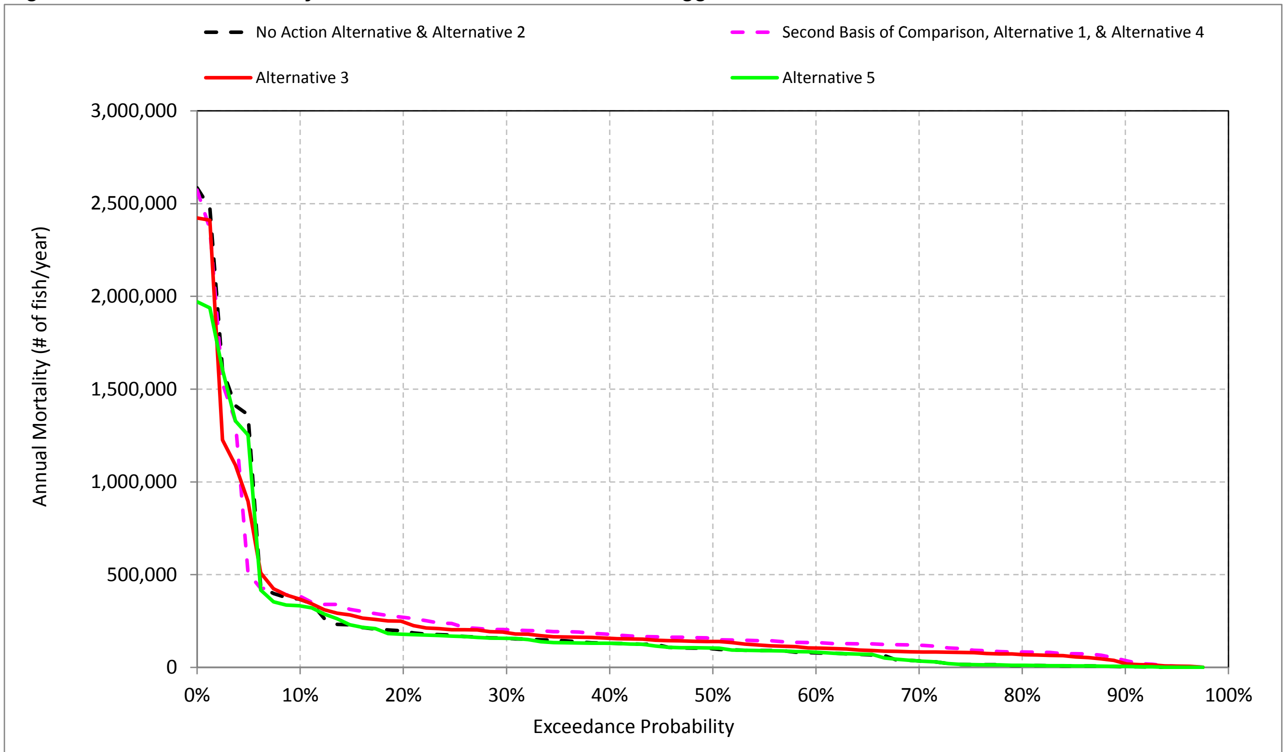
B.4. Winter-Run Chinook Salmon

Figure B-4-1. Annual Potential Production for Winter-Run Chinook Salmon



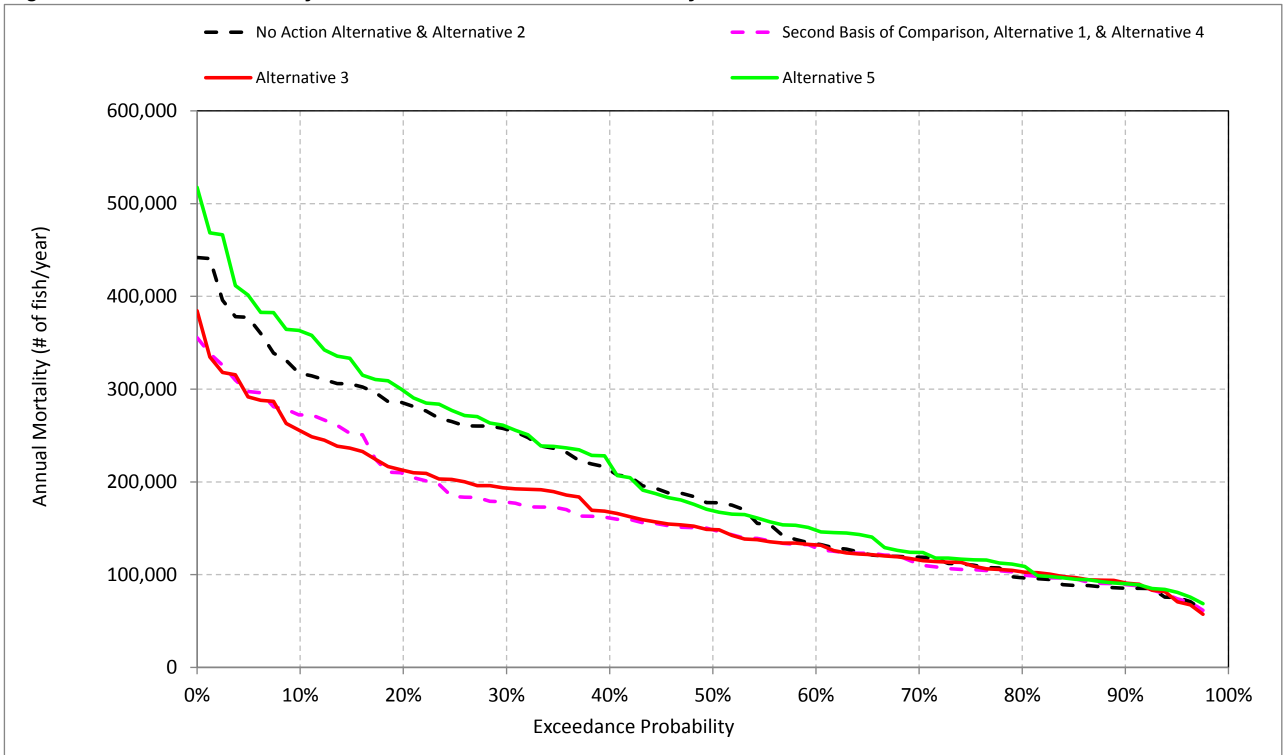
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-2. Annual Mortality for Winter-Run Chinook Salmon - Eggs



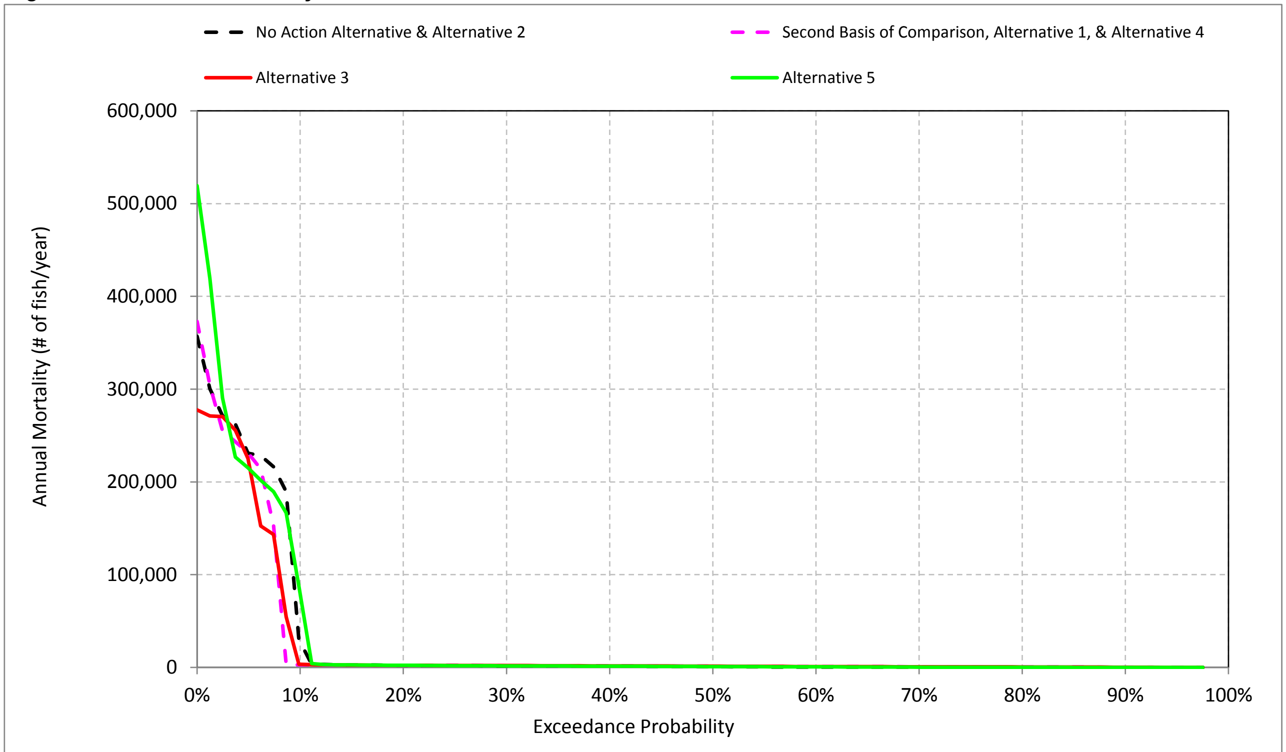
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-3. Annual Mortality for Winter-Run Chinook Salmon - Fry



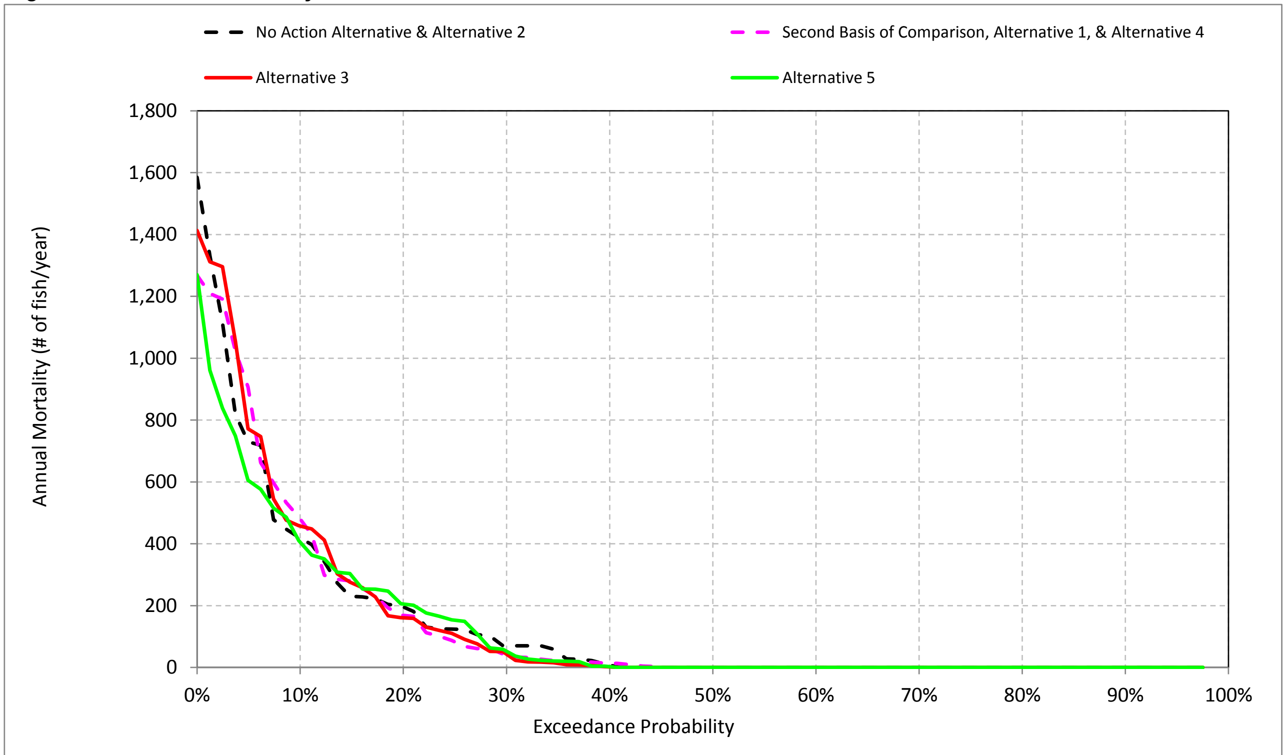
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-4. Annual Mortality for Winter-Run Chinook Salmon - Pre-Smolt



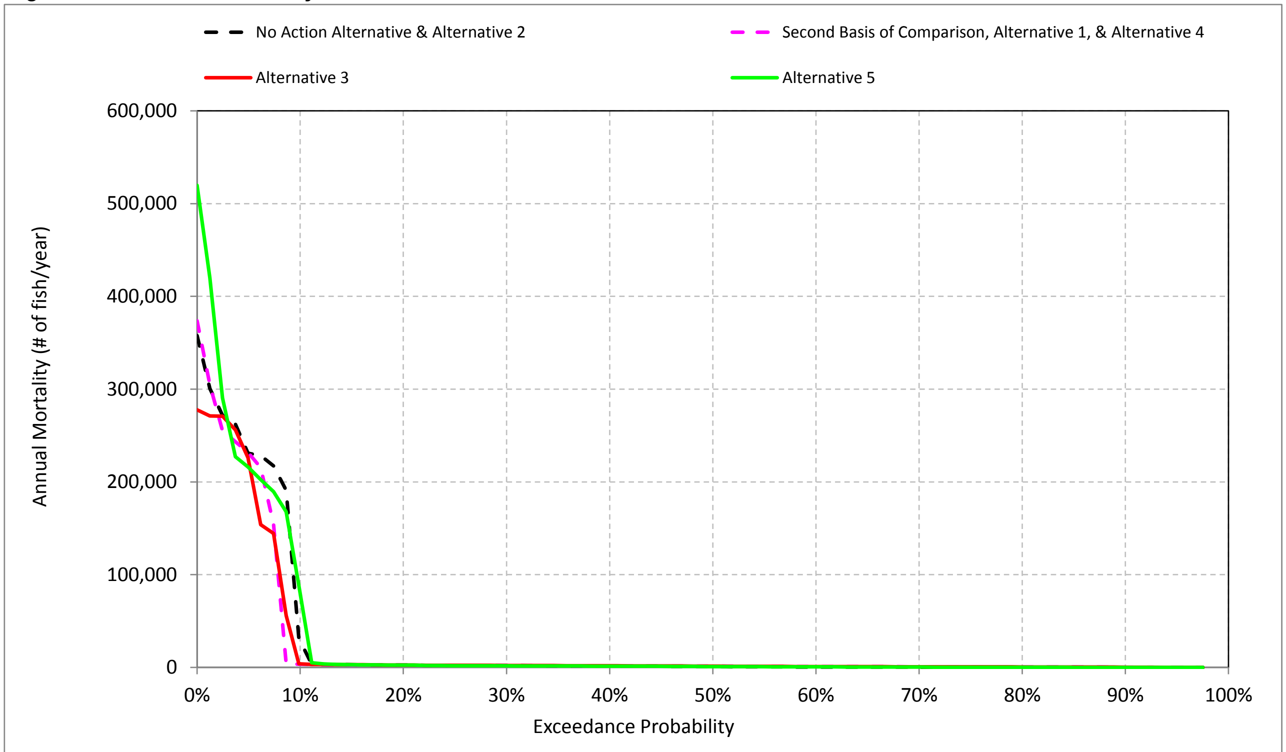
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-5. Annual Mortality for Winter-Run Chinook Salmon - Immature Smolt



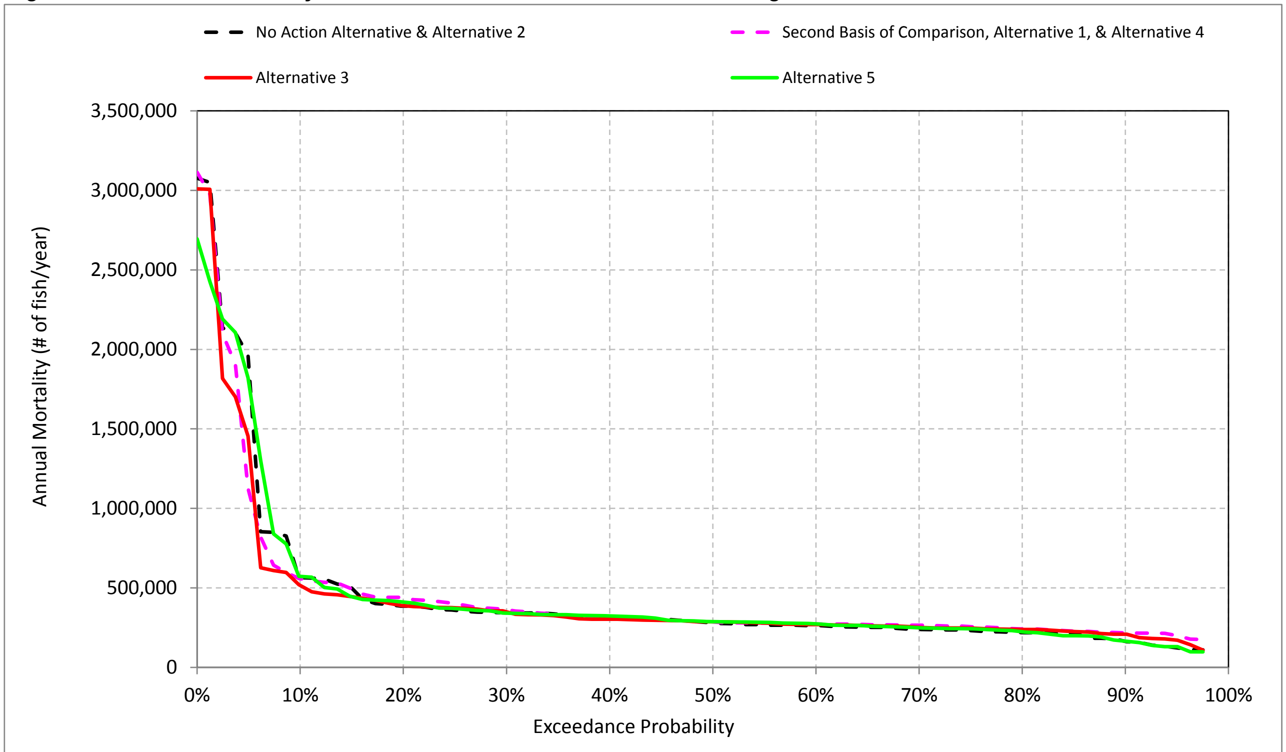
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-6. Annual Mortality for Winter-Run Chinook Salmon - Pre- & Immature Smolts



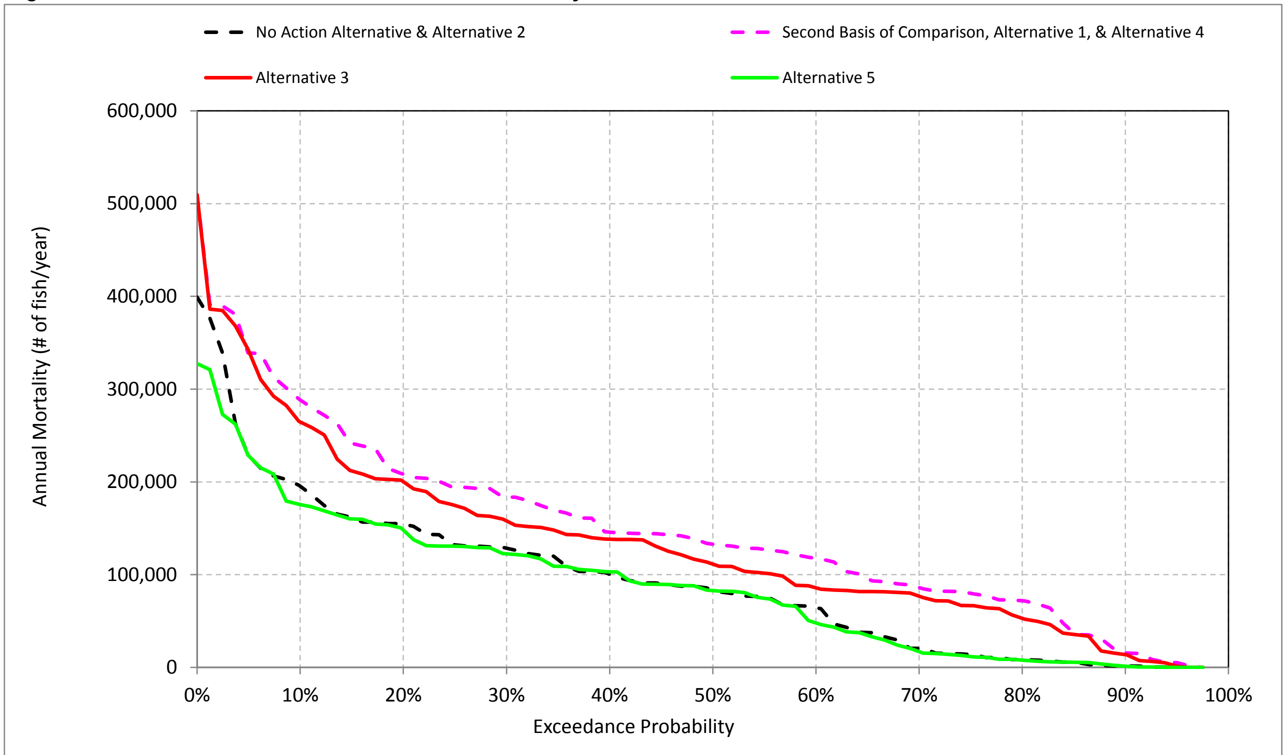
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-7. Annual Mortality for Winter-Run Chinook Salmon - All Lifestages



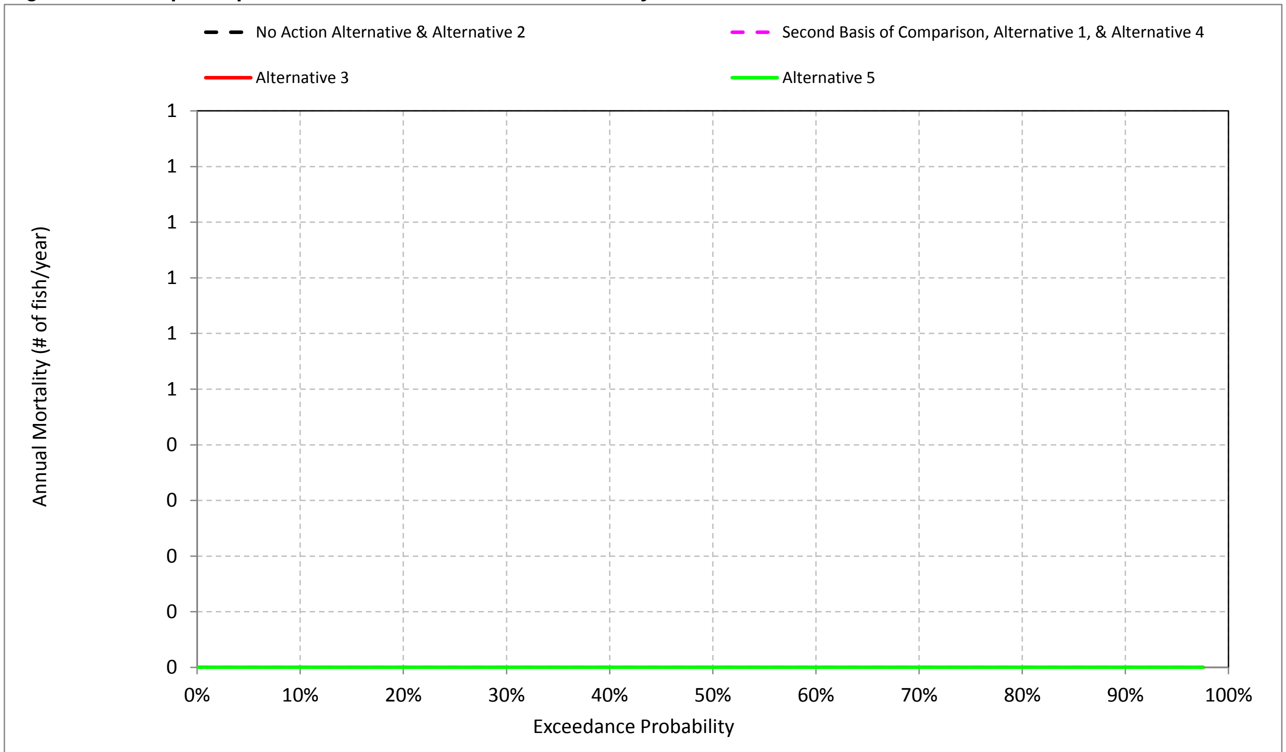
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-8. Incubation - Habitat based Annual Mortality for Winter-Run Chinook Salmon



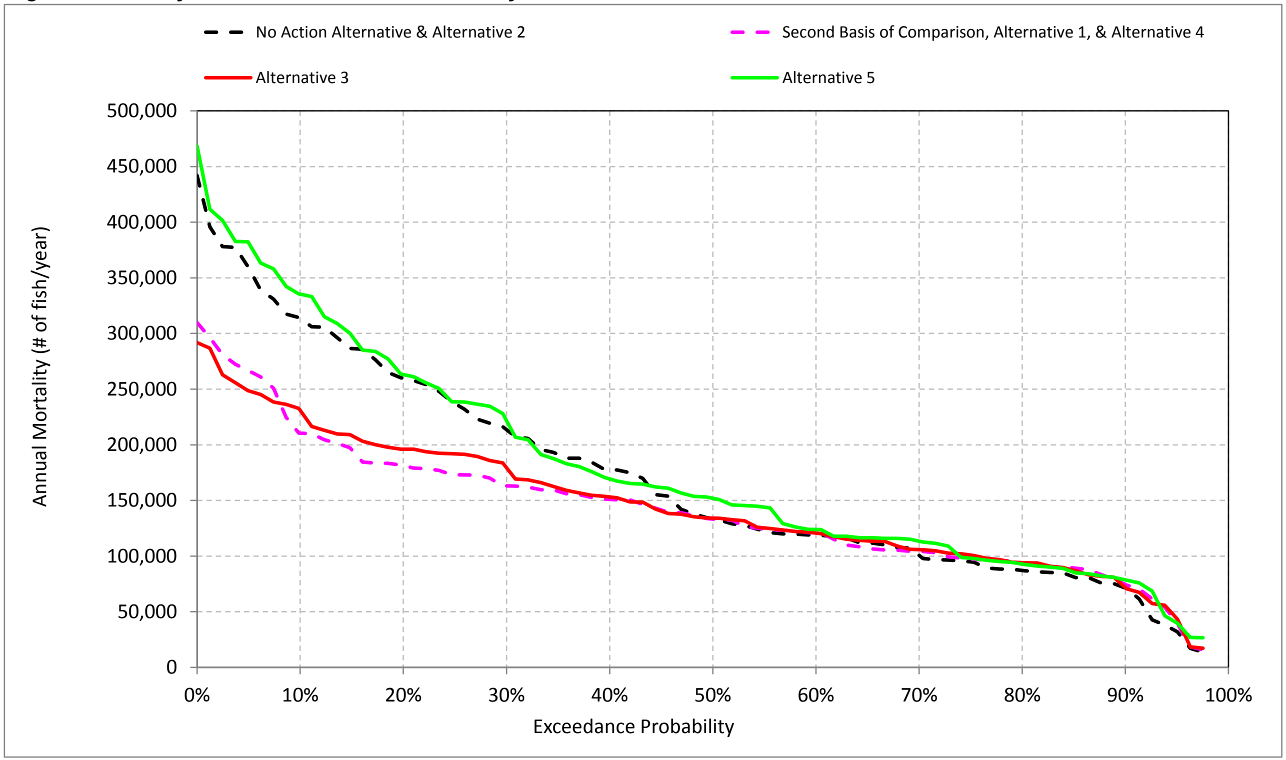
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-9. Super-imposition - Habitat based Annual Mortality for Winter-Run Chinook Salmon



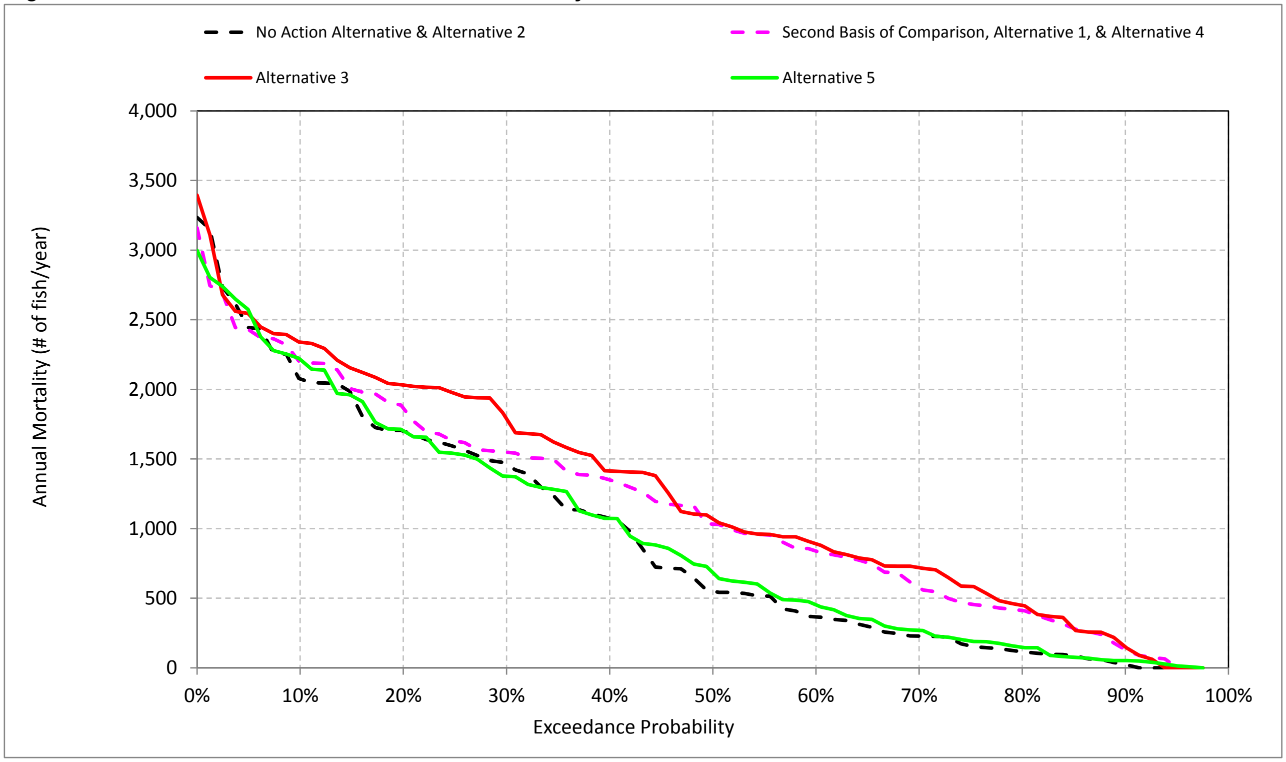
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-10. Fry - Habitat based Annual Mortality for Winter-Run Chinook Salmon



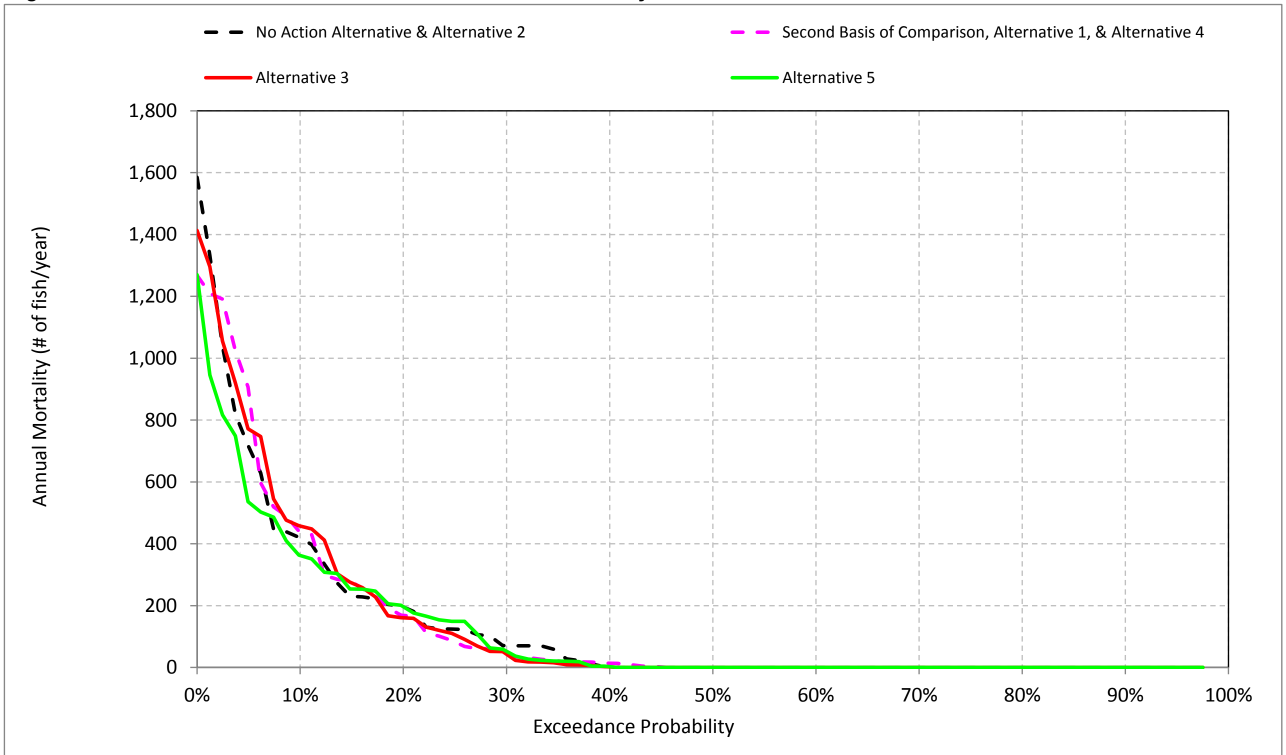
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-11. Pre-smolt - Habitat based Annual Mortality for Winter-Run Chinook Salmon



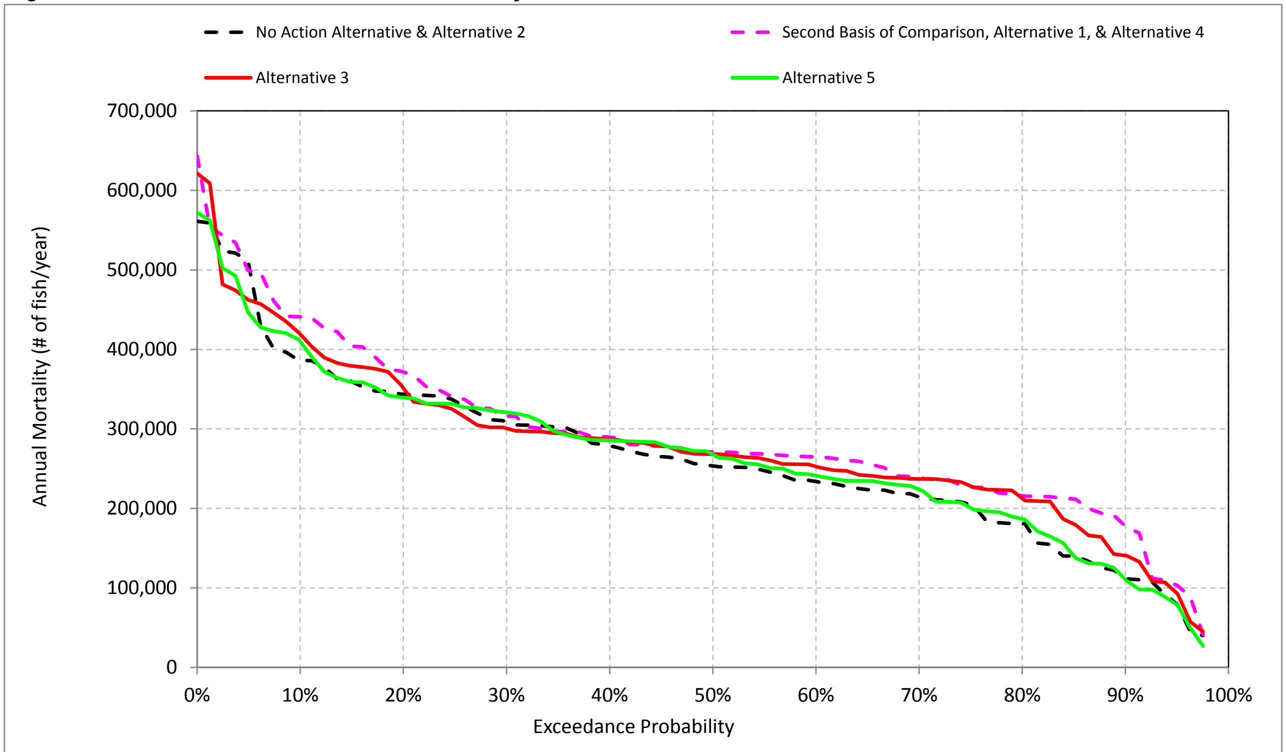
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-12. Immature Smolt - Habitat based Annual Mortality for Winter-Run Chinook Salmon



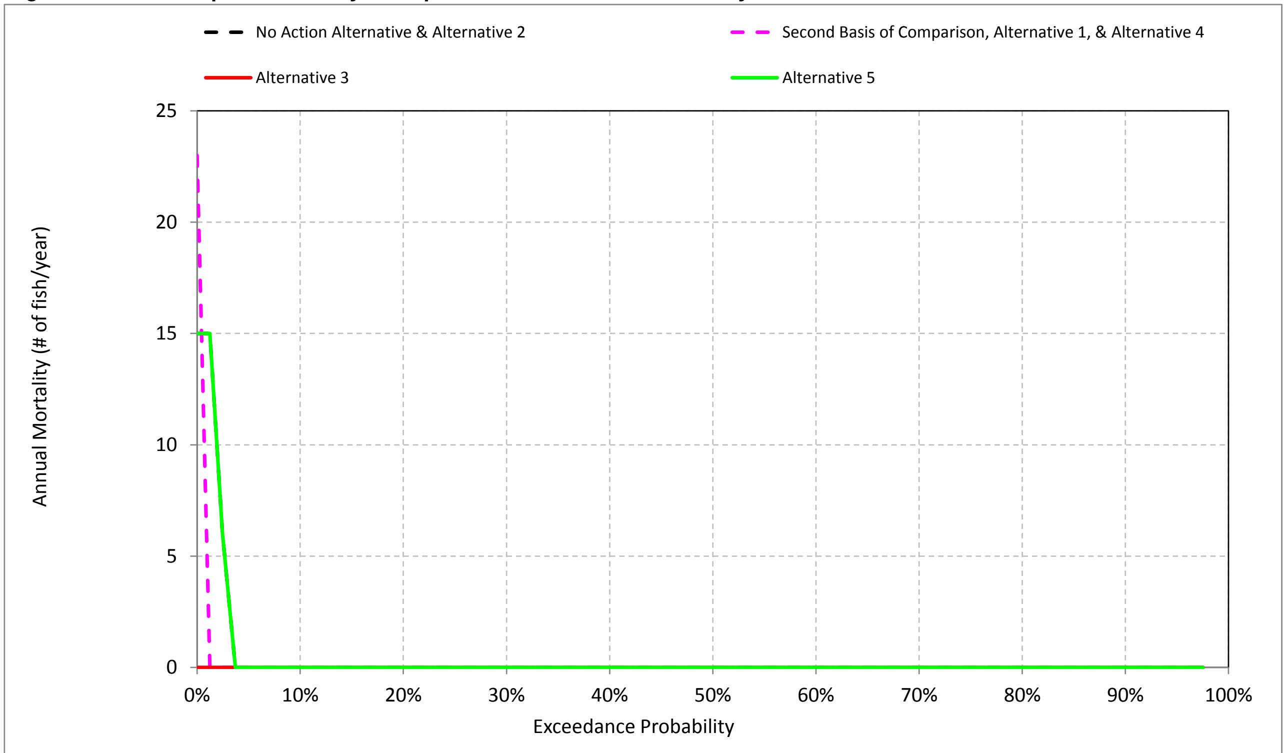
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-13. Total Habitat based Annual Mortality for Winter-Run Chinook Salmon



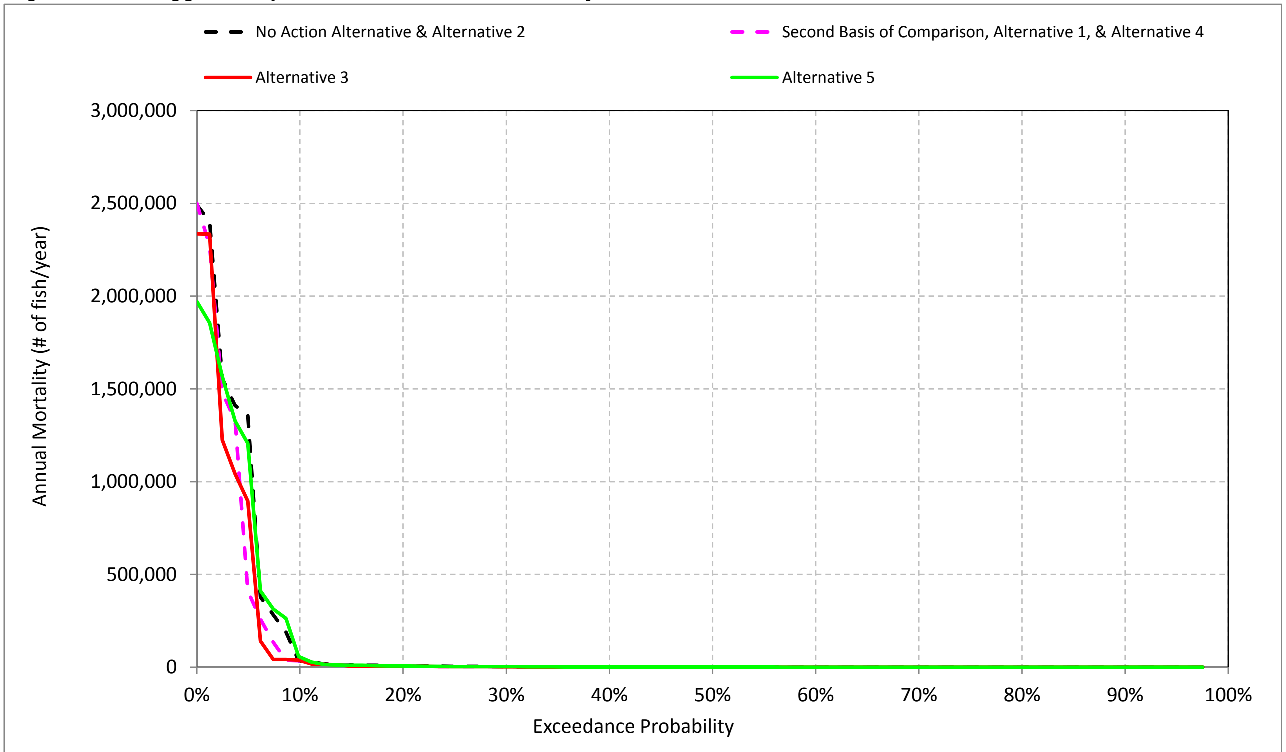
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-14. Pre-Spawn Mortality - Temperature based Annual Mortality for Winter-Run Chinook Salmon



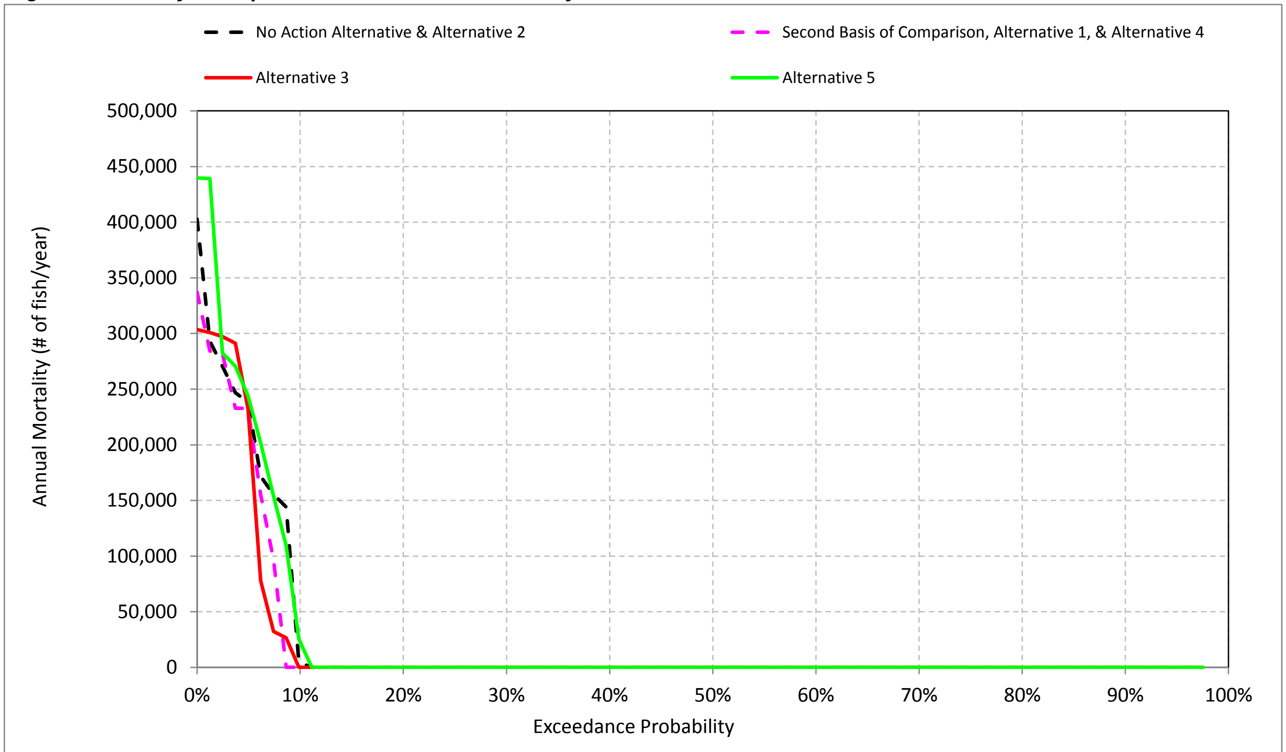
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-15. Eggs - Temperature based Annual Mortality for Winter-Run Chinook Salmon



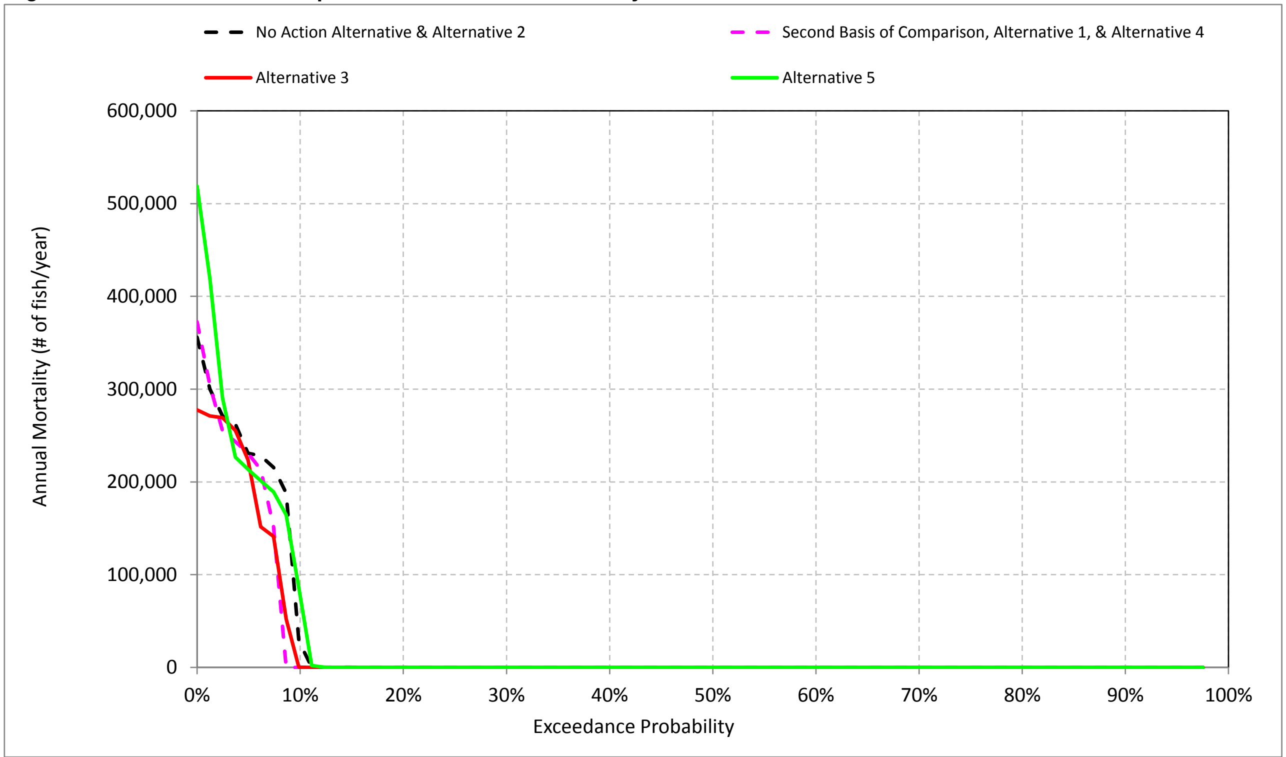
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-16. Fry - Temperature based Annual Mortality for Winter-Run Chinook Salmon



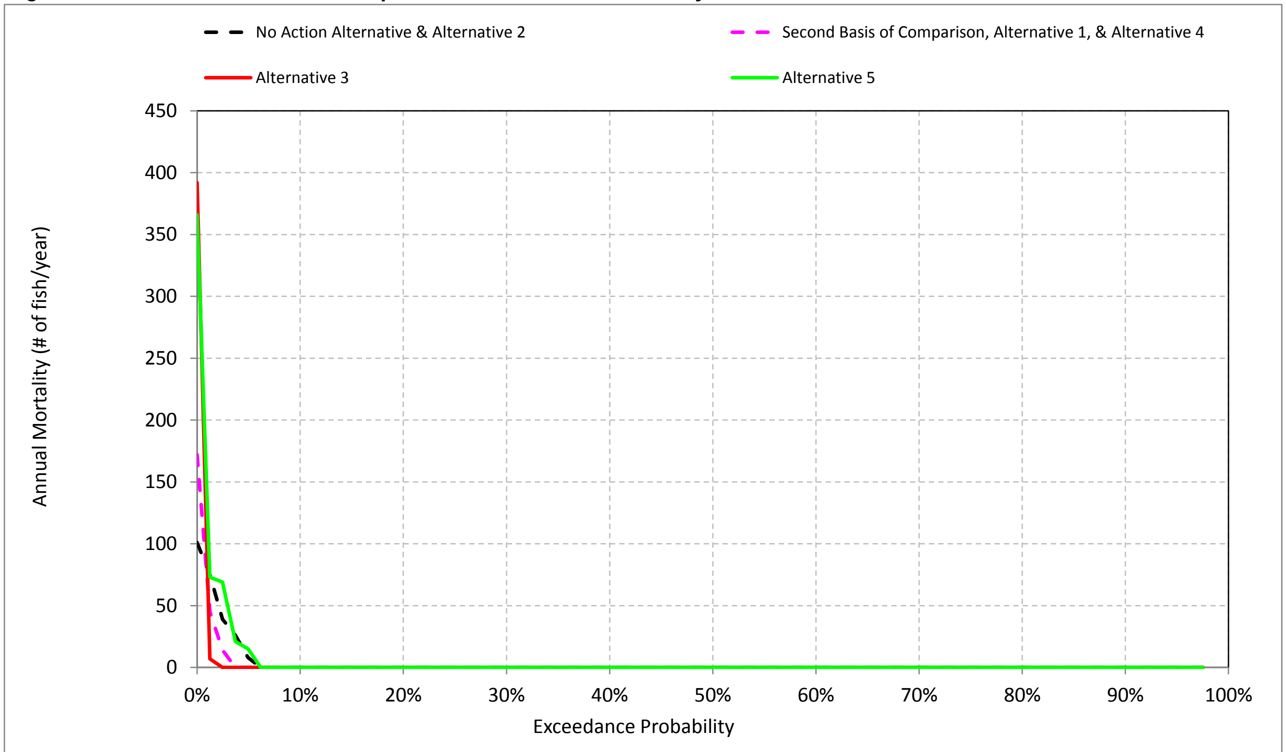
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-17. Pre-smolt - Temperature based Annual Mortality for Winter-Run Chinook Salmon



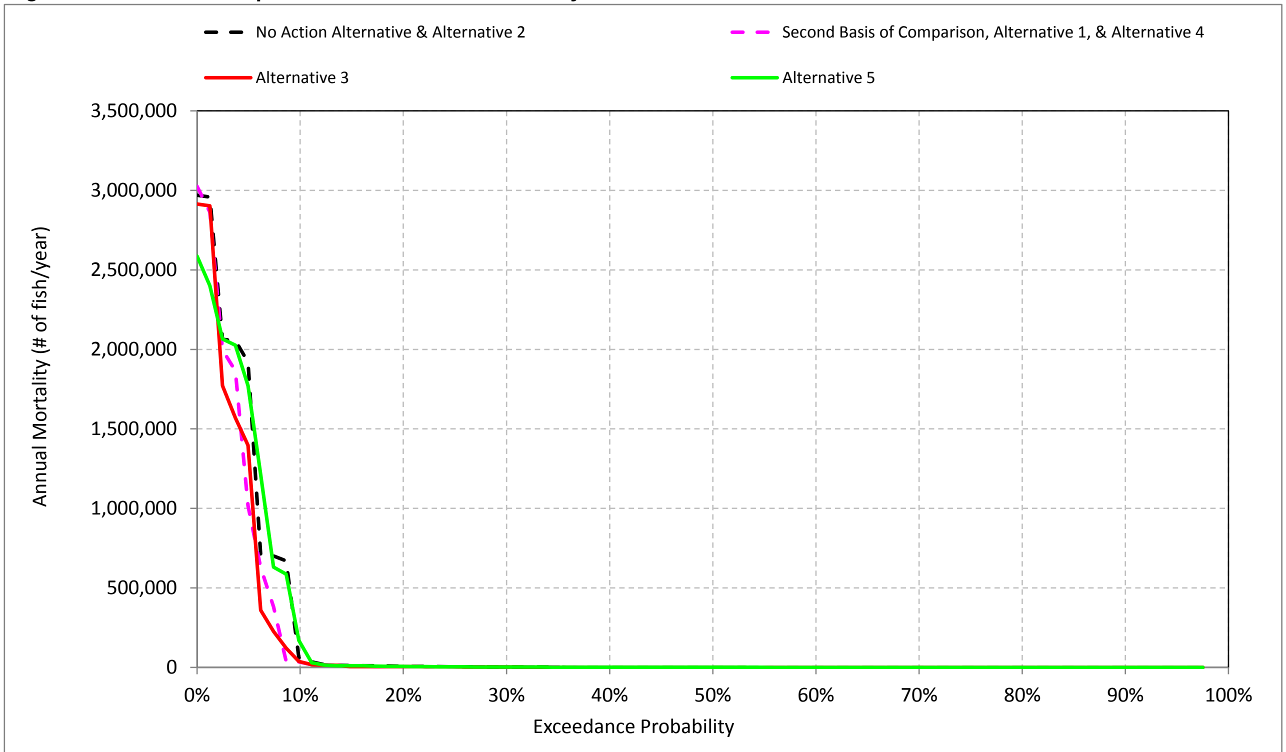
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-18. Immature Smolt - Temperature based Annual Mortality for Winter-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-19. Total Temperature based Annual Mortality for Winter-Run Chinook Salmon



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-1. Annual Potential Production for Winter-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	1,883,893
Alternative 1	1,885,400
Difference	1,507
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	1,952,705
Alternative 1	1,930,740
Difference	-21,965
Percent Difference	-1
Above Normal (12.5%)	
No Action Alternative	1,707,717
Alternative 1	1,746,928
Difference	39,211
Percent Difference	2
Below Normal (17.5%)	
No Action Alternative	1,863,415
Alternative 1	1,847,619
Difference	-15,795
Percent Difference	-1
Dry (22.5%)	
No Action Alternative	1,883,395
Alternative 1	1,894,107
Difference	10,712
Percent Difference	1
Critical (15%)	
No Action Alternative	1,906,250
Alternative 1	1,933,573
Difference	27,323
Percent Difference	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-4-2. Annual Mortality by Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year)				
	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	222,517	196,405	26,961	138	27,099
Alternative 1	259,052	162,983	23,312	137	23,449
Difference	36,535	-33,421	-3,649	-2	-3,650
Percent Difference[3]	16	-17	-14	-1	-13
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	90,910	197,835	1,943	54	1,997
Alternative 1	155,104	176,315	1,060	47	1,107
Difference	64,194	-21,520	-883	-7	-890
Percent Difference	71	-11	-45	-13	-45
Above Normal (12.5%)					
No Action Alternative	469,585	220,960	53,686	94	53,779
Alternative 1	438,691	167,899	63,706	103	63,808
Difference	-30,894	-53,061	10,020	9	10,029
Percent Difference	-7	-24	19	9	19
Below Normal (17.5%)					
No Action Alternative	275,022	176,292	19,822	61	19,884
Alternative 1	337,945	142,925	18,481	41	18,522
Difference	62,922	-33,367	-1,341	-21	-1,362
Percent Difference	23	-19	-7	-34	-7
Dry (22.5%)					
No Action Alternative	209,708	215,896	24,076	139	24,215
Alternative 1	240,069	172,393	22,611	143	22,755
Difference	30,361	-43,503	-1,465	4	-1,460
Percent Difference	14	-20	-6	3	-6
Critical (15%)					
No Action Alternative	259,734	167,072	71,553	447	72,000
Alternative 1	271,006	139,289	44,553	461	45,014
Difference	11,272	-27,783	-27,000	14	-26,985
Percent Difference	4	-17	-38	3	-37

1 Based on the 80-year simulation period
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.
3 Relative difference of the Annual average
4 Mortality values do not include base mortality
5 Eggs mortality includes pre-spawn mortality

Table B-4-3. Annual Mortality by Cause for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	178,654	267,367	446,021
Alternative 1	149,945	295,539	445,484
Difference	-28,708	28,172	-537
Percent Difference[3]	-16	11	0
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	3,522	287,219	290,741
Alternative 1	1,273	331,252	332,525
Difference	-2,249	44,034	41,785
Percent Difference	-64	15	14
Above Normal (12.5%)			
No Action Alternative	504,624	239,700	744,324
Alternative 1	388,548	281,850	670,398
Difference	-116,076	42,150	-73,926
Percent Difference	-23	18	-10
Below Normal (17.5%)			
No Action Alternative	212,903	258,295	471,198
Alternative 1	218,115	281,277	499,391
Difference	5,212	22,981	28,193
Percent Difference	2	9	6
Dry (22.5%)			
No Action Alternative	155,797	294,022	449,819
Alternative 1	134,348	300,869	435,217
Difference	-21,449	6,847	-14,602
Percent Difference	-14	2	-3
Critical (15%)			
No Action Alternative	280,793	218,012	498,805
Alternative 1	217,099	238,210	455,309
Difference	-63,694	20,198	-43,496
Percent Difference	-23	9	-9

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-4. Annual Mortality by Cause and Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	0	93,980	128,537	24,093	172,312	26,023	1,076	446,021
Alternative 1	0	151,512	107,540	20,257	142,726	22,149	1,300	445,484
Difference	0	57,532	-20,997	-3,836	-29,585	-3,875	225	-537
Percent Difference[3]	-36	61	-16	-16	-17	-15	21	0
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	0	88,673	2,236	182	197,652	1,103	893	290,741
Alternative 1	0	153,836	1,268	3	176,312	3	1,104	332,525
Difference	0	65,163	-969	-180	-21,340	-1,101	211	41,784
Percent Difference	0	73	-43	-98	-11	-100	24	14
Above Normal (12.5%)								
No Action Alternative	0	83,031	386,554	64,945	156,015	53,125	654	744,324
Alternative 1	0	169,913	268,778	56,974	110,925	62,797	1,012	670,398
Difference	0	86,882	-117,776	-7,972	-45,090	9,671	358	-73,926
Percent Difference	0	105	-30	-12	-29	18	55	-10
Below Normal (17.5%)								
No Action Alternative	0	101,792	173,231	20,940	155,352	18,732	1,152	471,198
Alternative 1	0	157,331	180,614	20,113	122,812	17,388	1,134	499,391
Difference	0	55,539	7,383	-827	-32,540	-1,344	-18	28,193
Percent Difference	0	55	4	-4	-21	-7	-2	6
Dry (22.5%)								
No Action Alternative	2	100,064	109,642	23,024	192,872	23,129	1,086	449,819
Alternative 1	1	148,149	91,919	21,162	151,231	21,266	1,488	435,217
Difference	0	48,085	-17,723	-1,862	-41,641	-1,863	402	-14,602
Percent Difference	-23	48	-16	-8	-22	-8	37	-3
Critical (15%)								
No Action Alternative	1	96,360	163,373	47,138	119,933	70,281	1,719	498,805
Alternative 1	0	129,397	141,609	32,354	106,935	43,136	1,878	455,309
Difference	-1	33,037	-21,764	-14,784	-12,999	-27,145	160	-43,496
Percent Difference	-100	34	-13	-31	-11	-39	9	-9

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-5. Annual Mortality by All Factors for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	0	93,980	0	128,537	24,093	172,312	26,020	941	3	135	446,021
Alternative 1	0	151,512	0	107,540	20,257	142,726	22,146	1,167	3	134	445,484
Difference	0	57,532	0	-20,997	-3,836	-29,585	-3,875	226	0	-1	-537
Percent Difference[3]	-36	61	0	-16	-16	-17	-15	24	-7	-1	0
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	0	88,673	0	2,236	182	197,652	1,101	842	3	51	290,741
Alternative 1	0	153,836	0	1,268	3	176,312	3	1,057	0	47	332,525
Difference	0	65,163	0	-969	-180	-21,340	-1,098	215	-3	-4	41,784
Percent Difference	0	73	0	-43	-98	-11	-100	26	-100	-8	14
Above Normal (12.5%)											
No Action Alternative	0	83,031	0	386,554	64,945	156,015	53,122	564	3	90	744,324
Alternative 1	0	169,913	0	268,778	56,974	110,925	62,779	926	17	85	670,398
Difference	0	86,882	0	-117,776	-7,972	-45,090	9,658	363	14	-5	-73,926
Percent Difference	0	105	0	-30	-12	-29	18	64	406	-6	-10
Below Normal (17.5%)											
No Action Alternative	0	101,792	0	173,231	20,940	155,352	18,732	1,091	0	61	471,198
Alternative 1	0	157,331	0	180,614	20,113	122,812	17,388	1,093	0	41	499,391
Difference	0	55,539	0	7,383	-827	-32,540	-1,344	3	0	-21	28,193
Percent Difference	0	55	0	4	-4	-21	-7	0	0	-34	6
Dry (22.5%)											
No Action Alternative	2	100,064	0	109,642	23,024	192,872	23,129	947	0	139	449,819
Alternative 1	1	148,149	0	91,919	21,162	151,231	21,264	1,348	3	141	435,217
Difference	0	48,085	0	-17,723	-1,862	-41,641	-1,865	401	3	2	-14,602
Percent Difference	-23	48	0	-16	-8	-22	-8	42	0	1	-3
Critical (15%)											
No Action Alternative	1	96,360	0	163,373	47,138	119,933	70,269	1,283	12	435	498,805
Alternative 1	0	129,397	0	141,609	32,354	106,935	43,135	1,418	1	460	455,309
Difference	-1	33,037	0	-21,764	-14,784	-12,999	-27,135	135	-11	25	-43,496
Percent Difference	-100	34	0	-13	-31	-11	-39	11	-90	6	-9

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-6. Annual Potential Production for Winter-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	1,883,893
Alternative 3	1,897,120
Difference	13,227
Percent Difference[3]	1
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	1,952,705
Alternative 3	1,944,614
Difference	-8,091
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	1,707,717
Alternative 3	1,752,903
Difference	45,186
Percent Difference	3
Below Normal (17.5%)	
No Action Alternative	1,863,415
Alternative 3	1,840,343
Difference	-23,072
Percent Difference	-1
Dry (22.5%)	
No Action Alternative	1,883,395
Alternative 3	1,919,466
Difference	36,071
Percent Difference	2
Critical (15%)	
No Action Alternative	1,906,250
Alternative 3	1,947,116
Difference	40,866
Percent Difference	2

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-4-7. Annual Mortality by Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	222,517	196,405	26,961	138	27,099
Alternative 3	237,813	165,266	21,803	140	21,943
Difference	15,296	-31,139	-5,158	2	-5,156
Percent Difference[3]	7	-16	-19	1	-19
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	90,910	197,835	1,943	54	1,997
Alternative 3	131,631	174,265	1,188	34	1,222
Difference	40,721	-23,569	-755	-20	-774
Percent Difference	45	-12	-39	-37	-39
Above Normal (12.5%)					
No Action Alternative	469,585	220,960	53,686	94	53,779
Alternative 3	443,487	166,295	54,841	70	54,912
Difference	-26,098	-54,664	1,156	-23	1,133
Percent Difference	-6	-25	2	-25	2
Below Normal (17.5%)					
No Action Alternative	275,022	176,292	19,822	61	19,884
Alternative 3	324,721	159,309	20,994	55	21,049
Difference	49,699	-16,983	1,172	-6	1,166
Percent Difference	18	-10	6	-10	6
Dry (22.5%)					
No Action Alternative	209,708	215,896	24,076	139	24,215
Alternative 3	207,993	170,244	16,866	166	17,032
Difference	-1,715	-45,653	-7,210	27	-7,183
Percent Difference	-1	-21	-30	19	-30
Critical (15%)					
No Action Alternative	259,734	167,072	71,553	447	72,000
Alternative 3	239,816	144,393	47,286	490	47,776
Difference	-19,918	-22,679	-24,267	43	-24,224
Percent Difference	-8	-14	-34	10	-34

1 Based on the 80-year simulation period
2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.
3 Relative difference of the Annual average
4 Mortality values do not include base mortality
5 Eggs mortality includes pre-spawn mortality

Table B-4-8. Annual Mortality by Cause for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	178,654	267,367	446,021
Alternative 3	142,827	282,195	425,022
Difference	-35,827	14,828	-20,999
Percent Difference[3]	-20	6	-5
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	3,522	287,219	290,741
Alternative 3	1,126	305,992	307,118
Difference	-2,396	18,773	16,377
Percent Difference	-68	7	6
Above Normal (12.5%)			
No Action Alternative	504,624	239,700	744,324
Alternative 3	430,489	234,205	664,694
Difference	-74,135	-5,495	-79,630
Percent Difference	-15	-2	-11
Below Normal (17.5%)			
No Action Alternative	212,903	258,295	471,198
Alternative 3	210,138	294,942	505,080
Difference	-2,765	36,647	33,882
Percent Difference	-1	14	7
Dry (22.5%)			
No Action Alternative	155,797	294,022	449,819
Alternative 3	95,635	299,633	395,268
Difference	-60,162	5,611	-54,551
Percent Difference	-39	2	-12
Critical (15%)			
No Action Alternative	280,793	218,012	498,805
Alternative 3	202,386	229,599	431,984
Difference	-78,407	11,587	-66,821
Percent Difference	-28	5	-13

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-9. Annual Mortality by Cause and Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	0	93,980	128,537	24,093	172,312	26,023	1,076	446,021
Alternative 3	0	135,049	102,763	19,523	145,743	20,541	1,402	425,022
Difference	0	41,070	-25,774	-4,571	-26,568	-5,482	326	-20,999
Percent Difference[3]	-100	44	-20	-19	-15	-21	30	-5
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	0	88,673	2,236	182	197,652	1,103	893	290,741
Alternative 3	0	130,505	1,126	1	174,265	0	1,222	307,118
Difference	0	41,832	-1,111	-181	-23,388	-1,103	329	16,377
Percent Difference	0	47	-50	-100	-12	-100	37	6
Above Normal (12.5%)								
No Action Alternative	0	83,031	386,554	64,945	156,015	53,125	654	744,324
Alternative 3	0	119,969	323,517	52,929	113,366	54,043	869	664,694
Difference	0	36,938	-63,037	-12,016	-42,648	917	215	-79,630
Percent Difference	0	44	-16	-19	-27	2	33	-11
Below Normal (17.5%)								
No Action Alternative	0	101,792	173,231	20,940	155,352	18,732	1,152	471,198
Alternative 3	0	155,899	168,822	21,483	137,826	19,833	1,217	505,080
Difference	0	54,108	-4,409	542	-17,525	1,101	65	33,882
Percent Difference	0	53	-3	3	-11	6	6	7
Dry (22.5%)								
No Action Alternative	2	100,064	109,642	23,024	192,872	23,129	1,086	449,819
Alternative 3	0	146,046	61,947	18,345	151,898	15,343	1,689	395,268
Difference	-2	45,982	-47,695	-4,679	-40,974	-7,786	603	-54,551
Percent Difference	-100	46	-44	-20	-21	-34	55	-12
Critical (15%)								
No Action Alternative	1	96,360	163,373	47,138	119,933	70,281	1,719	498,805
Alternative 3	0	116,643	123,172	33,460	110,932	45,753	2,023	431,984
Difference	-1	20,283	-40,201	-13,678	-9,001	-24,528	305	-66,821
Percent Difference	-100	21	-25	-29	-8	-35	18	-13

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-10. Annual Mortality by All Factors for Winter-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)										
Analysis Period	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	0	93,980	0	128,537	24,093	172,312	26,020	941	3	135	446,021
Alternative 3	0	135,049	0	102,763	19,523	145,743	20,536	1,267	5	135	425,022
Difference	0	41,070	0	-25,774	-4,571	-26,568	-5,484	326	2	0	-20,999
Percent Difference[3]	-100	44	0	-20	-19	-15	-21	35	60	0	-5
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	0	88,673	0	2,236	182	197,652	1,101	842	3	51	290,741
Alternative 3	0	130,505	0	1,126	1	174,265	0	1,188	0	34	307,118
Difference	0	41,832	0	-1,111	-181	-23,388	-1,101	346	-3	-17	16,377
Percent Difference	0	47	0	-50	-100	-12	-100	41	-100	-33	6
Above Normal (12.5%)											
No Action Alternative	0	83,031	0	386,554	64,945	156,015	53,122	564	3	90	744,324
Alternative 3	0	119,969	0	323,517	52,929	113,366	54,043	799	0	70	664,694
Difference	0	36,938	0	-63,037	-12,016	-42,648	921	235	-3	-20	-79,630
Percent Difference	0	44	0	-16	-19	-27	2	42	-100	-22	-11
Below Normal (17.5%)											
No Action Alternative	0	101,792	0	173,231	20,940	155,352	18,732	1,091	0	61	471,198
Alternative 3	0	155,899	0	168,822	21,483	137,826	19,832	1,162	1	54	505,080
Difference	0	54,108	0	-4,409	542	-17,525	1,100	72	1	-7	33,882
Percent Difference	0	53	0	-3	3	-11	6	7	0	-11	7
Dry (22.5%)											
No Action Alternative	2	100,064	0	109,642	23,024	192,872	23,129	947	0	139	449,819
Alternative 3	0	146,046	0	61,947	18,345	151,898	15,343	1,523	0	166	395,268
Difference	-2	45,982	0	-47,695	-4,679	-40,974	-7,786	576	0	27	-54,551
Percent Difference	-100	46	0	-44	-20	-21	-34	61	0	19	-12
Critical (15%)											
No Action Alternative	1	96,360	0	163,373	47,138	119,933	70,269	1,283	12	435	498,805
Alternative 3	0	116,643	0	123,172	33,460	110,932	45,720	1,566	33	457	431,984
Difference	-1	20,283	0	-40,201	-13,678	-9,001	-24,549	283	21	22	-66,821
Percent Difference	-100	21	0	-25	-29	-8	-35	22	180	5	-13

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-11. Annual Potential Production for Winter-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
No Action Alternative	1,883,893
Alternative 5	1,883,178
Difference	-715
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
No Action Alternative	1,952,705
Alternative 5	1,943,241
Difference	-9,464
Percent Difference	0
Above Normal (12.5%)	
No Action Alternative	1,707,717
Alternative 5	1,698,809
Difference	-8,908
Percent Difference	-1
Below Normal (17.5%)	
No Action Alternative	1,863,415
Alternative 5	1,898,667
Difference	35,252
Percent Difference	2
Dry (22.5%)	
No Action Alternative	1,883,395
Alternative 5	1,876,977
Difference	-6,419
Percent Difference	0
Critical (15%)	
No Action Alternative	1,906,250
Alternative 5	1,897,912
Difference	-8,338
Percent Difference	0

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-4-12. Annual Mortality by Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
No Action Alternative	222,517	196,405	26,961	138	27,099
Alternative 5	203,248	207,870	29,865	124	29,989
Difference	-19,269	11,465	2,904	-14	2,890
Percent Difference[3]	-9	6	11	-10	11
Water Year Types[2]					
Wet (32.5%)					
No Action Alternative	90,910	197,835	1,943	54	1,997
Alternative 5	87,970	210,570	4,085	28	4,113
Difference	-2,939	12,735	2,142	-26	2,117
Percent Difference	-3	6	110	-48	106
Above Normal (12.5%)					
No Action Alternative	469,585	220,960	53,686	94	53,779
Alternative 5	464,585	236,533	52,336	89	52,425
Difference	-5,000	15,573	-1,349	-5	-1,354
Percent Difference	-1	7	-3	-5	-3
Below Normal (17.5%)					
No Action Alternative	275,022	176,292	19,822	61	19,884
Alternative 5	191,541	178,323	31,052	108	31,160
Difference	-83,481	2,031	11,229	47	11,276
Percent Difference	-30	1	57	76	57
Dry (22.5%)					
No Action Alternative	209,708	215,896	24,076	139	24,215
Alternative 5	200,255	234,855	20,690	134	20,824
Difference	-9,453	18,959	-3,386	-5	-3,391
Percent Difference	-5	9	-14	-3	-14
Critical (15%)					
No Action Alternative	259,734	167,072	71,553	447	72,000
Alternative 5	253,379	172,126	79,375	365	79,740
Difference	-6,354	5,055	7,822	-82	7,740
Percent Difference	-2	3	11	-18	11

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-4-13. Annual Mortality by Cause for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
No Action Alternative	178,654	267,367	446,021
Alternative 5	170,139	270,968	441,107
Difference	-8,515	3,601	-4,914
Percent Difference[3]	-5	1	-1
Water Year Types[2]			
Wet (32.5%)			
No Action Alternative	3,522	287,219	290,741
Alternative 5	7,569	295,085	302,654
Difference	4,047	7,866	11,913
Percent Difference	115	3	4
Above Normal (12.5%)			
No Action Alternative	504,624	239,700	744,324
Alternative 5	499,928	253,615	753,543
Difference	-4,696	13,915	9,219
Percent Difference	-1	6	1
Below Normal (17.5%)			
No Action Alternative	212,903	258,295	471,198
Alternative 5	149,215	251,809	401,024
Difference	-63,688	-6,486	-70,174
Percent Difference	-30	-3	-15
Dry (22.5%)			
No Action Alternative	155,797	294,022	449,819
Alternative 5	146,764	309,170	455,934
Difference	-9,033	15,148	6,115
Percent Difference	-6	5	1
Critical (15%)			
No Action Alternative	280,793	218,012	498,805
Alternative 5	307,023	198,222	505,246
Difference	26,230	-19,790	6,441
Percent Difference	9	-9	1

1 Based on the 80-year simulation period

not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-14. Annual Mortality by Cause and Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
No Action Alternative	0	93,980	128,537	24,093	172,312	26,023	1,076	446,021
Alternative 5	0	89,100	114,147	27,082	180,788	28,909	1,080	441,107
Difference	0	-4,880	-14,389	2,989	8,476	2,886	5	-4,914
Percent Difference[3]	0	-5	-11	12	5	11	0	-1
Water Year Types[2]								
Wet (32.5%)								
No Action Alternative	0	88,673	2,236	182	197,652	1,103	893	290,741
Alternative 5	0	84,683	3,288	977	209,593	3,304	809	302,654
Difference	0	-3,991	1,051	795	11,941	2,201	-84	11,913
Percent Difference	0	-5	47	436	6	199	-9	4
Above Normal (12.5%)								
No Action Alternative	0	83,031	386,554	64,945	156,015	53,125	654	744,324
Alternative 5	0	80,569	384,016	64,143	172,390	51,769	656	753,543
Difference	0	-2,463	-2,538	-802	16,375	-1,356	2	9,219
Percent Difference	0	-3	-1	-1	10	-3	0	1
Below Normal (17.5%)								
No Action Alternative	0	101,792	173,231	20,940	155,352	18,732	1,152	471,198
Alternative 5	0	103,637	87,904	31,368	146,956	29,943	1,216	401,024
Difference	0	1,845	-85,326	10,427	-8,396	11,212	64	-70,174
Percent Difference	0	2	-49	50	-5	60	6	-15
Dry (22.5%)								
No Action Alternative	2	100,064	109,642	23,024	192,872	23,129	1,086	449,819
Alternative 5	2	94,247	106,007	21,110	213,744	19,645	1,179	455,934
Difference	0	-5,817	-3,635	-1,914	20,873	-3,484	93	6,115
Percent Difference	0	-6	-3	-8	11	-15	9	1
Critical (15%)								
No Action Alternative	1	96,360	163,373	47,138	119,933	70,281	1,719	498,805
Alternative 5	1	81,098	172,281	56,716	115,410	78,025	1,715	505,246
Difference	0	-15,262	8,908	9,578	-4,524	7,744	-4	6,441
Percent Difference	0	-16	5	20	-4	11	0	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-15. Annual Mortality by All Factors for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
No Action Alternative	0	93,980	0	128,537	24,093	172,312	26,020	941	3	135	446,021
Alternative 5	0	89,100	0	114,147	27,082	180,788	28,902	963	7	117	441,107
Difference	0	-4,880	0	-14,389	2,989	8,476	2,882	22	4	-18	-4,914
Percent Difference[3]	0	-5	0	-11	12	5	11	2	118	-13	-1
Water Year Types[2]											
Wet (32.5%)											
No Action Alternative	0	88,673	0	2,236	182	197,652	1,101	842	3	51	290,741
Alternative 5	0	84,683	0	3,288	977	209,593	3,302	784	3	26	302,654
Difference	0	-3,991	0	1,051	795	11,941	2,201	-59	0	-25	11,913
Percent Difference	0	-5	0	47	436	6	200	-7	-8	-50	4
Above Normal (12.5%)											
No Action Alternative	0	83,031	0	386,554	64,945	156,015	53,122	564	3	90	744,324
Alternative 5	0	80,569	0	384,016	64,143	172,390	51,732	604	37	52	753,543
Difference	0	-2,463	0	-2,538	-802	16,375	-1,389	40	33	-38	9,219
Percent Difference	0	-3	0	-1	-1	10	-3	7	976	-42	1
Below Normal (17.5%)											
No Action Alternative	0	101,792	0	173,231	20,940	155,352	18,732	1,091	0	61	471,198
Alternative 5	0	103,637	0	87,904	31,368	146,956	29,943	1,108	0	108	401,024
Difference	0	1,845	0	-85,326	10,427	-8,396	11,212	18	0	47	-70,174
Percent Difference	0	2	0	-49	50	-5	60	2	0	76	-15
Dry (22.5%)											
No Action Alternative	2	100,064	0	109,642	23,024	192,872	23,129	947	0	139	449,819
Alternative 5	2	94,247	0	106,007	21,110	213,744	19,645	1,045	0	134	455,934
Difference	0	-5,817	0	-3,635	-1,914	20,873	-3,484	98	0	-5	6,115
Percent Difference	0	-6	0	-3	-8	11	-15	10	0	-3	1
Critical (15%)											
No Action Alternative	1	96,360	0	163,373	47,138	119,933	70,269	1,283	12	435	498,805
Alternative 5	1	81,098	0	172,281	56,716	115,410	78,016	1,359	9	356	505,246
Difference	0	-15,262	0	8,908	9,578	-4,524	7,747	75	-3	-79	6,441
Percent Difference	0	-16	0	5	20	-4	11	6	-22	-18	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-16. Annual Potential Production for Winter-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	1,885,400
No Action Alternative	1,883,893
Difference	-1,507
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	1,930,740
No Action Alternative	1,952,705
Difference	21,965
Percent Difference	1
Above Normal (12.5%)	
Second Basis of Comparison	1,746,928
No Action Alternative	1,707,717
Difference	-39,211
Percent Difference	-2
Below Normal (17.5%)	
Second Basis of Comparison	1,847,619
No Action Alternative	1,863,415
Difference	15,795
Percent Difference	1
Dry (22.5%)	
Second Basis of Comparison	1,894,107
No Action Alternative	1,883,395
Difference	-10,712
Percent Difference	-1
Critical (15%)	
Second Basis of Comparison	1,933,573
No Action Alternative	1,906,250
Difference	-27,323
Percent Difference	-1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-4-17. Annual Mortality by Life Stage for Winter-Run Chinook Salmon

Analysis Period	Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
	Annual Mortality[4] (# of Fish/year)				
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	259,052	162,983	23,312	137	23,449
No Action Alternative	222,517	196,405	26,961	138	27,099
Difference	-36,535	33,421	3,649	2	3,650
Percent Difference[3]	-14	21	16	1	16
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	155,104	176,315	1,060	47	1,107
No Action Alternative	90,910	197,835	1,943	54	1,997
Difference	-64,194	21,520	883	7	890
Percent Difference	-41	12	83	15	80
Above Normal (12.5%)					
Second Basis of Comparison	438,691	167,899	63,706	103	63,808
No Action Alternative	469,585	220,960	53,686	94	53,779
Difference	30,894	53,061	-10,020	-9	-10,029
Percent Difference	7	32	-16	-8	-16
Below Normal (17.5%)					
Second Basis of Comparison	337,945	142,925	18,481	41	18,522
No Action Alternative	275,022	176,292	19,822	61	19,884
Difference	-62,922	33,367	1,341	21	1,362
Percent Difference	-19	23	7	50	7
Dry (22.5%)					
Second Basis of Comparison	240,069	172,393	22,611	143	22,755
No Action Alternative	209,708	215,896	24,076	139	24,215
Difference	-30,361	43,503	1,465	-4	1,460
Percent Difference	-13	25	6	-3	6
Critical (15%)					
Second Basis of Comparison	271,006	139,289	44,553	461	45,014
No Action Alternative	259,734	167,072	71,553	447	72,000
Difference	-11,272	27,783	27,000	-14	26,985
Percent Difference	-4	20	61	-3	60

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-4-18. Annual Mortality by Cause for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	149,945	295,539	445,484
No Action Alternative	178,654	267,367	446,021
Difference	28,708	-28,172	537
Percent Difference[3]	19	-10	0
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	1,273	331,252	332,525
No Action Alternative	3,522	287,219	290,741
Difference	2,249	-44,034	-41,785
Percent Difference	177	-13	-13
Above Normal (12.5%)			
Second Basis of Comparison	388,548	281,850	670,398
No Action Alternative	504,624	239,700	744,324
Difference	116,076	-42,150	73,926
Percent Difference	30	-15	11
Below Normal (17.5%)			
Second Basis of Comparison	218,115	281,277	499,391
No Action Alternative	212,903	258,295	471,198
Difference	-5,212	-22,981	-28,193
Percent Difference	-2	-8	-6
Dry (22.5%)			
Second Basis of Comparison	134,348	300,869	435,217
No Action Alternative	155,797	294,022	449,819
Difference	21,449	-6,847	14,602
Percent Difference	16	-2	3
Critical (15%)			
Second Basis of Comparison	217,099	238,210	455,309
No Action Alternative	280,793	218,012	498,805
Difference	63,694	-20,198	43,496
Percent Difference	29	-8	10

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-19. Annual Mortality by Cause and Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	0	151,512	107,540	20,257	142,726	22,149	1,300	445,484
No Action Alternative	0	93,980	128,537	24,093	172,312	26,023	1,076	446,021
Difference	0	-57,532	20,997	3,836	29,585	3,875	-225	537
Percent Difference[3]	57	-38	20	19	21	17	-17	0
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	0	153,836	1,268	3	176,312	3	1,104	332,525
No Action Alternative	0	88,673	2,236	182	197,652	1,103	893	290,741
Difference	0	-65,163	969	180	21,340	1,101	-211	-41,784
Percent Difference	0	-42	76	6,482	12	44,038	-19	-13
Above Normal (12.5%)								
Second Basis of Comparison	0	169,913	268,778	56,974	110,925	62,797	1,012	670,398
No Action Alternative	0	83,031	386,554	64,945	156,015	53,125	654	744,324
Difference	0	-86,882	117,776	7,972	45,090	-9,671	-358	73,926
Percent Difference	0	-51	44	14	41	-15	-35	11
Below Normal (17.5%)								
Second Basis of Comparison	0	157,331	180,614	20,113	122,812	17,388	1,134	499,391
No Action Alternative	0	101,792	173,231	20,940	155,352	18,732	1,152	471,198
Difference	0	-55,539	-7,383	827	32,540	1,344	18	-28,193
Percent Difference	0	-35	-4	4	26	8	2	-6
Dry (22.5%)								
Second Basis of Comparison	1	148,149	91,919	21,162	151,231	21,266	1,488	435,217
No Action Alternative	2	100,064	109,642	23,024	192,872	23,129	1,086	449,819
Difference	0	-48,085	17,723	1,862	41,641	1,863	-402	14,602
Percent Difference	30	-32	19	9	28	9	-27	3
Critical (15%)								
Second Basis of Comparison	0	129,397	141,609	32,354	106,935	43,136	1,878	455,309
No Action Alternative	1	96,360	163,373	47,138	119,933	70,281	1,719	498,805
Difference	1	-33,037	21,764	14,784	12,999	27,145	-160	43,496
Percent Difference	0	-26	15	46	12	63	-9	10

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-20. Annual Mortality by All Factors for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	0	151,512	0	107,540	20,257	142,726	22,146	1,167	3	134	445,484
No Action Alternative	0	93,980	0	128,537	24,093	172,312	26,020	941	3	135	446,021
Difference	0	-57,532	0	20,997	3,836	29,585	3,875	-226	0	1	537
Percent Difference[3]	57	-38	0	20	19	21	17	-19	8	1	0
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	0	153,836	0	1,268	3	176,312	3	1,057	0	47	332,525
No Action Alternative	0	88,673	0	2,236	182	197,652	1,101	842	3	51	290,741
Difference	0	-65,163	0	969	180	21,340	1,098	-215	3	4	-41,784
Percent Difference	0	-42	0	76	6,482	12	43,923	-20	0	9	-13
Above Normal (12.5%)											
Second Basis of Comparison	0	169,913	0	268,778	56,974	110,925	62,779	926	17	85	670,398
No Action Alternative	0	83,031	0	386,554	64,945	156,015	53,122	564	3	90	744,324
Difference	0	-86,882	0	117,776	7,972	45,090	-9,658	-363	-14	5	73,926
Percent Difference	0	-51	0	44	14	41	-15	-39	-80	6	11
Below Normal (17.5%)											
Second Basis of Comparison	0	157,331	0	180,614	20,113	122,812	17,388	1,093	0	41	499,391
No Action Alternative	0	101,792	0	173,231	20,940	155,352	18,732	1,091	0	61	471,198
Difference	0	-55,539	0	-7,383	827	32,540	1,344	-3	0	21	-28,193
Percent Difference	0	-35	0	-4	4	26	8	0	0	50	-6
Dry (22.5%)											
Second Basis of Comparison	1	148,149	0	91,919	21,162	151,231	21,264	1,348	3	141	435,217
No Action Alternative	2	100,064	0	109,642	23,024	192,872	23,129	947	0	139	449,819
Difference	0	-48,085	0	17,723	1,862	41,641	1,865	-401	-3	-2	14,602
Percent Difference	30	-32	0	19	9	28	9	-30	-100	-1	3
Critical (15%)											
Second Basis of Comparison	0	129,397	0	141,609	32,354	106,935	43,135	1,418	1	460	455,309
No Action Alternative	1	96,360	0	163,373	47,138	119,933	70,269	1,283	12	435	498,805
Difference	1	-33,037	0	21,764	14,784	12,999	27,135	-135	11	-25	43,496
Percent Difference	0	-26	0	15	46	12	63	-10	900	-5	10

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-21. Annual Potential Production for Winter-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	1,885,400
Alternative 3	1,897,120
Difference	11,720
Percent Difference[3]	1
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	1,930,740
Alternative 3	1,944,614
Difference	13,874
Percent Difference	1
Above Normal (12.5%)	
Second Basis of Comparison	1,746,928
Alternative 3	1,752,903
Difference	5,975
Percent Difference	0
Below Normal (17.5%)	
Second Basis of Comparison	1,847,619
Alternative 3	1,840,343
Difference	-7,277
Percent Difference	0
Dry (22.5%)	
Second Basis of Comparison	1,894,107
Alternative 3	1,919,466
Difference	25,359
Percent Difference	1
Critical (15%)	
Second Basis of Comparison	1,933,573
Alternative 3	1,947,116
Difference	13,543
Percent Difference	1

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-4-22. Annual Mortality by Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	259,052	162,983	23,312	137	23,449
Alternative 3	237,813	165,266	21,803	140	21,943
Difference	-21,239	2,283	-1,509	4	-1,506
Percent Difference[3]	-8	1	-6	3	-6
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	155,104	176,315	1,060	47	1,107
Alternative 3	131,631	174,265	1,188	34	1,222
Difference	-23,473	-2,050	128	-13	116
Percent Difference	-15	-1	12	-28	10
Above Normal (12.5%)					
Second Basis of Comparison	438,691	167,899	63,706	103	63,808
Alternative 3	443,487	166,295	54,841	70	54,912
Difference	4,795	-1,603	-8,864	-32	-8,897
Percent Difference	1	-1	-14	-31	-14
Below Normal (17.5%)					
Second Basis of Comparison	337,945	142,925	18,481	41	18,522
Alternative 3	324,721	159,309	20,994	55	21,049
Difference	-13,223	16,384	2,513	14	2,527
Percent Difference	-4	11	14	35	14
Dry (22.5%)					
Second Basis of Comparison	240,069	172,393	22,611	143	22,755
Alternative 3	207,993	170,244	16,866	166	17,032
Difference	-32,076	-2,150	-5,745	22	-5,723
Percent Difference	-13	-1	-25	16	-25
Critical (15%)					
Second Basis of Comparison	271,006	139,289	44,553	461	45,014
Alternative 3	239,816	144,393	47,286	490	47,776
Difference	-31,190	5,104	2,733	29	2,762
Percent Difference	-12	4	6	6	6

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-4-23. Annual Mortality by Cause for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Temperature	Flow	Total
Long-term			
Full Simulation Period[1]			
Second Basis of Comparison	149,945	295,539	445,484
Alternative 3	142,827	282,195	425,022
Difference	-7,118	-13,344	-20,462
Percent Difference[3]	-5	-5	-5
Water Year Types[2]			
Wet (32.5%)			
Second Basis of Comparison	1,273	331,252	332,525
Alternative 3	1,126	305,992	307,118
Difference	-147	-25,261	-25,407
Percent Difference	-12	-8	-8
Above Normal (12.5%)			
Second Basis of Comparison	388,548	281,850	670,398
Alternative 3	430,489	234,205	664,694
Difference	41,941	-47,645	-5,704
Percent Difference	11	-17	-1
Below Normal (17.5%)			
Second Basis of Comparison	218,115	281,277	499,391
Alternative 3	210,138	294,942	505,080
Difference	-7,977	13,666	5,688
Percent Difference	-4	5	1
Dry (22.5%)			
Second Basis of Comparison	134,348	300,869	435,217
Alternative 3	95,635	299,633	395,268
Difference	-38,713	-1,236	-39,949
Percent Difference	-29	0	-9
Critical (15%)			
Second Basis of Comparison	217,099	238,210	455,309
Alternative 3	202,386	229,599	431,984
Difference	-14,713	-8,612	-23,325
Percent Difference	-7	-4	-5

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-24. Annual Mortality by Cause and Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	0	151,512	107,540	20,257	142,726	22,149	1,300	445,484
Alternative 3	0	135,049	102,763	19,523	145,743	20,541	1,402	425,022
Difference	0	-16,462	-4,776	-734	3,017	-1,607	102	-20,462
Percent Difference[3]	-100	-11	-4	-4	2	-7	8	-5
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	0	153,836	1,268	3	176,312	3	1,104	332,525
Alternative 3	0	130,505	1,126	1	174,265	0	1,222	307,118
Difference	0	-23,331	-142	-2	-2,048	-3	118	-25,407
Percent Difference	0	-15	-11	-69	-1	-100	11	-8
Above Normal (12.5%)								
Second Basis of Comparison	0	169,913	268,778	56,974	110,925	62,797	1,012	670,398
Alternative 3	0	119,969	323,517	52,929	113,366	54,043	869	664,694
Difference	0	-49,944	54,739	-4,045	2,441	-8,754	-143	-5,704
Percent Difference	0	-29	20	-7	2	-14	-14	-1
Below Normal (17.5%)								
Second Basis of Comparison	0	157,331	180,614	20,113	122,812	17,388	1,134	499,391
Alternative 3	0	155,899	168,822	21,483	137,826	19,833	1,217	505,080
Difference	0	-1,432	-11,792	1,370	15,015	2,445	83	5,688
Percent Difference	0	-1	-7	7	12	14	7	1
Dry (22.5%)								
Second Basis of Comparison	1	148,149	91,919	21,162	151,231	21,266	1,488	435,217
Alternative 3	0	146,046	61,947	18,345	151,898	15,343	1,689	395,268
Difference	-1	-2,103	-29,972	-2,817	667	-5,923	200	-39,949
Percent Difference	-100	-1	-33	-13	0	-28	13	-9
Critical (15%)								
Second Basis of Comparison	0	129,397	141,609	32,354	106,935	43,136	1,878	455,309
Alternative 3	0	116,643	123,172	33,460	110,932	45,753	2,023	431,984
Difference	0	-12,754	-18,436	1,107	3,997	2,617	145	-23,325
Percent Difference	0	-10	-13	3	4	6	8	-5

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-25. Annual Mortality by All Factors for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year)										
	Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	0	151,512	0	107,540	20,257	142,726	22,146	1,167	3	134	445,484
Alternative 3	0	135,049	0	102,763	19,523	145,743	20,536	1,267	5	135	425,022
Difference	0	-16,462	0	-4,776	-734	3,017	-1,609	100	2	2	-20,462
Percent Difference[3]	-100	-11	0	-4	-4	2	-7	9	73	1	-5
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	0	153,836	0	1,268	3	176,312	3	1,057	0	47	332,525
Alternative 3	0	130,505	0	1,126	1	174,265	0	1,188	0	34	307,118
Difference	0	-23,331	0	-142	-2	-2,048	-3	131	0	-13	-25,407
Percent Difference	0	-15	0	-11	-69	-1	-100	12	0	-28	-8
Above Normal (12.5%)											
Second Basis of Comparison	0	169,913	0	268,778	56,974	110,925	62,779	926	17	85	670,398
Alternative 3	0	119,969	0	323,517	52,929	113,366	54,043	799	0	70	664,694
Difference	0	-49,944	0	54,739	-4,045	2,441	-8,737	-128	-17	-15	-5,704
Percent Difference	0	-29	0	20	-7	2	-14	-14	-100	-17	-1
Below Normal (17.5%)											
Second Basis of Comparison	0	157,331	0	180,614	20,113	122,812	17,388	1,093	0	41	499,391
Alternative 3	0	155,899	0	168,822	21,483	137,826	19,832	1,162	1	54	505,080
Difference	0	-1,432	0	-11,792	1,370	15,015	2,444	69	1	14	5,688
Percent Difference	0	-1	0	-7	7	12	14	6	0	34	1
Dry (22.5%)											
Second Basis of Comparison	1	148,149	0	91,919	21,162	151,231	21,264	1,348	3	141	435,217
Alternative 3	0	146,046	0	61,947	18,345	151,898	15,343	1,523	0	166	395,268
Difference	-1	-2,103	0	-29,972	-2,817	667	-5,921	176	-3	25	-39,949
Percent Difference	-100	-1	0	-33	-13	0	-28	13	-100	18	-9
Critical (15%)											
Second Basis of Comparison	0	129,397	0	141,609	32,354	106,935	43,135	1,418	1	460	455,309
Alternative 3	0	116,643	0	123,172	33,460	110,932	45,720	1,566	33	457	431,984
Difference	0	-12,754	0	-18,436	1,107	3,997	2,585	148	32	-3	-23,325
Percent Difference	0	-10	0	-13	3	4	6	10	2,700	-1	-5

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-26. Annual Potential Production for Winter-Run Chinook Salmon

Analysis Period	Annual Potential Production (# of Fish/year)
Long-term	
Full Simulation Period[1]	
Second Basis of Comparison	1,885,400
Alternative 5	1,883,178
Difference	-2,222
Percent Difference[3]	0
Water Year Types[2]	
Wet (32.5%)	
Second Basis of Comparison	1,930,740
Alternative 5	1,943,241
Difference	12,501
Percent Difference	1
Above Normal (12.5%)	
Second Basis of Comparison	1,746,928
Alternative 5	1,698,809
Difference	-48,120
Percent Difference	-3
Below Normal (17.5%)	
Second Basis of Comparison	1,847,619
Alternative 5	1,898,667
Difference	51,047
Percent Difference	3
Dry (22.5%)	
Second Basis of Comparison	1,894,107
Alternative 5	1,876,977
Difference	-17,130
Percent Difference	-1
Critical (15%)	
Second Basis of Comparison	1,933,573
Alternative 5	1,897,912
Difference	-35,661
Percent Difference	-2

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the annual average

Table B-4-27. Annual Mortality by Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Eggs	Fry	Pre-Smolt	Immature-Smolt	Juvenile (Pre & Immature Smolt)
Long-term					
Full Simulation Period[1]					
Second Basis of Comparison	259,052	162,983	23,312	137	23,449
Alternative 5	203,248	207,870	29,865	124	29,989
Difference	-55,804	44,886	6,553	-12	6,540
Percent Difference[3]	-22	28	28	-9	28
Water Year Types[2]					
Wet (32.5%)					
Second Basis of Comparison	155,104	176,315	1,060	47	1,107
Alternative 5	87,970	210,570	4,085	28	4,113
Difference	-67,133	34,255	3,025	-19	3,007
Percent Difference	-43	19	285	-40	272
Above Normal (12.5%)					
Second Basis of Comparison	438,691	167,899	63,706	103	63,808
Alternative 5	464,585	236,533	52,336	89	52,425
Difference	25,893	68,634	-11,369	-14	-11,383
Percent Difference	6	41	-18	-13	-18
Below Normal (17.5%)					
Second Basis of Comparison	337,945	142,925	18,481	41	18,522
Alternative 5	191,541	178,323	31,052	108	31,160
Difference	-146,403	35,399	12,571	67	12,638
Percent Difference	-43	25	68	165	68
Dry (22.5%)					
Second Basis of Comparison	240,069	172,393	22,611	143	22,755
Alternative 5	200,255	234,855	20,690	134	20,824
Difference	-39,814	62,462	-1,921	-9	-1,931
Percent Difference	-17	36	-8	-6	-8
Critical (15%)					
Second Basis of Comparison	271,006	139,289	44,553	461	45,014
Alternative 5	253,379	172,126	79,375	365	79,740
Difference	-17,627	32,838	34,822	-96	34,726
Percent Difference	-7	24	78	-21	77

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

5 Eggs mortality includes pre-spawn mortality

Table B-4-28. Annual Mortality by Cause for Winter-Run Chinook Salmon

	Annual Mortality[4] (# of Fish/year)		
Analysis Period	**Temperature**	**Flow**	**Total**
	Long-term		
Full Simulation Period[1]			
Second Basis of Comparison	149,945	295,539	445,484
Alternative 5	170,139	270,968	441,107
Difference	20,193	-24,571	-4,378
Percent Difference[3]	13	-8	-1
	Water Year Types[2]		
Wet (32.5%)			
Second Basis of Comparison	1,273	331,252	332,525
Alternative 5	7,569	295,085	302,654
Difference	6,296	-36,168	-29,872
Percent Difference	495	-11	-9
Above Normal (12.5%)			
Second Basis of Comparison	388,548	281,850	670,398
Alternative 5	499,928	253,615	753,543
Difference	111,380	-28,235	83,145
Percent Difference	29	-10	12
Below Normal (17.5%)			
Second Basis of Comparison	218,115	281,277	499,391
Alternative 5	149,215	251,809	401,024
Difference	-68,900	-29,468	-98,367
Percent Difference	-32	-10	-20
Dry (22.5%)			
Second Basis of Comparison	134,348	300,869	435,217
Alternative 5	146,764	309,170	455,934
Difference	12,416	8,302	20,717
Percent Difference	9	3	5
Critical (15%)			
Second Basis of Comparison	217,099	238,210	455,309
Alternative 5	307,023	198,222	505,246
Difference	89,925	-39,988	49,937
Percent Difference	41	-17	11

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-29. Annual Mortality by Cause and Life Stage for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Eggs Flow	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Juvenile Temperature	Juvenile Habitat	Total
Long-term								
Full Simulation Period[1]								
Second Basis of Comparison	0	151,512	107,540	20,257	142,726	22,149	1,300	445,484
Alternative 5	0	89,100	114,147	27,082	180,788	28,909	1,080	441,107
Difference	0	-62,412	6,608	6,825	38,061	6,761	-220	-4,378
Percent Difference[3]	57	-41	6	34	27	31	-17	-1
Water Year Types[2]								
Wet (32.5%)								
Second Basis of Comparison	0	153,836	1,268	3	176,312	3	1,104	332,525
Alternative 5	0	84,683	3,288	977	209,593	3,304	809	302,654
Difference	0	-69,153	2,020	974	33,281	3,302	-295	-29,872
Percent Difference	0	-45	159	35,183	19	132,074	-27	-9
Above Normal (12.5%)								
Second Basis of Comparison	0	169,913	268,778	56,974	110,925	62,797	1,012	670,398
Alternative 5	0	80,569	384,016	64,143	172,390	51,769	656	753,543
Difference	0	-89,345	115,238	7,169	61,465	-11,028	-355	83,145
Percent Difference	0	-53	43	13	55	-18	-35	12
Below Normal (17.5%)								
Second Basis of Comparison	0	157,331	180,614	20,113	122,812	17,388	1,134	499,391
Alternative 5	0	103,637	87,904	31,368	146,956	29,943	1,216	401,024
Difference	0	-53,694	-92,710	11,254	24,144	12,556	82	-98,367
Percent Difference	0	-34	-51	56	20	72	7	-20
Dry (22.5%)								
Second Basis of Comparison	1	148,149	91,919	21,162	151,231	21,266	1,488	435,217
Alternative 5	2	94,247	106,007	21,110	213,744	19,645	1,179	455,934
Difference	0	-53,902	14,088	-52	62,514	-1,621	-309	20,717
Percent Difference	30	-36	15	0	41	-8	-21	5
Critical (15%)								
Second Basis of Comparison	0	129,397	141,609	32,354	106,935	43,136	1,878	455,309
Alternative 5	1	81,098	172,281	56,716	115,410	78,025	1,715	505,246
Difference	1	-48,299	30,672	24,363	8,475	34,889	-164	49,937
Percent Difference	0	-37	22	75	8	81	-9	11

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Table B-4-30. Annual Mortality by All Factors for Winter-Run Chinook Salmon

Analysis Period	Annual Mortality[4] (# of Fish/year) Pre-Spawn Mortality	Incubation	Super-imposition	Eggs - Temperature	Fry - Temperature	Fry - Habitat	Pre-smolt - Temperature	Pre-smolt - Habitat	Smolt - Temperature	Smolt - Habitat	Total
Long-term											
Full Simulation Period[1]											
Second Basis of Comparison	0	151,512	0	107,540	20,257	142,726	22,146	1,167	3	134	445,484
Alternative 5	0	89,100	0	114,147	27,082	180,788	28,902	963	7	117	441,107
Difference	0	-62,412	0	6,608	6,825	38,061	6,757	-204	4	-16	-4,378
Percent Difference[3]	57	-41	0	6	34	27	31	-17	135	-12	-1
Water Year Types[2]											
Wet (32.5%)											
Second Basis of Comparison	0	153,836	0	1,268	3	176,312	3	1,057	0	47	332,525
Alternative 5	0	84,683	0	3,288	977	209,593	3,302	784	3	26	302,654
Difference	0	-69,153	0	2,020	974	33,281	3,299	-274	3	-21	-29,872
Percent Difference	0	-45	0	159	35,183	19	131,968	-26	0	-45	-9
Above Normal (12.5%)											
Second Basis of Comparison	0	169,913	0	268,778	56,974	110,925	62,779	926	17	85	670,398
Alternative 5	0	80,569	0	384,016	64,143	172,390	51,732	604	37	52	753,543
Difference	0	-89,345	0	115,238	7,169	61,465	-11,047	-322	19	-33	83,145
Percent Difference	0	-53	0	43	13	55	-18	-35	113	-39	12
Below Normal (17.5%)											
Second Basis of Comparison	0	157,331	0	180,614	20,113	122,812	17,388	1,093	0	41	499,391
Alternative 5	0	103,637	0	87,904	31,368	146,956	29,943	1,108	0	108	401,024
Difference	0	-53,694	0	-92,710	11,254	24,144	12,556	15	0	67	-98,367
Percent Difference	0	-34	0	-51	56	20	72	1	0	165	-20
Dry (22.5%)											
Second Basis of Comparison	1	148,149	0	91,919	21,162	151,231	21,264	1,348	3	141	435,217
Alternative 5	2	94,247	0	106,007	21,110	213,744	19,645	1,045	0	134	455,934
Difference	0	-53,902	0	14,088	-52	62,514	-1,619	-303	-3	-7	20,717
Percent Difference	30	-36	0	15	0	41	-8	-22	-100	-5	5
Critical (15%)											
Second Basis of Comparison	0	129,397	0	141,609	32,354	106,935	43,135	1,418	1	460	455,309
Alternative 5	1	81,098	0	172,281	56,716	115,410	78,016	1,359	9	356	505,246
Difference	1	-48,299	0	30,672	24,363	8,475	34,881	-60	8	-104	49,937
Percent Difference	0	-37	0	22	75	8	81	-4	679	-23	11

1 Based on the 80-year simulation period

2 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995). Water years may not correspond to the biological years in SALMOD.

3 Relative difference of the Annual average

4 Mortality values do not include base mortality

Appendix 9E

Weighted Useable Area Analysis

This appendix provides information about the methods and assumptions used for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis. It is organized in the following sections:

- Section 9E.1.1: Methodology
  - The fish and aquatic resources impacts analysis used weighted useable area (WUA) as a metric for evaluating changes in physical habitat related to flow. This section describes the overall analytical approach and assumptions. The following species are analyzed in this appendix:
    - Clear Creek Spring-run Chinook Salmon
    - Clear Creek Fall-run Chinook Salmon
    - Clear Creek Steelhead/Rainbow Trout
    - Sacramento River Fall-run Chinook Salmon
    - Sacramento River Late-Fall-run Chinook Salmon
    - Sacramento River Winter-run Chinook Salmon
    - Sacramento River Steelhead/Rainbow Trout
    - Lower Feather River Fall-run Chinook Salmon
    - Lower Feather River Steelhead
    - Lower American River Fall-run Chinook Salmon
    - Lower American River Steelhead
- Section 9E.1.2: Assumptions
  - This section provides a brief description of the assumptions for the WUA analysis for simulations of the No Action Alternative, Second Basis of Comparison, and other alternatives.
- Section 9E.2: Weighted Useable Area-Discharge Relationships
  - This section presents the WUA-discharge relationships that served as the basis for evaluating changes in habitat related to flow.
- Section 9E.3: Results
  - This section presents the WUA values generated for each water body, species, and life stage evaluated.

9E.1 Methodology and Assumptions

9E.1.1 Methodology

To compare the operational flow regime and evaluate the potential effects on habitat for anadromous species inhabiting streams, the relationships between streamflow and habitat availability were determined for each life stage of these species in the rivers in which flows may be altered by CVP and SWP operations.

Several studies have been conducted using the models and techniques contained within the Instream Flow Incremental Methodology (IFIM) to establish these relationships in streams within the study area. The analytic variable provided by the IFIM is total habitat, in units of WUA, for each life stage (fry, juvenile, and spawning) of each evaluation species (or race as applied to Chinook Salmon). Habitat (WUA) incorporates both macro- and microhabitat features. Macrohabitat features include changes in flow, and microhabitat features include the hydraulic and structural conditions (depth, velocity, substrate, or cover) affected by flow, which define the actual living space of the organisms. The total habitat available to a species/life stage at any streamflow is the area of overlap between available microhabitat and macrohabitat conditions. Because the combination of depths, velocities, and substrates preferred by species and life stages varies, WUA values at a given flow differ substantially for the species and life stages evaluated.

WUA-flow relationships have been developed for only some of the rivers where simulated flows were available. Therefore, flow-dependent habitat availability was evaluated quantitatively only for Clear Creek and the Sacramento, Feather, and American rivers and was not reported for other rivers evaluated in this EIS. Tables of the spawning habitat-discharge relationships used in the calculations of spawning WUA for these rivers are listed in Section 9E.3. Because the WUA-flow relationships developed by the most recent IFIM studies present WUA values within particular flow ranges at variable steps, the monthly flow for a particular reach often fell between two flows for which there were WUA values. In these cases, the value was determined by linear interpolation between the available WUA values for the flows immediately below and above the target flow. When the target flow was lower than the lowermost flow for which a WUA value exists, the corresponding WUA value was determined by linear interpolation between a flow of zero and the lowermost flow for which a WUA value exists. When the target flow was higher than the highest flow for which a WUA value exists, the corresponding WUA value was determined by assuming the WUA value for the highest flow.

WUA tables are available for three segments of Clear Creek: the Upper Alluvial Segment (Whiskeytown Dam to Camp Bridge); Canyon Segment (Camp Bridge to Clear Creek Road Bridge); and Lower Alluvial Segment (Clear Creek Road Bridge to Sacramento River). Spring-run Chinook Salmon spawn in the upper two segments, fall-run Chinook Salmon spawn in the lower segment, and Steelhead/Rainbow Trout spawn in all three segments. Spring-run Chinook Salmon and Steelhead fry and juveniles rear in all three segments, while fall-run Chinook Salmon rear in the lower segment. The relationships between WUA and flow in all of these segments for each of these species and life stages are based upon the flow released below Whiskeytown Dam and are described in USFWS (2007, 2011a, 2011b, 2013). For this analysis, if the WUA values for a species and life stage were in the upper section only, the upper two segments were combined for an upper Clear Creek total WUA value at each flow. The same approach was done for the lower segment. If the species and life stage spanned the entire Clear Creek, WUA values were combined for the three segments to provide an estimate of the total WUA available at each flow.

WUA tables are available for two segments of the Sacramento River: Keswick Dam to Battle Creek and Battle Creek to Deer Creek. Spring-run and fall-run Chinook Salmon and Steelhead spawn only in the upper segment; fry and juveniles rear in both segments. Each of these segments have multiple reaches identified and for which WUA was calculated (USFWS 2005a, 2005b, 2006). For this analysis, WUA estimates in each reach between Keswick Dam and Battle Creek were combined into an estimate of the total amount of habitat available in that river segment. Similarly, WUA estimates for reaches between Battle Creek and Deer Creek were combined into an estimate of the total amount of WUA available in that river segment.

For the American River, WUA estimates were available only for fall-run Chinook Salmon and Steelhead spawning. USFWS (2003) identified five reaches between Sailor Bar (River Mile [RM] 22.1) and Rossmoor (RM 16.6). The relationships between WUA and flow in all of these reaches was based upon the flow released below Nimbus Dam. For this analysis, WUA estimates within the five reaches were combined into an estimate of the total WUA in the American River at a given flow released from Nimbus Dam.

For the Feather River, WUA estimates are available for spring-run and fall-run Chinook Salmon and Steelhead spawning in two reaches: the low-flow channel from the fish barrier dam (RM 67) to the Thermalito Afterbay outlet (RM 59) and the lower Feather River high-flow channel from the Thermalito Afterbay outlet to Honcut Creek (RM 44). The relationship between WUA and flow in these reaches for each of these species is described in DWR (2004). The WUA-flow relationships developed by DWR (2004) are based upon the merging of IFIM data collected by DWR in 1992 and reviewed by DWR (2002), with new depth, velocity, substrate, and cover data collected along supplemental Physical Habitat Simulation System (PHABSIM) cross-section transects in 2002 and 2003. For this analysis, WUA estimates within the two reaches were kept separate, and estimates of WUA in each reach were based upon the different flows in each reach.

WUA values were calculated and presented only on a monthly time-step, and not as seasonal or annual values. WUA values based on the monthly CalSim II flows were prepared for detailed evaluation of the alternatives. Monthly WUA values are presented as the average total WUA in each river segment, for the entire 82-year simulation period and the average total WUA in each of five water year types for each alternative. Differences between the alternatives and the two bases of comparison (No Action Alternative and Second Basis of Comparison) were used to identify the effects of each alternative on habitat availability (WUA) for each species and life stage in each river. These comparisons were made only for the months in which the species and life stage were anticipated to be present in each river.

The ability to estimate WUA values is limited because of the monthly time-step of the CalSim II results. The monthly time-step is most limiting during the fall through spring seasons, when flows vary significantly on a daily basis because of hydrologic conditions. Hydrologic variability in the runoff and tributary flows cause significant variability of flows in the areas of interest for the WUA computations. During the periods of low flows, regulated flows from reservoir releases dampen the impact of daily variability of flows on WUA estimates. Monthly time-step simulation results do not capture the daily variability or change in variability between alternative operations. Nonetheless, these estimates provide an indication of the habitat differences among the alternative operational scenarios evaluated.

9E.1.2 Assumptions

Assumptions for the WUA analysis for the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 were developed with the surface water modeling tools and are described in Appendix 5A, Section B.

The following CalSim II model simulations were performed as the basis of evaluating the impacts of No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for simulation purposes, considered the same as Second Basis of Comparison.
- Alternative 5

Alternatives 1 and 4 modeling assumptions are the same as the Second Basis of Comparison, and Alternative 2 modeling assumptions are the same as the No Action Alternative; therefore, the assumptions for Alternatives 1, 2, and 4 are not discussed separately in this document.

Assumptions for each of these alternatives are reflected to monthly CalSim II flows that are used in the WUA analysis described in this section. The WUA area-discharge relationships described below pertain to all alternatives.

The WUA analysis starts with use of the monthly CalSim II model to project CVP and SWP water deliveries. Because this regional model uses monthly time steps to simulate requirements that change weekly or change through observations, it was determined that changes in the model of 5 percent or less were related to the uncertainties in the model processing. Therefore, reductions of 5 percent or less in this comparative WUA analysis are considered to be not substantially different, or "similar."

9E.2 Weighted Useable Area-Discharge Relationships

The WUA-discharge relationships (WUA curves) used for the analysis are presented at the end of this appendix by river reach and species. The "total" column represents the relationship that was used to calculate the WUA for each species and life-stage. Adjustments were made to the WUA relationship by adding a minimum and a maximum value at the first and last row of each table to make the interpolation scheme function.

9E.3 Results

The results of the WUA analysis are presented in the tables listed below. The tables show monthly WUA in acres for each river reach and fish species (as described in Section 9E.1.1) with monthly exceedance probabilities and long-term and water year type averages over the 82-year CalSim II simulation period. The tables also present the incremental difference in WUA for each alternative as compared to the No Action Alternative and the Second Basis of Comparison.

The results are presented in the following tables at the end of this appendix:

- C.1. Upper Clear Creek Spring-run Spawning WUA
- C.2. Total Clear Creek Spring-run Fry Rearing WUA
- C.3. Total Clear Creek Spring-run Juvenile Rearing WUA
- C.4. Lower Clear Creek Fall-run Spawning WUA
- C.5. Lower Clear Creek Fall-run Fry Rearing WUA
- C.6. Lower Clear Creek Fall-run Juvenile Rearing WUA
- C.7. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA
- C.8. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA
- C.9. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA
- C.10. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA
- C.11. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA
- C.12. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA
- C.13. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA

- C.14. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA
- C.15. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA
- C.16. Sacramento River Keswick to Battle Creek Late-Fall-run Juvenile Rearing WUA
- C.17. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA
- C.18. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA
- C.19. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA
- C.20. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA
- C.21. Feather River Low Flow Channel Steelhead Spawning WUA
- C.22. Feather River below Thermalito Steelhead Spawning WUA
- C.23. Feather River Low Flow Channel Fall-run Spawning WUA
- C.24. Feather River below Thermalito Fall-run Spawning WUA
- C.25. American River below Nimbus Fall-run Spawning WUA
- C.26. American River below Nimbus Steelhead Spawning WUA

9E.4 References

DWR (California Department of Water Resources). 2002. *Phase 1: Evaluation of project effects on instream flows and fish habitat*. Draft Report, SP-F16. Oroville Facilities Relicensing FERC Project No. 2100.

_____ (California Department of Water Resources). 2004. *Phase 2 Report, Evaluation of project effects on instream flows and fish habitat*. SP-F16. Oroville Facilities Relicensing FERC Project No. 2100.

USFWS (U.S. Fish and Wildlife Service). 2003. *Comparison of PHABSIM and 2-D Modeling of habitat for steelhead and fall-run Chinook Salmon spawning in the lower American River*.

_____. 2005a. *Flow-habitat relationships for fall-run Chinook Salmon spawning in the Sacramento River between Battle Creek and Clear Creek*.

_____. 2005b. *Flow-habitat relationships for Chinook Salmon rearing in the Sacramento River between Keswick Dam and Battle Creek*.

_____. 2006. *Relationships between flow fluctuations and redd dewatering and juvenile stranding for Chinook Salmon and steelhead in the Sacramento River between Keswick Dam and Battle Creek*.

_____. 2007. *Flow-habitat relationships for spring Chinook Salmon and steelhead/Rainbow Trout spawning in Clear Creek between Whiskeytown Dam and Clear Creek Road*.

_____. 2011a. *Flow-habitat relationships for fall-run Chinook Salmon and steelhead/Rainbow Trout spawning in Clear Creek between Clear Creek Road and the Sacramento River*.

_____. 2011b. *Flow-habitat relationships for spring-run Chinook Salmon and steelhead/Rainbow Trout rearing in Clear Creek between Whiskeytown Dam and Clear Creek Road*.

_____. 2013. *Flow-habitat relationships for spring-run and fall-run Chinook Salmon and steelhead/Rainbow Trout rearing in Clear Creek between Clear Creek Road and the Sacramento River*.

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Table 9E.B.1 Clear Creek Spring-Run WUA Curves

	WUA (square feet)		
Flow (cfs)	Upper Clear Creek Spring-run Spawning	Total Clear Creek Spring-run Fry Rearing	Total Clear Creek Spring-run Juvenile Rearing
0	0	0	0
50	1,737	305,087	181,084
75	3,319	300,786	231,295
100	4,986	302,878	276,361
125	6,504	308,988	316,822
150	7,948	310,298	353,767
175	9,486	314,688	391,364
200	10,739	318,856	421,350
225	11,905	330,375	447,973
250	13,020	338,441	473,325
275	14,067	355,645	495,004
300	15,078	369,849	515,631
350	16,876	381,099	552,011
400	18,463	389,480	583,890
450	19,744	407,051	605,088
500	20,726	420,617	635,094
550	21,379	438,624	653,678
600	22,034	463,029	662,533
650	22,581	470,058	676,055
700	22,855	471,109	686,271
750	22,924	476,652	693,625
800	23,039	480,913	699,399
850	22,953	497,147	701,810
900	23,012	510,275	703,629
99,999	23,012	510,275	703,629

Table 9E.B.2 Clear Creek Fall-run WUA Curves

	WUA (square feet)		
Flow (cfs)	Lower Clear Creek Fall-run Spawning	Lower Clear Creek Fall-run Fry Rearing	Lower Clear Creek Fall-run Juvenile Rearing
0	0	0	0
50	78,145	536,166	224,915
75	107,008	528,779	248,454
100	130,194	515,513	267,634
125	151,079	501,845	283,272
150	168,950	490,718	296,863
175	185,871	478,203	308,968
200	197,705	470,453	318,200
225	206,377	463,637	325,414
250	212,410	458,051	330,224
275	216,026	454,405	334,768
300	217,880	450,992	337,862
350	217,553	444,511	338,627
400	213,538	440,975	334,869
450	207,615	438,123	315,866
500	199,662	425,804	315,769
550	191,877	418,842	304,825
600	184,133	417,735	284,289
650	176,448	410,118	273,178
700	169,132	404,258	263,294
750	162,105	400,288	253,609
800	155,008	393,976	242,998
850	148,934	390,482	234,032
900	143,371	389,928	226,215
99,999	143,371	389,928	226,215

Table 9E.B.3 Clear Creek Steelhead/Rainbow Trout WUA Curves

	WUA (square feet)		
Flow (cfs)	Total Clear Creek Steelhead/Rainbow Trout Spawning	Total Clear Creek Steelhead/Rainbow Trout Fry Rearing	Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing
0	0	0	0
50	14,700	224,356	181,084
75	22,837	222,351	231,295
100	29,787	214,949	276,361
125	36,338	211,348	316,822
150	42,328	209,184	353,767
175	48,149	206,849	391,364
200	52,420	203,238	421,350
225	55,867	208,995	447,973
250	58,528	209,322	473,325
275	60,424	212,115	495,004
300	61,871	220,851	515,631
350	63,255	228,833	552,011
400	63,412	230,063	583,890
450	62,622	241,496	605,088
500	60,877	246,000	635,094
550	58,758	251,634	653,678
600	56,675	261,221	662,533
650	54,518	268,887	676,055
700	52,169	270,618	686,271
750	49,738	271,310	693,625
800	47,369	271,035	699,399
850	45,171	274,512	701,810
900	43,337	275,489	703,629
99,999	43,337	275,489	703,629

Table 9E.B.4 Sacramento River Fall-run WUA Curves

	WUA (square feet)			
Flow (cfs)	Battle Creek to Deer Creek Fall-run Spawning	Keswick to Battle Creek Fall-run Spawning	Keswick to Battle Creek Fall-run Fry Rearing	Keswick to Battle Creek Fall-run Juvenile Rearing
0	0	0	0	0
3,250	2,432,159	1,073,679	1,871,072	728,233
3,500	2,472,408	1,089,475	1,821,873	715,103
3,750	2,517,107	1,093,650	1,830,154	701,709
4,000	2,548,379	1,089,818	1,798,254	691,339
4,250	2,537,270	1,084,494	1,750,173	688,865
4,500	2,572,156	1,074,099	1,690,021	681,467
4,750	2,617,635	1,057,966	1,617,681	668,630
5,000	2,607,065	1,036,730	1,542,592	654,220
5,250	2,619,093	1,017,272	1,478,235	640,414
5,500	2,610,395	994,119	1,419,447	627,375
6,000	2,578,633	942,777	1,328,088	604,811
6,500	2,504,604	891,555	1,279,831	582,950
7,000	2,438,632	837,998	1,235,057	556,427
7,500	2,372,848	784,594	1,164,277	532,183
8,000	2,285,308	731,498	1,120,681	507,090
9,000	2,106,590	643,378	1,091,836	464,272
10,000	1,948,099	555,487	1,092,181	428,954
11,000	1,712,607	474,731	1,085,512	403,177
12,000	1,483,279	408,952	1,101,042	379,516
13,000	1,269,818	346,840	1,118,019	370,163
14,000	1,094,316	301,374	1,142,898	358,085
15,000	952,887	269,303	1,167,580	347,450
17,000	749,112	222,822	1,220,225	361,817
19,000	630,753	185,045	1,222,740	369,470
21,000	526,365	163,408	1,264,409	362,192
23,000	462,509	141,757	1,270,854	366,577
25,000	421,614	130,345	1,282,882	372,986
27,000	382,837	132,036	1,305,362	378,114
29,000	340,721	119,187	1,295,423	361,772
31,000	298,265	103,856	1,311,020	378,338
99,999	298,265	103,856	1,311,020	378,338

Table 9E.B.5 Sacramento River Late-Fall-run WUA Curves

	WUA (square feet)		
Flow (cfs)	Keswick to Battle Creek Late-Fall-run Spawning	Keswick to Battle Creek Late-Fall-run Fry Rearing	Keswick to Battle Creek Late-Fall-run Juvenile Rearing
0	0	0	0
3,250	1,357,068	1,757,540	659,077
3,500	1,378,274	1,718,590	648,446
3,750	1,378,912	1,740,549	637,005
4,000	1,370,262	1,721,404	628,277
4,250	1,359,143	1,680,035	627,744
4,500	1,342,482	1,629,936	620,092
4,750	1,320,680	1,571,143	608,977
5,000	1,295,212	1,502,665	596,274
5,250	1,271,113	1,437,972	583,959
5,500	1,243,776	1,376,346	572,860
6,000	1,181,069	1,261,669	554,054
6,500	1,122,270	1,203,340	536,133
7,000	1,065,218	1,147,957	513,493
7,500	1,012,511	1,076,669	490,854
8,000	962,228	1,032,614	471,581
9,000	881,467	996,279	433,927
10,000	808,457	1,001,320	402,178
11,000	775,199	996,976	379,536
12,000	662,349	1,032,176	359,783
13,000	591,015	1,066,055	351,167
14,000	536,623	1,113,975	340,209
15,000	490,838	1,157,098	332,332
17,000	416,672	1,168,615	350,563
19,000	343,307	1,080,514	360,158
21,000	290,800	1,116,739	355,202
23,000	236,295	1,127,194	361,149
25,000	202,402	1,134,116	369,272
27,000	185,740	1,225,596	376,024
29,000	164,178	1,262,909	363,757
31,000	140,077	1,244,123	382,314
99,999	140,077	1,244,123	382,314

Table 9E.B.6 Sacramento River Winter-run WUA Curves

	WUA (square feet)		
Flow (cfs)	Keswick to Battle Creek Winter-run Spawning	Keswick to Battle Creek Winter-run Fry Rearing	Keswick to Battle Creek Winter-run Juvenile Rearing
0	0	0	0
3,250	1,125,187	782,341	334,216
3,500	1,177,489	778,889	335,588
3,750	1,218,972	791,817	333,961
4,000	1,254,492	797,410	333,396
4,250	1,289,068	799,911	333,004
4,500	1,320,041	798,463	333,189
4,750	1,347,509	790,977	330,335
5,000	1,370,744	775,409	325,718
5,250	1,384,194	764,319	321,756
5,500	1,398,590	755,564	319,393
6,000	1,410,564	715,517	318,494
6,500	1,415,012	727,585	318,071
7,000	1,406,770	716,784	314,041
7,500	1,389,451	690,283	311,007
8,000	1,367,448	672,429	308,046
9,000	1,321,815	644,819	296,094
10,000	1,283,522	666,210	283,771
11,000	1,198,399	701,228	277,165
12,000	1,103,552	753,835	275,603
13,000	1,004,918	797,594	270,537
14,000	915,365	869,871	268,431
15,000	825,757	948,339	274,828
17,000	684,413	1,001,423	314,963
19,000	565,235	917,104	344,970
21,000	475,366	918,518	343,611
23,000	406,166	935,828	352,009
25,000	353,236	968,252	364,822
27,000	327,296	1,073,445	379,054
29,000	312,014	1,164,262	382,682
31,000	302,328	1,168,539	408,157
99,999	302,328	1,168,539	408,157

Table 9E.B.7 Sacramento River Steelhead/Rainbow Trout WUA Curves

	WUA (square feet)
Flow (cfs)	Keswick to Battle Creek Steelhead Spawning
0	0
3,250	271,412
3,500	278,641
3,750	281,518
4,000	281,229
4,250	280,488
4,500	282,045
4,750	282,780
5,000	283,534
5,250	285,728
5,500	288,401
6,000	289,884
6,500	289,103
7,000	284,623
7,500	276,950
8,000	268,176
9,000	251,698
10,000	232,933
11,000	210,724
12,000	189,312
13,000	167,383
14,000	146,119
15,000	126,295
17,000	93,806
19,000	70,820
21,000	58,872
23,000	46,682
25,000	44,177
27,000	41,301
29,000	35,380
31,000	32,295
99,999	32,295

Table 9E.B.8 Lower Feather River Fall-Run WUA Curves

	WUA (square feet)	
Flow (cfs)	Low Flow Channel Fall-run Spawning	Below Thermalito Fall-run Fry Rearing
0	0	0
150	3,460,980	20,780,100
200	5,903,400	26,322,670
250	8,565,240	30,204,290
300	11,197,250	32,691,770
350	13,691,620	33,679,540
400	15,979,160	34,378,390
450	18,011,420	34,878,890
500	19,778,950	35,137,160
550	21,271,740	35,198,090
600	22,472,430	35,058,990
650	23,416,740	34,748,930
700	24,090,230	34,278,830
750	24,525,810	32,571,050
800	24,736,140	30,408,820
850	24,741,090	28,051,660
900	24,567,120	25,750,770
950	24,248,470	23,704,410
1,000	23,821,070	21,947,580
1,100	22,655,140	20,471,850
1,200	21,237,340	19,214,760
1,300	19,662,700	18,140,940
1,400	18,012,660	17,155,790
1,500	16,416,190	16,256,150
1,600	14,861,290	15,441,510
1,800	12,004,900	14,676,420
2,000	9,588,350	13,960,600
2,250	7,178,580	13,282,640
2,500	5,454,150	12,622,640
2,750	4,264,050	11,366,810
3,000	3,523,410	10,224,170
99,999	3,523,410	10,224,170

Table 9E.B.9 Lower Feather River Steelhead WUA Curves

	WUA (square feet)	
Flow (cfs)	Low Flow Channel Steelhead Spawning	Below Thermalito Steelhead Fry Rearing
0	0	0
150	757,810	10,852,180
200	846,400	12,808,710
250	884,980	12,663,550
300	919,660	11,745,270
350	971,890	11,191,230
400	1,031,790	10,678,780
450	1,075,030	10,170,320
500	1,092,780	9,623,500
550	1,084,020	9,023,130
600	1,067,460	8,424,520
650	1,044,300	7,847,810
700	1,031,830	7,313,430
750	1,013,030	6,209,280
800	989,930	5,428,120
850	966,920	4,806,330
900	939,150	4,264,650
950	897,040	3,780,190
1,000	841,560	3,445,820
1,100	718,450	3,251,770
1,200	591,180	3,142,870
1,300	474,000	3,037,770
1,400	378,050	2,936,170
1,500	300,270	2,788,390
1,600	238,510	2,636,030
1,800	154,680	2,464,440
2,000	100,720	2,256,520
2,250	124,360	2,051,450
2,500	171,570	1,851,590
2,750	215,650	1,523,520
3,000	237,410	1,243,430
99,999	237,410	1,243,430

Table 9E.B.10 Lower American River Fall-run WUA Curves

Flow (cfs)	WUA (square feet) Sailor Bar to Rossmoor Fall-run Spawning
0	0
1,000	761,361
1,200	817,031
1,400	853,047
1,600	871,959
1,800	877,804
2,000	881,528
2,200	881,905
2,400	866,405
2,600	840,949
2,800	810,552
3,000	779,982
3,400	745,172
3,800	672,903
4,200	607,384
4,600	542,402
5,000	494,912
5,400	455,893
5,800	431,125
6,200	395,906
6,600	369,760
7,000	346,898
7,400	324,186
7,800	305,059
8,200	289,010
8,600	272,509
9,000	258,849
9,400	249,130
9,800	245,933
10,400	225,180
11,000	210,972
99,999	210,972

Table 9E.B.11 Lower American River Steelhead WUA Curves

Flow (cfs)	WUA (square feet) Sailor Bar to Rossmoor Fall-run Spawning
0	0
1,000	244,184
1,200	259,200
1,400	271,081
1,600	275,989
1,800	282,068
2,000	285,223
2,200	285,665
2,400	280,536
2,600	273,113
2,800	264,182
3,000	257,478
3,400	242,542
3,800	223,125
4,200	204,398
4,600	186,065
5,000	173,712
5,400	163,188
5,800	149,814
6,200	135,625
6,600	126,901
7,000	118,107
7,400	108,736
7,800	101,952
8,200	95,945
8,600	89,863
9,000	85,313
9,400	80,198
9,800	82,740
10,400	75,103
11,000	70,711
99,999	70,711

C.1. Upper Clear Creek Spring-run Spawning WUA

Table C-1-1. Upper Clear Creek Spring-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 1

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	0
90%	0
Long Term	
Full Simulation Period[b]	0
Water Year Types[c]	
Wet (32%)	0
Above Normal (16%)	0
Below Normal (13%)	0
Dry (24%)	0
Critical (15%)	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-1-2. Upper Clear Creek Spring-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 3

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	0
90%	0
Long Term	
Full Simulation Period[b]	0
Water Year Types[c]	
Wet (32%)	0
Above Normal (16%)	0
Below Normal (13%)	0
Dry (24%)	0
Critical (15%)	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-1-3. Upper Clear Creek Spring-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 5

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	0
90%	0
Long Term	
Full Simulation Period[b]	0
Water Year Types[c]	
Wet (32%)	0
Above Normal (16%)	0
Below Normal (13%)	0
Dry (24%)	0
Critical (15%)	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-1-4. Upper Clear Creek Spring-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

No Action Alternative

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	0
90%	0
Long Term	
Full Simulation Period[b]	0
Water Year Types[c]	
Wet (32%)	0
Above Normal (16%)	0
Below Normal (13%)	0
Dry (24%)	0
Critical (15%)	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-1-5. Upper Clear Creek Spring-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 3

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)
	Sep
Probability of Exceedance[a]	
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	0
90%	0
Long Term	
Full Simulation Period[b]	0
Water Year Types[c]	
Wet (32%)	0
Above Normal (16%)	0
Below Normal (13%)	0
Dry (24%)	0
Critical (15%)	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-1-6. Upper Clear Creek Spring-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 5

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	7,948
20%	7,948
30%	7,948
40%	7,948
50%	7,948
60%	7,948
70%	7,948
80%	7,948
90%	7,948
Long Term	
Full Simulation Period[b]	7,797
Water Year Types[c]	
Wet (32%)	7,948
Above Normal (16%)	7,948
Below Normal (13%)	7,948
Dry (24%)	7,948
Critical (15%)	6,913

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep
Probability of Exceedance[a]	
10%	0
20%	0
30%	0
40%	0
50%	0
60%	0
70%	0
80%	0
90%	0
Long Term	
Full Simulation Period[b]	0
Water Year Types[c]	
Wet (32%)	0
Above Normal (16%)	0
Below Normal (13%)	0
Dry (24%)	0
Critical (15%)	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.
b Based on the 82-year simulation period.
c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.2. Total Clear Creek Spring-run Fry Rearing WUA

Table C-2-1. Total Clear Creek Spring-run Fry Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 1

	Monthly WUA (Feet2)				
Statistic	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 1 minus No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-2-2. Total Clear Creek Spring-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification
(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-2-3. Total Clear Creek Spring-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 5

Statistic	Monthly WUA (Feet2) Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-2-4. Total Clear Creek Spring-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-2-5. Total Clear Creek Spring-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification
(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-2-6. Total Clear Creek Spring-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 5

Statistic	Monthly WUA (Feet2) Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	318,856	318,856	318,856	318,856	318,856
20%	318,856	318,856	318,856	318,856	318,856
30%	318,856	318,856	318,856	318,856	318,856
40%	318,856	318,856	318,856	318,856	318,856
50%	318,856	318,856	318,856	318,856	318,856
60%	318,856	318,856	318,856	318,856	318,856
70%	318,856	318,856	318,856	318,856	318,856
80%	318,856	318,856	318,856	318,856	318,856
90%	310,298	310,298	310,298	310,298	310,298
Long Term					
Full Simulation Period[b]	316,885	317,096	321,973	322,078	319,743
Water Year Types[c]					
Wet (32%)	318,856	318,856	333,581	333,581	326,218
Above Normal (16%)	316,216	316,881	317,539	318,198	318,198
Below Normal (13%)	318,078	318,078	318,078	318,078	318,078
Dry (24%)	316,284	316,717	317,144	317,144	317,144
Critical (15%)	313,246	313,246	313,246	313,246	313,246

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.3 Total Clear Creek Spring-run Juvenile Rearing WUA

Table C-3-1. Total Clear Creek Spring-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	497,000	421,350	249,321	249,321
20%	421,350	497,000	421,350	249,321	249,321
30%	421,350	497,000	421,350	249,321	249,321
40%	421,350	497,000	421,350	249,321	249,321
50%	421,350	497,000	421,350	249,321	249,321
60%	421,350	497,000	421,350	249,321	249,321
70%	421,350	497,000	421,350	249,321	249,321
80%	421,350	497,000	353,767	249,321	249,321
90%	353,767	460,240	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	484,633	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	497,000	421,350	249,321	249,321
Above Normal (16%)	416,151	497,000	421,350	249,321	249,321
Below Normal (13%)	415,206	493,658	409,062	249,321	249,321
Dry (24%)	407,833	487,810	397,696	249,321	249,321
Critical (15%)	375,476	430,869	289,769	249,321	249,321

Alternative 1

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	421,350	421,350	249,321	249,321
20%	421,350	421,350	421,350	249,321	249,321
30%	421,350	421,350	421,350	249,321	249,321
40%	421,350	421,350	421,350	249,321	249,321
50%	421,350	421,350	421,350	249,321	249,321
60%	421,350	421,350	421,350	249,321	249,321
70%	421,350	421,350	421,350	249,321	249,321
80%	421,350	421,350	353,767	249,321	249,321
90%	353,767	353,767	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	410,516	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	421,350	421,350	249,321	249,321
Above Normal (16%)	416,151	421,350	421,350	249,321	249,321
Below Normal (13%)	415,206	415,206	409,062	249,321	249,321
Dry (24%)	407,833	407,833	397,696	249,321	249,321
Critical (15%)	375,476	375,476	289,769	249,321	249,321

Alternative 1 minus No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	0	-75,650	0	0	0
20%	0	-75,650	0	0	0
30%	0	-75,650	0	0	0
40%	0	-75,650	0	0	0
50%	0	-75,650	0	0	0
60%	0	-75,650	0	0	0
70%	0	-75,650	0	0	0
80%	0	-75,650	0	0	0
90%	0	-106,473	0	0	0
Long Term					
Full Simulation Period[b]	0	-74,117	0	0	0
Water Year Types[c]					
Wet (32%)	0	-75,650	0	0	0
Above Normal (16%)	0	-75,650	0	0	0
Below Normal (13%)	0	-78,452	0	0	0
Dry (24%)	0	-79,977	0	0	0
Critical (15%)	0	-55,393	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-3-2. Total Clear Creek Spring-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	497,000	421,350	249,321	249,321
20%	421,350	497,000	421,350	249,321	249,321
30%	421,350	497,000	421,350	249,321	249,321
40%	421,350	497,000	421,350	249,321	249,321
50%	421,350	497,000	421,350	249,321	249,321
60%	421,350	497,000	421,350	249,321	249,321
70%	421,350	497,000	421,350	249,321	249,321
80%	421,350	497,000	353,767	249,321	249,321
90%	353,767	460,240	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	484,633	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	497,000	421,350	249,321	249,321
Above Normal (16%)	416,151	497,000	421,350	249,321	249,321
Below Normal (13%)	415,206	493,658	409,062	249,321	249,321
Dry (24%)	407,833	487,810	397,696	249,321	249,321
Critical (15%)	375,476	430,869	289,769	249,321	249,321

Alternative 3

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	421,350	421,350	249,321	249,321
20%	421,350	421,350	421,350	249,321	249,321
30%	421,350	421,350	421,350	249,321	249,321
40%	421,350	421,350	421,350	249,321	249,321
50%	421,350	421,350	421,350	249,321	249,321
60%	421,350	421,350	421,350	249,321	249,321
70%	421,350	421,350	421,350	249,321	249,321
80%	421,350	421,350	353,767	249,321	249,321
90%	353,767	353,767	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	410,516	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	421,350	421,350	249,321	249,321
Above Normal (16%)	416,151	421,350	421,350	249,321	249,321
Below Normal (13%)	415,206	415,206	409,062	249,321	249,321
Dry (24%)	407,833	407,833	397,696	249,321	249,321
Critical (15%)	375,476	375,476	289,769	249,321	249,321

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	0	-75,650	0	0	0
20%	0	-75,650	0	0	0
30%	0	-75,650	0	0	0
40%	0	-75,650	0	0	0
50%	0	-75,650	0	0	0
60%	0	-75,650	0	0	0
70%	0	-75,650	0	0	0
80%	0	-75,650	0	0	0
90%	0	-106,473	0	0	0
Long Term					
Full Simulation Period[b]	0	-74,117	0	0	0
Water Year Types[c]					
Wet (32%)	0	-75,650	0	0	0
Above Normal (16%)	0	-75,650	0	0	0
Below Normal (13%)	0	-78,452	0	0	0
Dry (24%)	0	-79,977	0	0	0
Critical (15%)	0	-55,393	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-3-3. Total Clear Creek Spring-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	497,000	421,350	249,321	249,321
20%	421,350	497,000	421,350	249,321	249,321
30%	421,350	497,000	421,350	249,321	249,321
40%	421,350	497,000	421,350	249,321	249,321
50%	421,350	497,000	421,350	249,321	249,321
60%	421,350	497,000	421,350	249,321	249,321
70%	421,350	497,000	421,350	249,321	249,321
80%	421,350	497,000	353,767	249,321	249,321
90%	353,767	460,240	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	484,633	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	497,000	421,350	249,321	249,321
Above Normal (16%)	416,151	497,000	421,350	249,321	249,321
Below Normal (13%)	415,206	493,658	409,062	249,321	249,321
Dry (24%)	407,833	487,810	397,696	249,321	249,321
Critical (15%)	375,476	430,869	289,769	249,321	249,321

Alternative 5

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	497,000	421,350	249,321	249,321
20%	421,350	497,000	421,350	249,321	249,321
30%	421,350	497,000	421,350	249,321	249,321
40%	421,350	497,000	421,350	249,321	249,321
50%	421,350	497,000	421,350	249,321	249,321
60%	421,350	497,000	421,350	249,321	249,321
70%	421,350	497,000	421,350	249,321	249,321
80%	421,350	497,000	353,767	249,321	249,321
90%	353,767	460,240	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	484,633	394,677	249,321	249,354
Water Year Types[c]					
Wet (32%)	421,350	497,000	421,350	249,321	249,321
Above Normal (16%)	416,151	497,000	421,350	249,321	249,321
Below Normal (13%)	415,206	493,658	409,062	249,321	249,321
Dry (24%)	407,833	487,810	397,696	249,321	249,321
Critical (15%)	375,476	430,869	289,769	249,321	249,542

Alternative 5 minus No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	32
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	221

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-3-4. Total Clear Creek Spring-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	421,350	421,350	249,321	249,321
20%	421,350	421,350	421,350	249,321	249,321
30%	421,350	421,350	421,350	249,321	249,321
40%	421,350	421,350	421,350	249,321	249,321
50%	421,350	421,350	421,350	249,321	249,321
60%	421,350	421,350	421,350	249,321	249,321
70%	421,350	421,350	421,350	249,321	249,321
80%	421,350	421,350	353,767	249,321	249,321
90%	353,767	353,767	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	410,516	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	421,350	421,350	249,321	249,321
Above Normal (16%)	416,151	421,350	421,350	249,321	249,321
Below Normal (13%)	415,206	415,206	409,062	249,321	249,321
Dry (24%)	407,833	407,833	397,696	249,321	249,321
Critical (15%)	375,476	375,476	289,769	249,321	249,321

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	497,000	421,350	249,321	249,321
20%	421,350	497,000	421,350	249,321	249,321
30%	421,350	497,000	421,350	249,321	249,321
40%	421,350	497,000	421,350	249,321	249,321
50%	421,350	497,000	421,350	249,321	249,321
60%	421,350	497,000	421,350	249,321	249,321
70%	421,350	497,000	421,350	249,321	249,321
80%	421,350	497,000	353,767	249,321	249,321
90%	353,767	460,240	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	484,633	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	497,000	421,350	249,321	249,321
Above Normal (16%)	416,151	497,000	421,350	249,321	249,321
Below Normal (13%)	415,206	493,658	409,062	249,321	249,321
Dry (24%)	407,833	487,810	397,696	249,321	249,321
Critical (15%)	375,476	430,869	289,769	249,321	249,321

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	0	75,650	0	0	0
20%	0	75,650	0	0	0
30%	0	75,650	0	0	0
40%	0	75,650	0	0	0
50%	0	75,650	0	0	0
60%	0	75,650	0	0	0
70%	0	75,650	0	0	0
80%	0	75,650	0	0	0
90%	0	106,473	0	0	0
Long Term					
Full Simulation Period[b]	0	74,117	0	0	0
Water Year Types[c]					
Wet (32%)	0	75,650	0	0	0
Above Normal (16%)	0	75,650	0	0	0
Below Normal (13%)	0	78,452	0	0	0
Dry (24%)	0	79,977	0	0	0
Critical (15%)	0	55,393	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-3-5. Total Clear Creek Spring-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	421,350	421,350	249,321	249,321
20%	421,350	421,350	421,350	249,321	249,321
30%	421,350	421,350	421,350	249,321	249,321
40%	421,350	421,350	421,350	249,321	249,321
50%	421,350	421,350	421,350	249,321	249,321
60%	421,350	421,350	421,350	249,321	249,321
70%	421,350	421,350	421,350	249,321	249,321
80%	421,350	421,350	353,767	249,321	249,321
90%	353,767	353,767	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	410,516	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	421,350	421,350	249,321	249,321
Above Normal (16%)	416,151	421,350	421,350	249,321	249,321
Below Normal (13%)	415,206	415,206	409,062	249,321	249,321
Dry (24%)	407,833	407,833	397,696	249,321	249,321
Critical (15%)	375,476	375,476	289,769	249,321	249,321

Alternative 3

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	421,350	421,350	249,321	249,321
20%	421,350	421,350	421,350	249,321	249,321
30%	421,350	421,350	421,350	249,321	249,321
40%	421,350	421,350	421,350	249,321	249,321
50%	421,350	421,350	421,350	249,321	249,321
60%	421,350	421,350	421,350	249,321	249,321
70%	421,350	421,350	421,350	249,321	249,321
80%	421,350	421,350	353,767	249,321	249,321
90%	353,767	353,767	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	410,516	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	421,350	421,350	249,321	249,321
Above Normal (16%)	416,151	421,350	421,350	249,321	249,321
Below Normal (13%)	415,206	415,206	409,062	249,321	249,321
Dry (24%)	407,833	407,833	397,696	249,321	249,321
Critical (15%)	375,476	375,476	289,769	249,321	249,321

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-3-6. Total Clear Creek Spring-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	421,350	421,350	249,321	249,321
20%	421,350	421,350	421,350	249,321	249,321
30%	421,350	421,350	421,350	249,321	249,321
40%	421,350	421,350	421,350	249,321	249,321
50%	421,350	421,350	421,350	249,321	249,321
60%	421,350	421,350	421,350	249,321	249,321
70%	421,350	421,350	421,350	249,321	249,321
80%	421,350	421,350	353,767	249,321	249,321
90%	353,767	353,767	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	410,516	394,677	249,321	249,321
Water Year Types[c]					
Wet (32%)	421,350	421,350	421,350	249,321	249,321
Above Normal (16%)	416,151	421,350	421,350	249,321	249,321
Below Normal (13%)	415,206	415,206	409,062	249,321	249,321
Dry (24%)	407,833	407,833	397,696	249,321	249,321
Critical (15%)	375,476	375,476	289,769	249,321	249,321

Alternative 5

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	421,350	497,000	421,350	249,321	249,321
20%	421,350	497,000	421,350	249,321	249,321
30%	421,350	497,000	421,350	249,321	249,321
40%	421,350	497,000	421,350	249,321	249,321
50%	421,350	497,000	421,350	249,321	249,321
60%	421,350	497,000	421,350	249,321	249,321
70%	421,350	497,000	421,350	249,321	249,321
80%	421,350	497,000	353,767	249,321	249,321
90%	353,767	460,240	353,767	249,321	249,321
Long Term					
Full Simulation Period[b]	409,692	484,633	394,677	249,321	249,354
Water Year Types[c]					
Wet (32%)	421,350	497,000	421,350	249,321	249,321
Above Normal (16%)	416,151	497,000	421,350	249,321	249,321
Below Normal (13%)	415,206	493,658	409,062	249,321	249,321
Dry (24%)	407,833	487,810	397,696	249,321	249,321
Critical (15%)	375,476	430,869	289,769	249,321	249,542

Alternative 5 minus Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	0	75,650	0	0	0
20%	0	75,650	0	0	0
30%	0	75,650	0	0	0
40%	0	75,650	0	0	0
50%	0	75,650	0	0	0
60%	0	75,650	0	0	0
70%	0	75,650	0	0	0
80%	0	75,650	0	0	0
90%	0	106,473	0	0	0
Long Term					
Full Simulation Period[b]	0	74,117	0	0	32
Water Year Types[c]					
Wet (32%)	0	75,650	0	0	0
Above Normal (16%)	0	75,650	0	0	0
Below Normal (13%)	0	78,452	0	0	0
Dry (24%)	0	79,977	0	0	0
Critical (15%)	0	55,393	0	0	221

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.4. Lower Clear Creek Fall-run Spawning WUA

Table C-4-1. Lower Clear Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)		
Statistic	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	186,712	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	177,529	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 1

	Monthly WUA (Feet2)		
Statistic	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,739	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	181,738	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 1 minus No Action Alternative

	Monthly WUA (Feet2)		
Statistic	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	0	0	0
20%	0	0	0
30%	0	0	0
40%	0	0	0
50%	0	0	0
60%	0	0	0
70%	0	0	0
80%	0	0	0
90%	0	0	0
Long Term			
Full Simulation Period[b]	1,027	0	0
Water Year Types[c]			
Wet (32%)	0	0	0
Above Normal (16%)	0	0	0
Below Normal (13%)	0	0	0
Dry (24%)	4,210	0	0
Critical (15%)	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-4-2. Lower Clear Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	186,712	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	177,529	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 3

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,739	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	181,738	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	0	0	0
20%	0	0	0
30%	0	0	0
40%	0	0	0
50%	0	0	0
60%	0	0	0
70%	0	0	0
80%	0	0	0
90%	0	0	0
Long Term			
Full Simulation Period[b]	1,027	0	0
Water Year Types[c]			
Wet (32%)	0	0	0
Above Normal (16%)	0	0	0
Below Normal (13%)	0	0	0
Dry (24%)	4,210	0	0
Critical (15%)	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-4-3. Lower Clear Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	186,712	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	177,529	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 5

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,547	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	180,953	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	0	0	0
20%	0	0	0
30%	0	0	0
40%	0	0	0
50%	0	0	0
60%	0	0	0
70%	0	0	0
80%	0	0	0
90%	0	0	0
Long Term			
Full Simulation Period[b]	835	0	0
Water Year Types[c]			
Wet (32%)	0	0	0
Above Normal (16%)	0	0	0
Below Normal (13%)	0	0	0
Dry (24%)	3,424	0	0
Critical (15%)	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-4-4. Lower Clear Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,739	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	181,738	187,131	190,516
Critical (15%)	173,364	177,702	177,702

No Action Alternative

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	186,712	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	177,529	187,131	190,516
Critical (15%)	173,364	177,702	177,702

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	0	0	0
20%	0	0	0
30%	0	0	0
40%	0	0	0
50%	0	0	0
60%	0	0	0
70%	0	0	0
80%	0	0	0
90%	0	0	0
Long Term			
Full Simulation Period[b]	-1,027	0	0
Water Year Types[c]			
Wet (32%)	0	0	0
Above Normal (16%)	0	0	0
Below Normal (13%)	0	0	0
Dry (24%)	-4,210	0	0
Critical (15%)	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-4-5. Lower Clear Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,739	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	181,738	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 3

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,739	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	181,738	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	0	0	0
20%	0	0	0
30%	0	0	0
40%	0	0	0
50%	0	0	0
60%	0	0	0
70%	0	0	0
80%	0	0	0
90%	0	0	0
Long Term			
Full Simulation Period[b]	0	0	0
Water Year Types[c]			
Wet (32%)	0	0	0
Above Normal (16%)	0	0	0
Below Normal (13%)	0	0	0
Dry (24%)	0	0	0
Critical (15%)	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-4-6. Lower Clear Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,739	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	181,738	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 5

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	197,705	197,705	197,705
20%	197,705	197,705	197,705
30%	197,705	197,705	197,705
40%	197,705	197,705	197,705
50%	197,705	197,705	197,705
60%	197,705	197,705	197,705
70%	197,705	197,705	197,705
80%	197,705	197,705	197,705
90%	168,950	168,950	168,950
Long Term			
Full Simulation Period[b]	187,547	189,970	191,622
Water Year Types[c]			
Wet (32%)	197,705	197,705	197,705
Above Normal (16%)	184,084	185,860	191,069
Below Normal (13%)	195,091	195,091	195,091
Dry (24%)	180,953	187,131	190,516
Critical (15%)	173,364	177,702	177,702

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	0	0	0
20%	0	0	0
30%	0	0	0
40%	0	0	0
50%	0	0	0
60%	0	0	0
70%	0	0	0
80%	0	0	0
90%	0	0	0
Long Term			
Full Simulation Period[b]	-192	0	0
Water Year Types[c]			
Wet (32%)	0	0	0
Above Normal (16%)	0	0	0
Below Normal (13%)	0	0	0
Dry (24%)	-786	0	0
Critical (15%)	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.5. Lower Clear Creek Fall-run Fry Rearing WUA

Table C-5-1. Lower Clear Creek Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 1

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-5-2. Lower Clear Creek Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 3

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-5-3. Lower Clear Creek Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 5

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-5-4. Lower Clear Creek Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-5-5. Lower Clear Creek Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 3

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-5-6. Lower Clear Creek Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 5

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	490,718	490,718	490,718	490,718
20%	470,453	470,453	470,453	470,453
30%	470,453	470,453	470,453	470,453
40%	470,453	470,453	470,453	470,453
50%	470,453	470,453	470,453	470,453
60%	470,453	470,453	470,453	470,453
70%	470,453	470,453	470,453	470,453
80%	470,453	470,453	470,453	470,453
90%	470,453	470,453	470,453	470,453
Long Term				
Full Simulation Period[b]	472,251	472,004	472,986	473,968
Water Year Types[c]				
Wet (32%)	464,259	464,259	467,356	470,453
Above Normal (16%)	473,571	472,012	472,012	472,012
Below Normal (13%)	472,295	472,295	472,295	472,295
Dry (24%)	474,506	474,506	474,506	474,506
Critical (15%)	484,341	484,341	484,341	484,341

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.6. Lower Clear Creek Fall-run Juvenile Rearing WUA

Table C-6-1. Lower Clear Creek Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	335,067	318,200	256,126	256,126	296,863
20%	335,067	318,200	256,126	256,126	296,863
30%	335,067	318,200	256,126	256,126	296,863
40%	335,067	318,200	256,126	256,126	296,863
50%	335,067	318,200	256,126	256,126	296,863
60%	335,067	318,200	256,126	256,126	296,863
70%	335,067	318,200	256,126	256,126	296,863
80%	335,067	296,863	256,126	256,126	296,863
90%	327,741	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	332,168	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	335,067	318,200	256,126	256,126	296,863
Above Normal (16%)	335,067	318,200	256,126	256,126	296,863
Below Normal (13%)	334,401	314,321	256,126	256,126	296,863
Dry (24%)	333,236	310,732	256,126	256,126	296,863
Critical (15%)	318,916	271,483	256,126	256,126	284,872

Alternative 1

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	318,200	318,200	256,126	256,126	296,863
20%	318,200	318,200	256,126	256,126	296,863
30%	318,200	318,200	256,126	256,126	296,863
40%	318,200	318,200	256,126	256,126	296,863
50%	318,200	318,200	256,126	256,126	296,863
60%	318,200	318,200	256,126	256,126	296,863
70%	318,200	318,200	256,126	256,126	296,863
80%	318,200	296,863	256,126	256,126	296,863
90%	296,863	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	314,721	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	318,200	318,200	256,126	256,126	296,863
Above Normal (16%)	318,200	318,200	256,126	256,126	296,863
Below Normal (13%)	316,260	314,321	256,126	256,126	296,863
Dry (24%)	313,933	310,732	256,126	256,126	296,863
Critical (15%)	303,318	271,483	256,126	256,126	284,872

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	-16,867	0	0	0	0
20%	-16,867	0	0	0	0
30%	-16,867	0	0	0	0
40%	-16,867	0	0	0	0
50%	-16,867	0	0	0	0
60%	-16,867	0	0	0	0
70%	-16,867	0	0	0	0
80%	-16,867	0	0	0	0
90%	-30,878	0	0	0	0
Long Term					
Full Simulation Period[b]	-17,447	0	0	0	0
Water Year Types[c]					
Wet (32%)	-16,867	0	0	0	0
Above Normal (16%)	-16,867	0	0	0	0
Below Normal (13%)	-18,141	0	0	0	0
Dry (24%)	-19,303	0	0	0	0
Critical (15%)	-15,598	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-6-2. Lower Clear Creek Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	335,067	318,200	256,126	256,126	296,863
20%	335,067	318,200	256,126	256,126	296,863
30%	335,067	318,200	256,126	256,126	296,863
40%	335,067	318,200	256,126	256,126	296,863
50%	335,067	318,200	256,126	256,126	296,863
60%	335,067	318,200	256,126	256,126	296,863
70%	335,067	318,200	256,126	256,126	296,863
80%	335,067	296,863	256,126	256,126	296,863
90%	327,741	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	332,168	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	335,067	318,200	256,126	256,126	296,863
Above Normal (16%)	335,067	318,200	256,126	256,126	296,863
Below Normal (13%)	334,401	314,321	256,126	256,126	296,863
Dry (24%)	333,236	310,732	256,126	256,126	296,863
Critical (15%)	318,916	271,483	256,126	256,126	284,872

Alternative 3

Statistic	Monthly WUA (Feet2)				
	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	318,200	318,200	256,126	256,126	296,863
20%	318,200	318,200	256,126	256,126	296,863
30%	318,200	318,200	256,126	256,126	296,863
40%	318,200	318,200	256,126	256,126	296,863
50%	318,200	318,200	256,126	256,126	296,863
60%	318,200	318,200	256,126	256,126	296,863
70%	318,200	318,200	256,126	256,126	296,863
80%	318,200	296,863	256,126	256,126	296,863
90%	296,863	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	314,721	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	318,200	318,200	256,126	256,126	296,863
Above Normal (16%)	318,200	318,200	256,126	256,126	296,863
Below Normal (13%)	316,260	314,321	256,126	256,126	296,863
Dry (24%)	313,933	310,732	256,126	256,126	296,863
Critical (15%)	303,318	271,483	256,126	256,126	284,872

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	-16,867	0	0	0	0
20%	-16,867	0	0	0	0
30%	-16,867	0	0	0	0
40%	-16,867	0	0	0	0
50%	-16,867	0	0	0	0
60%	-16,867	0	0	0	0
70%	-16,867	0	0	0	0
80%	-16,867	0	0	0	0
90%	-30,878	0	0	0	0
Long Term					
Full Simulation Period[b]	-17,447	0	0	0	0
Water Year Types[c]					
Wet (32%)	-16,867	0	0	0	0
Above Normal (16%)	-16,867	0	0	0	0
Below Normal (13%)	-18,141	0	0	0	0
Dry (24%)	-19,303	0	0	0	0
Critical (15%)	-15,598	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-6-3. Lower Clear Creek Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	335,067	318,200	256,126	256,126	296,863
20%	335,067	318,200	256,126	256,126	296,863
30%	335,067	318,200	256,126	256,126	296,863
40%	335,067	318,200	256,126	256,126	296,863
50%	335,067	318,200	256,126	256,126	296,863
60%	335,067	318,200	256,126	256,126	296,863
70%	335,067	318,200	256,126	256,126	296,863
80%	335,067	296,863	256,126	256,126	296,863
90%	327,741	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	332,168	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	335,067	318,200	256,126	256,126	296,863
Above Normal (16%)	335,067	318,200	256,126	256,126	296,863
Below Normal (13%)	334,401	314,321	256,126	256,126	296,863
Dry (24%)	333,236	310,732	256,126	256,126	296,863
Critical (15%)	318,916	271,483	256,126	256,126	284,872

Alternative 5

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	335,067	318,200	256,126	256,126	296,863
20%	335,067	318,200	256,126	256,126	296,863
30%	335,067	318,200	256,126	256,126	296,863
40%	335,067	318,200	256,126	256,126	296,863
50%	335,067	318,200	256,126	256,126	296,863
60%	335,067	318,200	256,126	256,126	296,863
70%	335,067	318,200	256,126	256,126	296,863
80%	335,067	296,863	256,126	256,126	296,863
90%	327,741	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	332,168	309,022	256,126	256,140	295,108
Water Year Types[c]					
Wet (32%)	335,067	318,200	256,126	256,126	296,863
Above Normal (16%)	335,067	318,200	256,126	256,126	296,863
Below Normal (13%)	334,401	314,321	256,126	256,126	296,863
Dry (24%)	333,236	310,732	256,126	256,126	296,863
Critical (15%)	318,916	271,483	256,126	256,220	284,872

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	14	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	94	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-6-4. Lower Clear Creek Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	318,200	318,200	256,126	256,126	296,863
20%	318,200	318,200	256,126	256,126	296,863
30%	318,200	318,200	256,126	256,126	296,863
40%	318,200	318,200	256,126	256,126	296,863
50%	318,200	318,200	256,126	256,126	296,863
60%	318,200	318,200	256,126	256,126	296,863
70%	318,200	318,200	256,126	256,126	296,863
80%	318,200	296,863	256,126	256,126	296,863
90%	296,863	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	314,721	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	318,200	318,200	256,126	256,126	296,863
Above Normal (16%)	318,200	318,200	256,126	256,126	296,863
Below Normal (13%)	316,260	314,321	256,126	256,126	296,863
Dry (24%)	313,933	310,732	256,126	256,126	296,863
Critical (15%)	303,318	271,483	256,126	256,126	284,872

No Action Alternative

	Monthly WUA (Feet2)				
Statistic	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	335,067	318,200	256,126	256,126	296,863
20%	335,067	318,200	256,126	256,126	296,863
30%	335,067	318,200	256,126	256,126	296,863
40%	335,067	318,200	256,126	256,126	296,863
50%	335,067	318,200	256,126	256,126	296,863
60%	335,067	318,200	256,126	256,126	296,863
70%	335,067	318,200	256,126	256,126	296,863
80%	335,067	296,863	256,126	256,126	296,863
90%	327,741	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	332,168	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	335,067	318,200	256,126	256,126	296,863
Above Normal (16%)	335,067	318,200	256,126	256,126	296,863
Below Normal (13%)	334,401	314,321	256,126	256,126	296,863
Dry (24%)	333,236	310,732	256,126	256,126	296,863
Critical (15%)	318,916	271,483	256,126	256,126	284,872

No Action Alternative minus Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	16,867	0	0	0	0
20%	16,867	0	0	0	0
30%	16,867	0	0	0	0
40%	16,867	0	0	0	0
50%	16,867	0	0	0	0
60%	16,867	0	0	0	0
70%	16,867	0	0	0	0
80%	16,867	0	0	0	0
90%	30,878	0	0	0	0
Long Term					
Full Simulation Period[b]	17,447	0	0	0	0
Water Year Types[c]					
Wet (32%)	16,867	0	0	0	0
Above Normal (16%)	16,867	0	0	0	0
Below Normal (13%)	18,141	0	0	0	0
Dry (24%)	19,303	0	0	0	0
Critical (15%)	15,598	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-6-5. Lower Clear Creek Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	318,200	318,200	256,126	256,126	296,863
20%	318,200	318,200	256,126	256,126	296,863
30%	318,200	318,200	256,126	256,126	296,863
40%	318,200	318,200	256,126	256,126	296,863
50%	318,200	318,200	256,126	256,126	296,863
60%	318,200	318,200	256,126	256,126	296,863
70%	318,200	318,200	256,126	256,126	296,863
80%	318,200	296,863	256,126	256,126	296,863
90%	296,863	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	314,721	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	318,200	318,200	256,126	256,126	296,863
Above Normal (16%)	318,200	318,200	256,126	256,126	296,863
Below Normal (13%)	316,260	314,321	256,126	256,126	296,863
Dry (24%)	313,933	310,732	256,126	256,126	296,863
Critical (15%)	303,318	271,483	256,126	256,126	284,872

Alternative 3

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	318,200	318,200	256,126	256,126	296,863
20%	318,200	318,200	256,126	256,126	296,863
30%	318,200	318,200	256,126	256,126	296,863
40%	318,200	318,200	256,126	256,126	296,863
50%	318,200	318,200	256,126	256,126	296,863
60%	318,200	318,200	256,126	256,126	296,863
70%	318,200	318,200	256,126	256,126	296,863
80%	318,200	296,863	256,126	256,126	296,863
90%	296,863	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	314,721	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	318,200	318,200	256,126	256,126	296,863
Above Normal (16%)	318,200	318,200	256,126	256,126	296,863
Below Normal (13%)	316,260	314,321	256,126	256,126	296,863
Dry (24%)	313,933	310,732	256,126	256,126	296,863
Critical (15%)	303,318	271,483	256,126	256,126	284,872

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-6-6. Lower Clear Creek Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	318,200	318,200	256,126	256,126	296,863
20%	318,200	318,200	256,126	256,126	296,863
30%	318,200	318,200	256,126	256,126	296,863
40%	318,200	318,200	256,126	256,126	296,863
50%	318,200	318,200	256,126	256,126	296,863
60%	318,200	318,200	256,126	256,126	296,863
70%	318,200	318,200	256,126	256,126	296,863
80%	318,200	296,863	256,126	256,126	296,863
90%	296,863	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	314,721	309,022	256,126	256,126	295,108
Water Year Types[c]					
Wet (32%)	318,200	318,200	256,126	256,126	296,863
Above Normal (16%)	318,200	318,200	256,126	256,126	296,863
Below Normal (13%)	316,260	314,321	256,126	256,126	296,863
Dry (24%)	313,933	310,732	256,126	256,126	296,863
Critical (15%)	303,318	271,483	256,126	256,126	284,872

Alternative 5

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	335,067	318,200	256,126	256,126	296,863
20%	335,067	318,200	256,126	256,126	296,863
30%	335,067	318,200	256,126	256,126	296,863
40%	335,067	318,200	256,126	256,126	296,863
50%	335,067	318,200	256,126	256,126	296,863
60%	335,067	318,200	256,126	256,126	296,863
70%	335,067	318,200	256,126	256,126	296,863
80%	335,067	296,863	256,126	256,126	296,863
90%	327,741	296,863	256,126	256,126	296,863
Long Term					
Full Simulation Period[b]	332,168	309,022	256,126	256,140	295,108
Water Year Types[c]					
Wet (32%)	335,067	318,200	256,126	256,126	296,863
Above Normal (16%)	335,067	318,200	256,126	256,126	296,863
Below Normal (13%)	334,401	314,321	256,126	256,126	296,863
Dry (24%)	333,236	310,732	256,126	256,126	296,863
Critical (15%)	318,916	271,483	256,126	256,220	284,872

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]					
10%	16,867	0	0	0	0
20%	16,867	0	0	0	0
30%	16,867	0	0	0	0
40%	16,867	0	0	0	0
50%	16,867	0	0	0	0
60%	16,867	0	0	0	0
70%	16,867	0	0	0	0
80%	16,867	0	0	0	0
90%	30,878	0	0	0	0
Long Term					
Full Simulation Period[b]	17,447	0	0	14	0
Water Year Types[c]					
Wet (32%)	16,867	0	0	0	0
Above Normal (16%)	16,867	0	0	0	0
Below Normal (13%)	18,141	0	0	0	0
Dry (24%)	19,303	0	0	0	0
Critical (15%)	15,598	0	0	94	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.7. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA

Table C-7-1. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 1

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-7-2. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-7-3. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification
(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-7-4. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-7-5. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 3

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 3 minus Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification
(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-7-6. Total Clear Creek Steelhead/Rainbow Trout Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	87,297	87,297	87,297	87,297	87,297
20%	87,297	87,297	87,297	87,297	87,297
30%	87,297	87,297	87,297	87,297	87,297
40%	87,297	87,297	87,297	87,297	87,297
50%	87,297	87,297	87,297	87,297	87,297
60%	87,297	87,297	87,297	87,297	87,297
70%	87,297	87,297	87,297	87,297	87,297
80%	87,297	87,297	87,297	87,297	87,297
90%	73,006	73,006	73,006	73,006	73,006
Long Term					
Full Simulation Period[b]	84,256	83,874	84,048	84,414	84,779
Water Year Types[c]					
Wet (32%)	87,297	84,991	84,991	86,144	87,297
Above Normal (16%)	83,999	85,098	86,198	86,198	86,198
Below Normal (13%)	85,998	85,998	85,998	85,998	85,998
Dry (24%)	83,724	84,439	84,439	84,439	84,439
Critical (15%)	77,237	77,237	77,237	77,237	77,237

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.8. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA

Table C-8-1. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Feb	Mar	Apr	May	Jun
	Monthly WUA (Feet2)				
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	212,960	209,184
20%	203,238	203,238	203,238	212,960	209,184
30%	203,238	203,238	203,238	212,960	203,238
40%	203,238	203,238	203,238	212,960	203,238
50%	203,238	203,238	203,238	212,960	203,238
60%	203,238	203,238	203,238	212,960	203,238
70%	203,238	203,238	203,238	212,960	203,238
80%	203,238	203,238	203,238	212,960	203,238
90%	203,238	203,238	203,238	209,153	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	212,118	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	212,960	203,238
Above Normal (16%)	203,695	203,695	203,695	212,960	203,238
Below Normal (13%)	203,779	203,779	203,779	212,614	204,319
Dry (24%)	204,427	204,427	204,427	212,009	205,319
Critical (15%)	207,187	207,187	207,187	209,104	215,493

Alternative 1

Statistic	Feb	Mar	Apr	May	Jun
	Monthly WUA (Feet2)				
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	209,184	209,184
20%	203,238	203,238	203,238	203,238	209,184
30%	203,238	203,238	203,238	203,238	203,238
40%	203,238	203,238	203,238	203,238	203,238
50%	203,238	203,238	203,238	203,238	203,238
60%	203,238	203,238	203,238	203,238	203,238
70%	203,238	203,238	203,238	203,238	203,238
80%	203,238	203,238	203,238	203,238	203,238
90%	203,238	203,238	203,238	203,238	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	204,178	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	203,238	203,238
Above Normal (16%)	203,695	203,695	203,695	203,238	203,238
Below Normal (13%)	203,779	203,779	203,779	203,779	204,319
Dry (24%)	204,427	204,427	204,427	204,427	205,319
Critical (15%)	207,187	207,187	207,187	207,187	215,493

Alternative 1 minus No Action Alternative

Statistic	Feb	Mar	Apr	May	Jun
	Monthly WUA (Feet2)				
Probability of Exceedance[a]					
10%	0	0	0	-3,776	0
20%	0	0	0	-9,722	0
30%	0	0	0	-9,722	0
40%	0	0	0	-9,722	0
50%	0	0	0	-9,722	0
60%	0	0	0	-9,722	0
70%	0	0	0	-9,722	0
80%	0	0	0	-9,722	0
90%	0	0	0	-5,915	0
Long Term					
Full Simulation Period[b]	0	0	0	-7,939	0
Water Year Types[c]					
Wet (32%)	0	0	0	-9,722	0
Above Normal (16%)	0	0	0	-9,722	0
Below Normal (13%)	0	0	0	-8,836	0
Dry (24%)	0	0	0	-7,581	0
Critical (15%)	0	0	0	-1,917	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-8-2. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	212,960	209,184
20%	203,238	203,238	203,238	212,960	209,184
30%	203,238	203,238	203,238	212,960	203,238
40%	203,238	203,238	203,238	212,960	203,238
50%	203,238	203,238	203,238	212,960	203,238
60%	203,238	203,238	203,238	212,960	203,238
70%	203,238	203,238	203,238	212,960	203,238
80%	203,238	203,238	203,238	212,960	203,238
90%	203,238	203,238	203,238	209,153	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	212,118	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	212,960	203,238
Above Normal (16%)	203,695	203,695	203,695	212,960	203,238
Below Normal (13%)	203,779	203,779	203,779	212,614	204,319
Dry (24%)	204,427	204,427	204,427	212,009	205,319
Critical (15%)	207,187	207,187	207,187	209,104	215,493

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	209,184	209,184
20%	203,238	203,238	203,238	203,238	209,184
30%	203,238	203,238	203,238	203,238	203,238
40%	203,238	203,238	203,238	203,238	203,238
50%	203,238	203,238	203,238	203,238	203,238
60%	203,238	203,238	203,238	203,238	203,238
70%	203,238	203,238	203,238	203,238	203,238
80%	203,238	203,238	203,238	203,238	203,238
90%	203,238	203,238	203,238	203,238	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	204,178	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	203,238	203,238
Above Normal (16%)	203,695	203,695	203,695	203,238	203,238
Below Normal (13%)	203,779	203,779	203,779	203,779	204,319
Dry (24%)	204,427	204,427	204,427	204,427	205,319
Critical (15%)	207,187	207,187	207,187	207,187	215,493

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	0	0	0	-3,776	0
20%	0	0	0	-9,722	0
30%	0	0	0	-9,722	0
40%	0	0	0	-9,722	0
50%	0	0	0	-9,722	0
60%	0	0	0	-9,722	0
70%	0	0	0	-9,722	0
80%	0	0	0	-9,722	0
90%	0	0	0	-5,915	0
Long Term					
Full Simulation Period[b]	0	0	0	-7,939	0
Water Year Types[c]					
Wet (32%)	0	0	0	-9,722	0
Above Normal (16%)	0	0	0	-9,722	0
Below Normal (13%)	0	0	0	-8,836	0
Dry (24%)	0	0	0	-7,581	0
Critical (15%)	0	0	0	-1,917	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-8-3. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	212,960	209,184
20%	203,238	203,238	203,238	212,960	209,184
30%	203,238	203,238	203,238	212,960	203,238
40%	203,238	203,238	203,238	212,960	203,238
50%	203,238	203,238	203,238	212,960	203,238
60%	203,238	203,238	203,238	212,960	203,238
70%	203,238	203,238	203,238	212,960	203,238
80%	203,238	203,238	203,238	212,960	203,238
90%	203,238	203,238	203,238	209,153	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	212,118	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	212,960	203,238
Above Normal (16%)	203,695	203,695	203,695	212,960	203,238
Below Normal (13%)	203,779	203,779	203,779	212,614	204,319
Dry (24%)	204,427	204,427	204,427	212,009	205,319
Critical (15%)	207,187	207,187	207,187	209,104	215,493

Alternative 5

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	212,960	209,184
20%	203,238	203,238	203,238	212,960	209,184
30%	203,238	203,238	203,238	212,960	203,238
40%	203,238	203,238	203,238	212,960	203,238
50%	203,238	203,238	203,238	212,960	203,238
60%	203,238	203,238	203,238	212,960	203,238
70%	203,238	203,238	203,238	212,960	203,238
80%	203,238	203,238	203,238	212,960	203,238
90%	203,238	203,238	203,238	209,153	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	212,118	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	212,960	203,238
Above Normal (16%)	203,695	203,695	203,695	212,960	203,238
Below Normal (13%)	203,779	203,779	203,779	212,614	204,319
Dry (24%)	204,427	204,427	204,427	212,009	205,319
Critical (15%)	207,187	207,187	207,187	209,104	215,493

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-8-4. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	209,184	209,184
20%	203,238	203,238	203,238	203,238	209,184
30%	203,238	203,238	203,238	203,238	203,238
40%	203,238	203,238	203,238	203,238	203,238
50%	203,238	203,238	203,238	203,238	203,238
60%	203,238	203,238	203,238	203,238	203,238
70%	203,238	203,238	203,238	203,238	203,238
80%	203,238	203,238	203,238	203,238	203,238
90%	203,238	203,238	203,238	203,238	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	204,178	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	203,238	203,238
Above Normal (16%)	203,695	203,695	203,695	203,238	203,238
Below Normal (13%)	203,779	203,779	203,779	203,779	204,319
Dry (24%)	204,427	204,427	204,427	204,427	205,319
Critical (15%)	207,187	207,187	207,187	207,187	215,493

No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	212,960	209,184
20%	203,238	203,238	203,238	212,960	209,184
30%	203,238	203,238	203,238	212,960	203,238
40%	203,238	203,238	203,238	212,960	203,238
50%	203,238	203,238	203,238	212,960	203,238
60%	203,238	203,238	203,238	212,960	203,238
70%	203,238	203,238	203,238	212,960	203,238
80%	203,238	203,238	203,238	212,960	203,238
90%	203,238	203,238	203,238	209,153	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	212,118	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	212,960	203,238
Above Normal (16%)	203,695	203,695	203,695	212,960	203,238
Below Normal (13%)	203,779	203,779	203,779	212,614	204,319
Dry (24%)	204,427	204,427	204,427	212,009	205,319
Critical (15%)	207,187	207,187	207,187	209,104	215,493

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	0	0	0	3,776	0
20%	0	0	0	9,722	0
30%	0	0	0	9,722	0
40%	0	0	0	9,722	0
50%	0	0	0	9,722	0
60%	0	0	0	9,722	0
70%	0	0	0	9,722	0
80%	0	0	0	9,722	0
90%	0	0	0	5,915	0
Long Term					
Full Simulation Period[b]	0	0	0	7,939	0
Water Year Types[c]					
Wet (32%)	0	0	0	9,722	0
Above Normal (16%)	0	0	0	9,722	0
Below Normal (13%)	0	0	0	8,836	0
Dry (24%)	0	0	0	7,581	0
Critical (15%)	0	0	0	1,917	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification
(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-8-5. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	209,184	209,184
20%	203,238	203,238	203,238	203,238	209,184
30%	203,238	203,238	203,238	203,238	203,238
40%	203,238	203,238	203,238	203,238	203,238
50%	203,238	203,238	203,238	203,238	203,238
60%	203,238	203,238	203,238	203,238	203,238
70%	203,238	203,238	203,238	203,238	203,238
80%	203,238	203,238	203,238	203,238	203,238
90%	203,238	203,238	203,238	203,238	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	204,178	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	203,238	203,238
Above Normal (16%)	203,695	203,695	203,695	203,238	203,238
Below Normal (13%)	203,779	203,779	203,779	203,779	204,319
Dry (24%)	204,427	204,427	204,427	204,427	205,319
Critical (15%)	207,187	207,187	207,187	207,187	215,493

Alternative 3

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	209,184	209,184
20%	203,238	203,238	203,238	203,238	209,184
30%	203,238	203,238	203,238	203,238	203,238
40%	203,238	203,238	203,238	203,238	203,238
50%	203,238	203,238	203,238	203,238	203,238
60%	203,238	203,238	203,238	203,238	203,238
70%	203,238	203,238	203,238	203,238	203,238
80%	203,238	203,238	203,238	203,238	203,238
90%	203,238	203,238	203,238	203,238	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	204,178	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	203,238	203,238
Above Normal (16%)	203,695	203,695	203,695	203,238	203,238
Below Normal (13%)	203,779	203,779	203,779	203,779	204,319
Dry (24%)	204,427	204,427	204,427	204,427	205,319
Critical (15%)	207,187	207,187	207,187	207,187	215,493

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-8-6. Total Clear Creek Steelhead/Rainbow Trout Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	209,184	209,184
20%	203,238	203,238	203,238	203,238	209,184
30%	203,238	203,238	203,238	203,238	203,238
40%	203,238	203,238	203,238	203,238	203,238
50%	203,238	203,238	203,238	203,238	203,238
60%	203,238	203,238	203,238	203,238	203,238
70%	203,238	203,238	203,238	203,238	203,238
80%	203,238	203,238	203,238	203,238	203,238
90%	203,238	203,238	203,238	203,238	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	204,178	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	203,238	203,238
Above Normal (16%)	203,695	203,695	203,695	203,238	203,238
Below Normal (13%)	203,779	203,779	203,779	203,779	204,319
Dry (24%)	204,427	204,427	204,427	204,427	205,319
Critical (15%)	207,187	207,187	207,187	207,187	215,493

Alternative 5

	Monthly WUA (Feet2)				
Statistic	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	209,184	209,184	209,184	212,960	209,184
20%	203,238	203,238	203,238	212,960	209,184
30%	203,238	203,238	203,238	212,960	203,238
40%	203,238	203,238	203,238	212,960	203,238
50%	203,238	203,238	203,238	212,960	203,238
60%	203,238	203,238	203,238	212,960	203,238
70%	203,238	203,238	203,238	212,960	203,238
80%	203,238	203,238	203,238	212,960	203,238
90%	203,238	203,238	203,238	209,153	203,238
Long Term					
Full Simulation Period[b]	206,013	205,132	204,251	212,118	205,684
Water Year Types[c]					
Wet (32%)	208,796	206,017	203,238	212,960	203,238
Above Normal (16%)	203,695	203,695	203,695	212,960	203,238
Below Normal (13%)	203,779	203,779	203,779	212,614	204,319
Dry (24%)	204,427	204,427	204,427	212,009	205,319
Critical (15%)	207,187	207,187	207,187	209,104	215,493

Alternative 5 minus Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	0	0	0	3,776	0
20%	0	0	0	9,722	0
30%	0	0	0	9,722	0
40%	0	0	0	9,722	0
50%	0	0	0	9,722	0
60%	0	0	0	9,722	0
70%	0	0	0	9,722	0
80%	0	0	0	9,722	0
90%	0	0	0	5,915	0
Long Term					
Full Simulation Period[b]	0	0	0	7,939	0
Water Year Types[c]					
Wet (32%)	0	0	0	9,722	0
Above Normal (16%)	0	0	0	9,722	0
Below Normal (13%)	0	0	0	8,836	0
Dry (24%)	0	0	0	7,581	0
Critical (15%)	0	0	0	1,917	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification
(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.9. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA

Table C-9-1. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	397,531	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	378,132	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 1

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	399,868	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	387,712	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 1 minus No Action Alternative

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	0	0	0	0	0	0
20%	0	0	0	0	0	0
30%	0	0	0	0	0	0
40%	0	0	0	0	0	0
50%	0	0	0	0	0	0
60%	0	0	0	0	0	0
70%	0	0	0	0	0	0
80%	0	0	0	0	0	0
90%	0	0	0	0	0	0
Long Term						
Full Simulation Period[b]	0	0	0	2,337	0	0
Water Year Types[c]						
Wet (32%)	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0
Dry (24%)	0	0	0	9,580	0	0
Critical (15%)	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-9-2. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	397,531	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	378,132	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 3

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	399,868	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	387,712	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 3 minus No Action Alternative

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	0	0	0	0	0	0
20%	0	0	0	0	0	0
30%	0	0	0	0	0	0
40%	0	0	0	0	0	0
50%	0	0	0	0	0	0
60%	0	0	0	0	0	0
70%	0	0	0	0	0	0
80%	0	0	0	0	0	0
90%	0	0	0	0	0	0
Long Term						
Full Simulation Period[b]	0	0	0	2,337	0	0
Water Year Types[c]						
Wet (32%)	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0
Dry (24%)	0	0	0	9,580	0	0
Critical (15%)	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-9-3. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)					
	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	397,531	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	378,132	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 5

Statistic	Monthly WUA (Feet2)					
	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,354	349,555	399,466	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	386,066	397,829	404,454
Critical (15%)	249,321	249,542	324,987	367,536	375,476	375,476

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)					
	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	0	0	0	0	0	0
20%	0	0	0	0	0	0
30%	0	0	0	0	0	0
40%	0	0	0	0	0	0
50%	0	0	0	0	0	0
60%	0	0	0	0	0	0
70%	0	0	0	0	0	0
80%	0	0	0	0	0	0
90%	0	0	0	0	0	0
Long Term						
Full Simulation Period[b]	0	32	0	1,935	0	0
Water Year Types[c]						
Wet (32%)	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0
Dry (24%)	0	0	0	7,934	0	0
Critical (15%)	0	221	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-9-4. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	399,868	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	387,712	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

No Action Alternative

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	397,531	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	378,132	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

No Action Alternative minus Second Basis of Comparison

	Monthly WUA (Feet2)					
Statistic	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	0	0	0	0	0	0
20%	0	0	0	0	0	0
30%	0	0	0	0	0	0
40%	0	0	0	0	0	0
50%	0	0	0	0	0	0
60%	0	0	0	0	0	0
70%	0	0	0	0	0	0
80%	0	0	0	0	0	0
90%	0	0	0	0	0	0
Long Term						
Full Simulation Period[b]	0	0	0	-2,337	0	0
Water Year Types[c]						
Wet (32%)	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0
Dry (24%)	0	0	0	-9,580	0	0
Critical (15%)	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-9-5. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)					
	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	399,868	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	387,712	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 3

Statistic	Monthly WUA (Feet2)					
	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	399,868	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	387,712	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)					
	Jul	Aug	Sep	Oct	Nov	Dec
Probability of Exceedance[a]						
10%	0	0	0	0	0	0
20%	0	0	0	0	0	0
30%	0	0	0	0	0	0
40%	0	0	0	0	0	0
50%	0	0	0	0	0	0
60%	0	0	0	0	0	0
70%	0	0	0	0	0	0
80%	0	0	0	0	0	0
90%	0	0	0	0	0	0
Long Term						
Full Simulation Period[b]	0	0	0	0	0	0
Water Year Types[c]						
Wet (32%)	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0
Dry (24%)	0	0	0	0	0	0
Critical (15%)	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-9-6. Total Clear Creek Steelhead/Rainbow Trout Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Jul	Aug	Sep	Oct	Nov	Dec
	Monthly WUA (Feet2)					
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,321	349,555	399,868	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	387,712	397,829	404,454
Critical (15%)	249,321	249,321	324,987	367,536	375,476	375,476

Alternative 5

Statistic	Jul	Aug	Sep	Oct	Nov	Dec
	Monthly WUA (Feet2)					
Probability of Exceedance[a]						
10%	249,321	249,321	353,767	421,350	421,350	421,350
20%	249,321	249,321	353,767	421,350	421,350	421,350
30%	249,321	249,321	353,767	421,350	421,350	421,350
40%	249,321	249,321	353,767	421,350	421,350	421,350
50%	249,321	249,321	353,767	421,350	421,350	421,350
60%	249,321	249,321	353,767	421,350	421,350	421,350
70%	249,321	249,321	353,767	421,350	421,350	421,350
80%	249,321	249,321	353,767	421,350	421,350	421,350
90%	249,321	249,321	353,767	353,767	353,767	353,767
Long Term						
Full Simulation Period[b]	249,321	249,354	349,555	399,466	403,987	407,219
Water Year Types[c]						
Wet (32%)	249,321	249,321	353,767	421,350	421,350	421,350
Above Normal (16%)	249,321	249,321	353,767	392,471	395,561	405,754
Below Normal (13%)	249,321	249,321	353,767	415,206	415,206	415,206
Dry (24%)	249,321	249,321	353,767	386,066	397,829	404,454
Critical (15%)	249,321	249,542	324,987	367,536	375,476	375,476

Alternative 5 minus Second Basis of Comparison

Statistic	Jul	Aug	Sep	Oct	Nov	Dec
	Monthly WUA (Feet2)					
Probability of Exceedance[a]						
10%	0	0	0	0	0	0
20%	0	0	0	0	0	0
30%	0	0	0	0	0	0
40%	0	0	0	0	0	0
50%	0	0	0	0	0	0
60%	0	0	0	0	0	0
70%	0	0	0	0	0	0
80%	0	0	0	0	0	0
90%	0	0	0	0	0	0
Long Term						
Full Simulation Period[b]	0	32	0	-401	0	0
Water Year Types[c]						
Wet (32%)	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0
Dry (24%)	0	0	0	-1,646	0	0
Critical (15%)	0	221	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.10. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA

Table C-10-1. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,611,760	2,611,057	2,612,631	2,612,797
20%	2,600,910	2,599,556	2,544,749	2,589,528
30%	2,581,802	2,577,781	2,470,196	2,545,194
40%	2,559,436	2,524,364	2,399,009	2,498,496
50%	2,464,136	2,469,472	2,240,547	2,431,325
60%	2,074,148	2,362,473	1,937,765	2,177,929
70%	1,759,375	2,239,138	1,726,837	1,647,019
80%	1,312,640	2,159,758	1,469,982	752,125
90%	948,053	2,004,975	1,274,759	401,738
Long Term				
Full Simulation Period[b]	2,061,189	2,370,068	2,033,170	1,914,685
Water Year Types[c]				
Wet (32%)	1,244,507	2,256,115	1,749,171	1,088,491
Above Normal (16%)	2,031,473	2,386,839	1,953,380	1,797,287
Below Normal (13%)	2,534,356	2,340,807	2,010,650	2,442,865
Dry (24%)	2,568,048	2,429,377	2,212,340	2,452,807
Critical (15%)	2,584,359	2,526,770	2,456,964	2,450,916

Alternative 1

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,606,453	2,610,923	2,613,004	2,615,120
20%	2,598,686	2,607,118	2,590,324	2,606,353
30%	2,590,641	2,590,380	2,540,705	2,581,186
40%	2,581,703	2,552,232	2,522,164	2,523,587
50%	2,568,920	2,488,692	2,471,020	2,429,050
60%	2,544,110	2,423,341	2,415,878	2,114,265
70%	2,511,568	2,198,680	2,348,647	1,522,077
80%	2,468,817	2,149,445	2,135,419	649,981
90%	2,037,416	2,077,807	1,651,010	310,774
Long Term				
Full Simulation Period[b]	2,453,532	2,391,156	2,277,239	1,889,000
Water Year Types[c]				
Wet (32%)	2,263,522	2,319,171	2,072,824	1,004,115
Above Normal (16%)	2,482,326	2,412,105	2,220,931	1,815,000
Below Normal (13%)	2,557,385	2,339,463	2,208,996	2,424,318
Dry (24%)	2,557,171	2,404,188	2,483,729	2,453,917
Critical (15%)	2,566,099	2,550,090	2,499,547	2,454,183

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	-5,308	-134	373	2,323
20%	-2,224	7,563	45,576	16,826
30%	8,839	12,598	70,509	35,992
40%	22,267	27,867	123,154	25,091
50%	104,785	19,220	230,473	-2,275
60%	469,961	60,867	478,112	-63,664
70%	752,193	-40,458	621,810	-124,942
80%	1,156,177	-10,312	665,437	-102,144
90%	1,089,363	72,832	376,251	-90,964
Long Term				
Full Simulation Period[b]	392,343	21,088	244,070	-25,685
Water Year Types[c]				
Wet (32%)	1,019,014	63,056	323,653	-84,376
Above Normal (16%)	450,853	25,266	267,551	17,713
Below Normal (13%)	23,029	-1,344	198,346	-18,548
Dry (24%)	-10,877	-25,189	271,389	1,110
Critical (15%)	-18,261	23,320	42,583	3,267

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-10-2. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,611,760	2,611,057	2,612,631	2,612,797
20%	2,600,910	2,599,556	2,544,749	2,589,528
30%	2,581,802	2,577,781	2,470,196	2,545,194
40%	2,559,436	2,524,364	2,399,009	2,498,496
50%	2,464,136	2,469,472	2,240,547	2,431,325
60%	2,074,148	2,362,473	1,937,765	2,177,929
70%	1,759,375	2,239,138	1,726,837	1,647,019
80%	1,312,640	2,159,758	1,469,982	752,125
90%	948,053	2,004,975	1,274,759	401,738
Long Term				
Full Simulation Period[b]	2,061,189	2,370,068	2,033,170	1,914,685
Water Year Types[c]				
Wet (32%)	1,244,507	2,256,115	1,749,171	1,088,491
Above Normal (16%)	2,031,473	2,386,839	1,953,380	1,797,287
Below Normal (13%)	2,534,356	2,340,807	2,010,650	2,442,865
Dry (24%)	2,568,048	2,429,377	2,212,340	2,452,807
Critical (15%)	2,584,359	2,526,770	2,456,964	2,450,916

Alternative 3

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,610,761	2,611,696	2,613,329	2,615,189
20%	2,605,860	2,608,507	2,597,800	2,597,011
30%	2,594,432	2,590,731	2,559,776	2,574,680
40%	2,575,290	2,563,650	2,536,506	2,498,042
50%	2,560,249	2,498,190	2,464,905	2,429,136
60%	2,516,696	2,350,599	2,425,645	2,114,277
70%	2,467,821	2,244,905	2,344,898	1,689,342
80%	2,260,206	2,149,050	2,185,503	596,021
90%	2,071,507	2,050,347	1,540,280	310,571
Long Term				
Full Simulation Period[b]	2,418,831	2,385,202	2,288,411	1,894,223
Water Year Types[c]				
Wet (32%)	2,233,398	2,330,886	2,080,687	1,020,249
Above Normal (16%)	2,488,512	2,398,918	2,211,994	1,836,432
Below Normal (13%)	2,328,080	2,356,349	2,250,946	2,425,247
Dry (24%)	2,574,770	2,356,076	2,477,850	2,440,175
Critical (15%)	2,568,402	2,563,018	2,539,877	2,453,750

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	-999	639	699	2,392
20%	4,950	8,952	53,051	7,483
30%	12,630	12,949	89,580	29,487
40%	15,854	39,286	137,497	-453
50%	96,114	28,718	224,358	-2,189
60%	442,548	-11,874	487,880	-63,652
70%	708,446	5,767	618,060	42,322
80%	947,565	-10,708	715,521	-156,104
90%	1,123,455	45,372	265,521	-91,166
Long Term				
Full Simulation Period[b]	357,641	15,134	255,241	-20,462
Water Year Types[c]				
Wet (32%)	988,891	74,771	331,515	-68,242
Above Normal (16%)	457,039	12,079	258,615	39,145
Below Normal (13%)	-206,276	15,542	240,296	-17,618
Dry (24%)	6,722	-73,301	265,510	-12,632
Critical (15%)	-15,957	36,248	82,913	2,835

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-10-3. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)			
Statistic	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,611,760	2,611,057	2,612,631	2,612,797
20%	2,600,910	2,599,556	2,544,749	2,589,528
30%	2,581,802	2,577,781	2,470,196	2,545,194
40%	2,559,436	2,524,364	2,399,009	2,498,496
50%	2,464,136	2,469,472	2,240,547	2,431,325
60%	2,074,148	2,362,473	1,937,765	2,177,929
70%	1,759,375	2,239,138	1,726,837	1,647,019
80%	1,312,640	2,159,758	1,469,982	752,125
90%	948,053	2,004,975	1,274,759	401,738
Long Term				
Full Simulation Period[b]	2,061,189	2,370,068	2,033,170	1,914,685
Water Year Types[c]				
Wet (32%)	1,244,507	2,256,115	1,749,171	1,088,491
Above Normal (16%)	2,031,473	2,386,839	1,953,380	1,797,287
Below Normal (13%)	2,534,356	2,340,807	2,010,650	2,442,865
Dry (24%)	2,568,048	2,429,377	2,212,340	2,452,807
Critical (15%)	2,584,359	2,526,770	2,456,964	2,450,916

Alternative 5

	Monthly WUA (Feet2)			
Statistic	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,611,931	2,609,252	2,613,648	2,612,701
20%	2,607,848	2,599,478	2,548,586	2,589,573
30%	2,589,521	2,577,154	2,472,212	2,546,403
40%	2,572,950	2,530,355	2,394,587	2,508,878
50%	2,473,102	2,466,248	2,237,779	2,430,966
60%	2,098,873	2,353,753	1,900,885	2,177,965
70%	1,776,211	2,248,644	1,721,923	1,646,356
80%	1,312,108	2,161,981	1,478,431	755,029
90%	949,948	1,989,000	1,277,028	418,307
Long Term				
Full Simulation Period[b]	2,068,256	2,374,403	2,031,675	1,916,401
Water Year Types[c]				
Wet (32%)	1,250,456	2,271,658	1,734,787	1,088,118
Above Normal (16%)	2,047,769	2,375,225	1,958,032	1,796,068
Below Normal (13%)	2,524,203	2,343,624	2,012,371	2,447,206
Dry (24%)	2,581,652	2,435,460	2,217,886	2,454,150
Critical (15%)	2,588,738	2,522,580	2,462,055	2,458,554

Alternative 5 minus No Action Alternative

	Monthly WUA (Feet2)			
Statistic	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	170	**-1,805**	1,018	**-96**
20%	6,938	**-78**	3,837	45
30%	7,719	**-628**	2,015	1,209
40%	13,515	5,991	**-4,422**	10,383
50%	8,966	**-3,224**	**-2,768**	**-359**
60%	24,725	**-8,721**	**-36,881**	36
70%	16,836	9,506	**-4,914**	**-664**
80%	**-532**	2,223	8,449	2,904
90%	1,896	**-15,974**	2,268	16,570
Long Term				
Full Simulation Period[b]	7,066	4,335	**-1,495**	1,716
Water Year Types[c]				
Wet (32%)	5,949	15,543	**-14,384**	**-373**
Above Normal (16%)	16,296	**-11,614**	4,652	**-1,220**
Below Normal (13%)	**-10,153**	2,817	1,721	4,341
Dry (24%)	13,604	6,083	5,547	1,343
Critical (15%)	4,379	**-4,190**	5,091	7,638

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-10-4. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,606,453	2,610,923	2,613,004	2,615,120
20%	2,598,686	2,607,118	2,590,324	2,606,353
30%	2,590,641	2,590,380	2,540,705	2,581,186
40%	2,581,703	2,552,232	2,522,164	2,523,587
50%	2,568,920	2,488,692	2,471,020	2,429,050
60%	2,544,110	2,423,341	2,415,878	2,114,265
70%	2,511,568	2,198,680	2,348,647	1,522,077
80%	2,468,817	2,149,445	2,135,419	649,981
90%	2,037,416	2,077,807	1,651,010	310,774
Long Term				
Full Simulation Period[b]	2,453,532	2,391,156	2,277,239	1,889,000
Water Year Types[c]				
Wet (32%)	2,263,522	2,319,171	2,072,824	1,004,115
Above Normal (16%)	2,482,326	2,412,105	2,220,931	1,815,000
Below Normal (13%)	2,557,385	2,339,463	2,208,996	2,424,318
Dry (24%)	2,557,171	2,404,188	2,483,729	2,453,917
Critical (15%)	2,566,099	2,550,090	2,499,547	2,454,183

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,611,760	2,611,057	2,612,631	2,612,797
20%	2,600,910	2,599,556	2,544,749	2,589,528
30%	2,581,802	2,577,781	2,470,196	2,545,194
40%	2,559,436	2,524,364	2,399,009	2,498,496
50%	2,464,136	2,469,472	2,240,547	2,431,325
60%	2,074,148	2,362,473	1,937,765	2,177,929
70%	1,759,375	2,239,138	1,726,837	1,647,019
80%	1,312,640	2,159,758	1,469,982	752,125
90%	948,053	2,004,975	1,274,759	401,738
Long Term				
Full Simulation Period[b]	2,061,189	2,370,068	2,033,170	1,914,685
Water Year Types[c]				
Wet (32%)	1,244,507	2,256,115	1,749,171	1,088,491
Above Normal (16%)	2,031,473	2,386,839	1,953,380	1,797,287
Below Normal (13%)	2,534,356	2,340,807	2,010,650	2,442,865
Dry (24%)	2,568,048	2,429,377	2,212,340	2,452,807
Critical (15%)	2,584,359	2,526,770	2,456,964	2,450,916

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	5,308	134	-373	-2,323
20%	2,224	-7,563	-45,576	-16,826
30%	-8,839	-12,598	-70,509	-35,992
40%	-22,267	-27,867	-123,154	-25,091
50%	-104,785	-19,220	-230,473	2,275
60%	-469,961	-60,867	-478,112	63,664
70%	-752,193	40,458	-621,810	124,942
80%	-1,156,177	10,312	-665,437	102,144
90%	-1,089,363	-72,832	-376,251	90,964
Long Term				
Full Simulation Period[b]	-392,343	-21,088	-244,070	25,685
Water Year Types[c]				
Wet (32%)	-1,019,014	-63,056	-323,653	84,376
Above Normal (16%)	-450,853	-25,266	-267,551	-17,713
Below Normal (13%)	-23,029	1,344	-198,346	18,548
Dry (24%)	10,877	25,189	-271,389	-1,110
Critical (15%)	18,261	-23,320	-42,583	-3,267

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-10-5. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,606,453	2,610,923	2,613,004	2,615,120
20%	2,598,686	2,607,118	2,590,324	2,606,353
30%	2,590,641	2,590,380	2,540,705	2,581,186
40%	2,581,703	2,552,232	2,522,164	2,523,587
50%	2,568,920	2,488,692	2,471,020	2,429,050
60%	2,544,110	2,423,341	2,415,878	2,114,265
70%	2,511,568	2,198,680	2,348,647	1,522,077
80%	2,468,817	2,149,445	2,135,419	649,981
90%	2,037,416	2,077,807	1,651,010	310,774
Long Term				
Full Simulation Period[b]	2,453,532	2,391,156	2,277,239	1,889,000
Water Year Types[c]				
Wet (32%)	2,263,522	2,319,171	2,072,824	1,004,115
Above Normal (16%)	2,482,326	2,412,105	2,220,931	1,815,000
Below Normal (13%)	2,557,385	2,339,463	2,208,996	2,424,318
Dry (24%)	2,557,171	2,404,188	2,483,729	2,453,917
Critical (15%)	2,566,099	2,550,090	2,499,547	2,454,183

Alternative 3

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,610,761	2,611,696	2,613,329	2,615,189
20%	2,605,860	2,608,507	2,597,800	2,597,011
30%	2,594,432	2,590,731	2,559,776	2,574,680
40%	2,575,290	2,563,650	2,536,506	2,498,042
50%	2,560,249	2,498,190	2,464,905	2,429,136
60%	2,516,696	2,350,599	2,425,645	2,114,277
70%	2,467,821	2,244,905	2,344,898	1,689,342
80%	2,260,206	2,149,050	2,185,503	596,021
90%	2,071,507	2,050,347	1,540,280	310,571
Long Term				
Full Simulation Period[b]	2,418,831	2,385,202	2,288,411	1,894,223
Water Year Types[c]				
Wet (32%)	2,233,398	2,330,886	2,080,687	1,020,249
Above Normal (16%)	2,488,512	2,398,918	2,211,994	1,836,432
Below Normal (13%)	2,328,080	2,356,349	2,250,946	2,425,247
Dry (24%)	2,574,770	2,356,076	2,477,850	2,440,175
Critical (15%)	2,568,402	2,563,018	2,539,877	2,453,750

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	4,308	773	326	69
20%	7,174	1,389	7,475	-9,343
30%	3,791	351	19,071	-6,505
40%	-6,413	11,418	14,343	-25,545
50%	-8,671	9,498	-6,115	86
60%	-27,413	-72,742	9,768	12
70%	-43,748	46,225	-3,750	167,265
80%	-208,611	-395	50,083	-53,960
90%	34,091	-27,459	-110,730	-202
Long Term				
Full Simulation Period[b]	-34,702	-5,954	11,172	5,223
Water Year Types[c]				
Wet (32%)	-30,124	11,715	7,863	16,134
Above Normal (16%)	6,186	-13,187	-8,936	21,431
Below Normal (13%)	-229,305	16,886	41,950	930
Dry (24%)	17,599	-48,112	-5,880	-13,742
Critical (15%)	2,304	12,928	40,330	-433

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-10-6. Sacramento River Battle Creek to Deer Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,606,453	2,610,923	2,613,004	2,615,120
20%	2,598,686	2,607,118	2,590,324	2,606,353
30%	2,590,641	2,590,380	2,540,705	2,581,186
40%	2,581,703	2,552,232	2,522,164	2,523,587
50%	2,568,920	2,488,692	2,471,020	2,429,050
60%	2,544,110	2,423,341	2,415,878	2,114,265
70%	2,511,568	2,198,680	2,348,647	1,522,077
80%	2,468,817	2,149,445	2,135,419	649,981
90%	2,037,416	2,077,807	1,651,010	310,774
Long Term				
Full Simulation Period[b]	2,453,532	2,391,156	2,277,239	1,889,000
Water Year Types[c]				
Wet (32%)	2,263,522	2,319,171	2,072,824	1,004,115
Above Normal (16%)	2,482,326	2,412,105	2,220,931	1,815,000
Below Normal (13%)	2,557,385	2,339,463	2,208,996	2,424,318
Dry (24%)	2,557,171	2,404,188	2,483,729	2,453,917
Critical (15%)	2,566,099	2,550,090	2,499,547	2,454,183

Alternative 5

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	2,611,931	2,609,252	2,613,648	2,612,701
20%	2,607,848	2,599,478	2,548,586	2,589,573
30%	2,589,521	2,577,154	2,472,212	2,546,403
40%	2,572,950	2,530,355	2,394,587	2,508,878
50%	2,473,102	2,466,248	2,237,779	2,430,966
60%	2,098,873	2,353,753	1,900,885	2,177,965
70%	1,776,211	2,248,644	1,721,923	1,646,356
80%	1,312,108	2,161,981	1,478,431	755,029
90%	949,948	1,989,000	1,277,028	418,307
Long Term				
Full Simulation Period[b]	2,068,256	2,374,403	2,031,675	1,916,401
Water Year Types[c]				
Wet (32%)	1,250,456	2,271,658	1,734,787	1,088,118
Above Normal (16%)	2,047,769	2,375,225	1,958,032	1,796,068
Below Normal (13%)	2,524,203	2,343,624	2,012,371	2,447,206
Dry (24%)	2,581,652	2,435,460	2,217,886	2,454,150
Critical (15%)	2,588,738	2,522,580	2,462,055	2,458,554

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	5,478	-1,672	645	-2,419
20%	9,162	-7,640	-41,738	-16,781
30%	-1,120	-13,226	-68,493	-34,783
40%	-8,753	-21,877	-127,576	-14,709
50%	-95,819	-22,444	-233,241	1,916
60%	-445,236	-69,588	-514,993	63,700
70%	-735,357	49,964	-626,724	124,278
80%	-1,156,709	12,535	-656,989	105,048
90%	-1,087,468	-88,806	-373,982	107,534
Long Term				
Full Simulation Period[b]	-385,276	-16,752	-245,564	27,401
Water Year Types[c]				
Wet (32%)	-1,013,066	-47,514	-338,037	84,003
Above Normal (16%)	-434,557	-36,880	-262,899	-18,933
Below Normal (13%)	-33,182	4,162	-196,625	22,889
Dry (24%)	24,481	31,272	-265,843	233
Critical (15%)	22,640	-27,510	-37,492	4,371

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.11. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA

Table C-11-1. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,074,933	1,071,766	1,084,531	1,090,813
20%	1,068,693	1,055,003	1,083,385	1,086,203
30%	1,059,032	1,028,294	1,064,343	1,084,597
40%	1,022,534	981,340	1,028,071	1,084,031
50%	946,852	935,007	938,966	1,083,095
60%	679,708	857,031	826,749	1,071,937
70%	547,205	804,100	693,902	994,128
80%	415,717	737,992	541,879	612,062
90%	288,927	684,923	443,183	241,531
Long Term				
Full Simulation Period[b]	775,472	901,077	838,248	894,774
Water Year Types[c]				
Wet (32%)	397,164	848,767	756,753	608,821
Above Normal (16%)	676,556	915,921	815,092	869,943
Below Normal (13%)	999,599	866,710	827,549	1,077,935
Dry (24%)	1,041,977	916,695	874,647	1,074,316
Critical (15%)	1,052,675	1,003,809	989,051	1,074,106

Alternative 1

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,075,063	1,084,537	1,088,587	1,090,562
20%	1,070,202	1,070,164	1,084,595	1,086,381
30%	1,061,602	1,039,011	1,077,634	1,085,311
40%	1,024,656	1,007,580	1,069,954	1,084,228
50%	1,010,066	958,002	1,034,898	1,082,736
60%	984,835	915,882	1,006,817	1,073,877
70%	955,282	792,903	963,392	922,017
80%	921,879	736,193	853,474	440,476
90%	666,878	689,992	766,031	176,647
Long Term				
Full Simulation Period[b]	954,392	915,813	964,036	870,201
Water Year Types[c]				
Wet (32%)	838,409	885,485	919,516	516,092
Above Normal (16%)	946,747	928,105	929,572	906,878
Below Normal (13%)	1,002,301	871,146	939,385	1,070,070
Dry (24%)	1,033,166	906,014	1,025,717	1,076,055
Critical (15%)	1,038,764	1,025,479	1,017,627	1,071,403

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	130	12,771	4,056	-250
20%	1,509	15,160	1,210	178
30%	2,570	10,717	13,292	714
40%	2,122	26,240	41,883	197
50%	63,215	22,995	95,932	-360
60%	305,127	58,852	180,068	1,940
70%	408,077	-11,197	269,489	-72,111
80%	506,162	-1,800	311,594	-171,587
90%	377,950	5,069	322,847	-64,884
Long Term				
Full Simulation Period[b]	178,920	14,735	125,788	-24,573
Water Year Types[c]				
Wet (32%)	441,244	36,718	162,763	-92,729
Above Normal (16%)	270,191	12,185	114,481	36,935
Below Normal (13%)	2,702	4,436	111,836	-7,866
Dry (24%)	-8,811	-10,681	151,070	1,738
Critical (15%)	-13,911	21,670	28,576	-2,703

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-11-2. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,074,933	1,071,766	1,084,531	1,090,813
20%	1,068,693	1,055,003	1,083,385	1,086,203
30%	1,059,032	1,028,294	1,064,343	1,084,597
40%	1,022,534	981,340	1,028,071	1,084,031
50%	946,852	935,007	938,966	1,083,095
60%	679,708	857,031	826,749	1,071,937
70%	547,205	804,100	693,902	994,128
80%	415,717	737,992	541,879	612,062
90%	288,927	684,923	443,183	241,531
Long Term				
Full Simulation Period[b]	775,472	901,077	838,248	894,774
Water Year Types[c]				
Wet (32%)	397,164	848,767	756,753	608,821
Above Normal (16%)	676,556	915,921	815,092	869,943
Below Normal (13%)	999,599	866,710	827,549	1,077,935
Dry (24%)	1,041,977	916,695	874,647	1,074,316
Critical (15%)	1,052,675	1,003,809	989,051	1,074,106

Alternative 3

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,075,087	1,078,796	1,086,362	1,091,106
20%	1,067,969	1,062,764	1,084,474	1,086,289
30%	1,050,075	1,033,900	1,079,992	1,084,965
40%	1,029,594	1,007,376	1,071,104	1,084,236
50%	999,853	962,210	1,045,663	1,082,321
60%	967,954	884,014	1,018,409	1,065,798
70%	928,132	807,938	964,944	940,990
80%	806,964	724,973	895,430	431,219
90%	691,766	684,537	763,489	175,746
Long Term				
Full Simulation Period[b]	932,453	909,513	970,527	869,416
Water Year Types[c]				
Wet (32%)	818,164	890,447	924,853	519,907
Above Normal (16%)	949,036	918,229	919,388	904,151
Below Normal (13%)	870,415	880,602	965,796	1,070,366
Dry (24%)	1,041,141	878,291	1,022,832	1,070,050
Critical (15%)	1,037,833	1,019,916	1,042,050	1,070,462

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	154	7,030	1,830	293
20%	-724	7,761	1,089	86
30%	-8,957	5,606	15,649	369
40%	7,061	26,036	43,033	205
50%	53,001	27,203	106,698	-775
60%	288,246	26,983	191,660	-6,139
70%	380,927	3,838	271,041	-53,138
80%	391,247	-13,019	353,551	-180,843
90%	402,839	-387	320,305	-65,785
Long Term				
Full Simulation Period[b]	156,980	8,435	132,279	-25,359
Water Year Types[c]				
Wet (32%)	421,000	41,680	168,100	-88,914
Above Normal (16%)	272,480	2,309	104,297	34,209
Below Normal (13%)	-129,184	13,892	138,247	-7,570
Dry (24%)	-837	-38,405	148,185	-4,267
Critical (15%)	-14,842	16,108	52,999	-3,645

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-11-3. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,074,933	1,071,766	1,084,531	1,090,813
20%	1,068,693	1,055,003	1,083,385	1,086,203
30%	1,059,032	1,028,294	1,064,343	1,084,597
40%	1,022,534	981,340	1,028,071	1,084,031
50%	946,852	935,007	938,966	1,083,095
60%	679,708	857,031	826,749	1,071,937
70%	547,205	804,100	693,902	994,128
80%	415,717	737,992	541,879	612,062
90%	288,927	684,923	443,183	241,531
Long Term				
Full Simulation Period[b]	775,472	901,077	838,248	894,774
Water Year Types[c]				
Wet (32%)	397,164	848,767	756,753	608,821
Above Normal (16%)	676,556	915,921	815,092	869,943
Below Normal (13%)	999,599	866,710	827,549	1,077,935
Dry (24%)	1,041,977	916,695	874,647	1,074,316
Critical (15%)	1,052,675	1,003,809	989,051	1,074,106

Alternative 5

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,072,916	1,069,935	1,086,073	1,090,825
20%	1,063,291	1,041,299	1,083,662	1,086,256
30%	1,039,438	1,024,636	1,068,169	1,084,652
40%	1,010,234	979,947	1,037,490	1,084,126
50%	961,558	933,945	943,760	1,083,444
60%	699,800	865,331	813,216	1,074,982
70%	551,004	814,714	677,917	1,002,473
80%	430,718	753,181	543,537	619,534
90%	289,670	673,982	444,992	248,783
Long Term				
Full Simulation Period[b]	774,734	901,062	838,739	895,619
Water Year Types[c]				
Wet (32%)	398,505	855,599	750,331	609,125
Above Normal (16%)	686,295	908,103	821,298	866,608
Below Normal (13%)	987,463	868,779	828,188	1,079,389
Dry (24%)	1,043,490	919,730	879,326	1,075,557
Critical (15%)	1,042,779	990,417	991,210	1,079,429

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	-2,018	-1,831	1,542	12
20%	-5,402	-13,704	278	53
30%	-19,594	-3,658	3,826	56
40%	-12,300	-1,393	9,419	94
50%	14,707	-1,062	4,794	349
60%	20,092	8,300	-13,534	3,046
70%	3,799	10,614	-15,985	8,345
80%	15,001	15,189	1,658	7,472
90%	743	-10,942	1,809	7,252
Long Term				
Full Simulation Period[b]	-738	-15	490	844
Water Year Types[c]				
Wet (32%)	1,341	6,832	-6,422	304
Above Normal (16%)	9,739	-7,817	6,206	-3,335
Below Normal (13%)	-12,137	2,069	638	1,454
Dry (24%)	1,513	3,035	4,679	1,240
Critical (15%)	-9,896	-13,392	2,159	5,322

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-11-4. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)			
Statistic	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,075,063	1,084,537	1,088,587	1,090,562
20%	1,070,202	1,070,164	1,084,595	1,086,381
30%	1,061,602	1,039,011	1,077,634	1,085,311
40%	1,024,656	1,007,580	1,069,954	1,084,228
50%	1,010,066	958,002	1,034,898	1,082,736
60%	984,835	915,882	1,006,817	1,073,877
70%	955,282	792,903	963,392	922,017
80%	921,879	736,193	853,474	440,476
90%	666,878	689,992	766,031	176,647
Long Term				
Full Simulation Period[b]	954,392	915,813	964,036	870,201
Water Year Types[c]				
Wet (32%)	838,409	885,485	919,516	516,092
Above Normal (16%)	946,747	928,105	929,572	906,878
Below Normal (13%)	1,002,301	871,146	939,385	1,070,070
Dry (24%)	1,033,166	906,014	1,025,717	1,076,055
Critical (15%)	1,038,764	1,025,479	1,017,627	1,071,403

No Action Alternative

	Monthly WUA (Feet2)			
Statistic	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,074,933	1,071,766	1,084,531	1,090,813
20%	1,068,693	1,055,003	1,083,385	1,086,203
30%	1,059,032	1,028,294	1,064,343	1,084,597
40%	1,022,534	981,340	1,028,071	1,084,031
50%	946,852	935,007	938,966	1,083,095
60%	679,708	857,031	826,749	1,071,937
70%	547,205	804,100	693,902	994,128
80%	415,717	737,992	541,879	612,062
90%	288,927	684,923	443,183	241,531
Long Term				
Full Simulation Period[b]	775,472	901,077	838,248	894,774
Water Year Types[c]				
Wet (32%)	397,164	848,767	756,753	608,821
Above Normal (16%)	676,556	915,921	815,092	869,943
Below Normal (13%)	999,599	866,710	827,549	1,077,935
Dry (24%)	1,041,977	916,695	874,647	1,074,316
Critical (15%)	1,052,675	1,003,809	989,051	1,074,106

No Action Alternative minus Second Basis of Comparison

	Monthly WUA (Feet2)			
Statistic	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	-130	-12,771	-4,056	250
20%	-1,509	-15,160	-1,210	-178
30%	-2,570	-10,717	-13,292	-714
40%	-2,122	-26,240	-41,883	-197
50%	-63,215	-22,995	-95,932	360
60%	-305,127	-58,852	-180,068	-1,940
70%	-408,077	11,197	-269,489	72,111
80%	-506,162	1,800	-311,594	171,587
90%	-377,950	-5,069	-322,847	64,884
Long Term				
Full Simulation Period[b]	-178,920	-14,735	-125,788	24,573
Water Year Types[c]				
Wet (32%)	-441,244	-36,718	-162,763	92,729
Above Normal (16%)	-270,191	-12,185	-114,481	-36,935
Below Normal (13%)	-2,702	-4,436	-111,836	7,866
Dry (24%)	8,811	10,681	-151,070	-1,738
Critical (15%)	13,911	-21,670	-28,576	2,703

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-11-5. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,075,063	1,084,537	1,088,587	1,090,562
20%	1,070,202	1,070,164	1,084,595	1,086,381
30%	1,061,602	1,039,011	1,077,634	1,085,311
40%	1,024,656	1,007,580	1,069,954	1,084,228
50%	1,010,066	958,002	1,034,898	1,082,736
60%	984,835	915,882	1,006,817	1,073,877
70%	955,282	792,903	963,392	922,017
80%	921,879	736,193	853,474	440,476
90%	666,878	689,992	766,031	176,647
Long Term				
Full Simulation Period[b]	954,392	915,813	964,036	870,201
Water Year Types[c]				
Wet (32%)	838,409	885,485	919,516	516,092
Above Normal (16%)	946,747	928,105	929,572	906,878
Below Normal (13%)	1,002,301	871,146	939,385	1,070,070
Dry (24%)	1,033,166	906,014	1,025,717	1,076,055
Critical (15%)	1,038,764	1,025,479	1,017,627	1,071,403

Alternative 3

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,075,087	1,078,796	1,086,362	1,091,106
20%	1,067,969	1,062,764	1,084,474	1,086,289
30%	1,050,075	1,033,900	1,079,992	1,084,965
40%	1,029,594	1,007,376	1,071,104	1,084,236
50%	999,853	962,210	1,045,663	1,082,321
60%	967,954	884,014	1,018,409	1,065,798
70%	928,132	807,938	964,944	940,990
80%	806,964	724,973	895,430	431,219
90%	691,766	684,537	763,489	175,746
Long Term				
Full Simulation Period[b]	932,453	909,513	970,527	869,416
Water Year Types[c]				
Wet (32%)	818,164	890,447	924,853	519,907
Above Normal (16%)	949,036	918,229	919,388	904,151
Below Normal (13%)	870,415	880,602	965,796	1,070,366
Dry (24%)	1,041,141	878,291	1,022,832	1,070,050
Critical (15%)	1,037,833	1,019,916	1,042,050	1,070,462

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	24	-5,741	-2,226	543
20%	-2,233	-7,399	-121	-92
30%	-11,527	-5,111	2,358	-346
40%	4,938	-204	1,150	8
50%	-10,214	4,208	10,766	-415
60%	-16,881	-31,869	11,592	-8,079
70%	-27,150	15,035	1,552	18,973
80%	-114,915	-11,219	41,957	-9,256
90%	24,889	-5,456	-2,542	-901
Long Term				
Full Simulation Period[b]	-21,939	-6,300	6,491	-785
Water Year Types[c]				
Wet (32%)	-20,245	4,962	5,337	3,815
Above Normal (16%)	2,289	-9,876	-10,184	-2,726
Below Normal (13%)	-131,886	9,456	26,412	296
Dry (24%)	7,974	-27,724	-2,885	-6,005
Critical (15%)	-931	-5,562	24,423	-942

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-11-6. Sacramento River Keswick to Battle Creek Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,075,063	1,084,537	1,088,587	1,090,562
20%	1,070,202	1,070,164	1,084,595	1,086,381
30%	1,061,602	1,039,011	1,077,634	1,085,311
40%	1,024,656	1,007,580	1,069,954	1,084,228
50%	1,010,066	958,002	1,034,898	1,082,736
60%	984,835	915,882	1,006,817	1,073,877
70%	955,282	792,903	963,392	922,017
80%	921,879	736,193	853,474	440,476
90%	666,878	689,992	766,031	176,647
Long Term				
Full Simulation Period[b]	954,392	915,813	964,036	870,201
Water Year Types[c]				
Wet (32%)	838,409	885,485	919,516	516,092
Above Normal (16%)	946,747	928,105	929,572	906,878
Below Normal (13%)	1,002,301	871,146	939,385	1,070,070
Dry (24%)	1,033,166	906,014	1,025,717	1,076,055
Critical (15%)	1,038,764	1,025,479	1,017,627	1,071,403

Alternative 5

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	1,072,916	1,069,935	1,086,073	1,090,825
20%	1,063,291	1,041,299	1,083,662	1,086,256
30%	1,039,438	1,024,636	1,068,169	1,084,652
40%	1,010,234	979,947	1,037,490	1,084,126
50%	961,558	933,945	943,760	1,083,444
60%	699,800	865,331	813,216	1,074,982
70%	551,004	814,714	677,917	1,002,473
80%	430,718	753,181	543,537	619,534
90%	289,670	673,982	444,992	248,783
Long Term				
Full Simulation Period[b]	774,734	901,062	838,739	895,619
Water Year Types[c]				
Wet (32%)	398,505	855,599	750,331	609,125
Above Normal (16%)	686,295	908,103	821,298	866,608
Below Normal (13%)	987,463	868,779	828,188	1,079,389
Dry (24%)	1,043,490	919,730	879,326	1,075,557
Critical (15%)	1,042,779	990,417	991,210	1,079,429

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)			
	Sep	Oct	Nov	Dec
Probability of Exceedance[a]				
10%	-2,148	-14,602	-2,514	263
20%	-6,911	-28,864	-932	-125
30%	-22,164	-14,375	-9,466	-659
40%	-14,422	-27,632	-32,464	-103
50%	-48,508	-24,057	-91,137	708
60%	-285,035	-50,552	-193,602	1,106
70%	-404,278	21,811	-285,474	80,456
80%	-491,161	16,989	-309,936	179,059
90%	-377,207	-16,011	-321,039	72,135
Long Term				
Full Simulation Period[b]	-179,658	-14,750	-125,297	25,418
Water Year Types[c]				
Wet (32%)	-439,904	-29,886	-169,185	93,034
Above Normal (16%)	-260,452	-20,002	-108,275	-40,270
Below Normal (13%)	-14,839	-2,367	-111,197	9,320
Dry (24%)	10,324	13,715	-146,391	-498
Critical (15%)	4,015	-35,062	-26,417	8,026

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.12. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA

Table C-12-1. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,999	1,837,941	1,839,149	1,846,924
20%	1,833,589	1,834,217	1,834,343	1,839,318
30%	1,811,962	1,829,031	1,830,698	1,834,085
40%	1,775,420	1,812,257	1,811,473	1,810,269
50%	1,766,469	1,745,795	1,661,674	1,743,299
60%	1,688,348	1,645,492	1,530,919	1,653,325
70%	1,428,559	1,311,020	1,311,020	1,311,020
80%	1,276,856	1,231,975	1,281,326	1,225,664
90%	1,183,556	1,108,337	1,220,578	1,108,003
Long Term				
Full Simulation Period[b]	1,602,491	1,590,612	1,571,611	1,583,807
Water Year Types[c]				
Wet (32%)	1,383,273	1,344,092	1,371,660	1,330,653
Above Normal (16%)	1,538,908	1,472,333	1,441,339	1,466,921
Below Normal (13%)	1,738,904	1,759,324	1,574,595	1,732,096
Dry (24%)	1,747,973	1,757,216	1,787,039	1,758,763
Critical (15%)	1,778,828	1,820,551	1,784,184	1,831,408

Alternative 1

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,447	1,837,875	1,839,315	1,846,944
20%	1,827,387	1,834,682	1,834,204	1,839,665
30%	1,810,323	1,829,615	1,828,499	1,833,002
40%	1,775,114	1,793,817	1,802,530	1,808,892
50%	1,760,438	1,706,232	1,673,635	1,704,154
60%	1,696,983	1,581,030	1,439,494	1,640,408
70%	1,311,416	1,303,986	1,311,020	1,300,764
80%	1,268,338	1,215,295	1,277,051	1,220,621
90%	1,177,260	1,104,493	1,197,414	1,116,350
Long Term				
Full Simulation Period[b]	1,597,909	1,557,190	1,564,976	1,570,429
Water Year Types[c]				
Wet (32%)	1,343,276	1,326,407	1,351,949	1,330,942
Above Normal (16%)	1,591,617	1,433,555	1,399,937	1,427,190
Below Normal (13%)	1,726,938	1,645,079	1,574,016	1,664,987
Dry (24%)	1,758,414	1,744,848	1,786,756	1,768,554
Critical (15%)	1,770,645	1,797,825	1,827,406	1,827,605

Alternative 1 minus No Action Alternative

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	-552	-66	166	20
20%	-6,202	465	-139	347
30%	-1,639	584	-2,198	-1,083
40%	-306	-18,440	-8,942	-1,378
50%	-6,031	-39,563	11,961	-39,146
60%	8,635	-64,462	-91,424	-12,917
70%	-117,143	-7,034	0	-10,256
80%	-8,518	-16,680	-4,275	-5,044
90%	-6,295	-3,845	-23,163	8,348
Long Term				
Full Simulation Period[b]	-4,582	-33,423	-6,635	-13,378
Water Year Types[c]				
Wet (32%)	-39,998	-17,685	-19,712	289
Above Normal (16%)	52,708	-38,777	-41,402	-39,731
Below Normal (13%)	-11,966	-114,245	-580	-67,110
Dry (24%)	10,442	-12,368	-283	9,791
Critical (15%)	-8,182	-22,725	43,222	-3,803

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-12-2. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,999	1,837,941	1,839,149	1,846,924
20%	1,833,589	1,834,217	1,834,343	1,839,318
30%	1,811,962	1,829,031	1,830,698	1,834,085
40%	1,775,420	1,812,257	1,811,473	1,810,269
50%	1,766,469	1,745,795	1,661,674	1,743,299
60%	1,688,348	1,645,492	1,530,919	1,653,325
70%	1,428,559	1,311,020	1,311,020	1,311,020
80%	1,276,856	1,231,975	1,281,326	1,225,664
90%	1,183,556	1,108,337	1,220,578	1,108,003
Long Term				
Full Simulation Period[b]	1,602,491	1,590,612	1,571,611	1,583,807
Water Year Types[c]				
Wet (32%)	1,383,273	1,344,092	1,371,660	1,330,653
Above Normal (16%)	1,538,908	1,472,333	1,441,339	1,466,921
Below Normal (13%)	1,738,904	1,759,324	1,574,595	1,732,096
Dry (24%)	1,747,973	1,757,216	1,787,039	1,758,763
Critical (15%)	1,778,828	1,820,551	1,784,184	1,831,408

Alternative 3

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,835,974	1,838,496	1,838,677	1,847,188
20%	1,827,096	1,835,518	1,834,419	1,838,711
30%	1,811,574	1,830,317	1,830,254	1,833,185
40%	1,771,154	1,809,580	1,810,678	1,807,068
50%	1,749,945	1,736,821	1,661,344	1,704,256
60%	1,658,354	1,646,633	1,371,780	1,640,456
70%	1,328,034	1,304,031	1,311,020	1,303,088
80%	1,277,735	1,219,419	1,268,292	1,219,321
90%	1,177,261	1,107,001	1,197,406	1,116,168
Long Term				
Full Simulation Period[b]	1,592,203	1,566,772	1,562,546	1,569,754
Water Year Types[c]				
Wet (32%)	1,351,062	1,328,270	1,352,032	1,330,949
Above Normal (16%)	1,581,549	1,447,056	1,402,862	1,430,399
Below Normal (13%)	1,728,987	1,645,383	1,558,479	1,666,917
Dry (24%)	1,731,786	1,757,650	1,807,936	1,764,199
Critical (15%)	1,768,194	1,823,029	1,786,396	1,824,995

Alternative 3 minus No Action Alternative

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	-1,025	555	-471	264
20%	-6,493	1,300	76	-607
30%	-388	1,286	-444	-900
40%	-4,266	-2,678	-795	-3,201
50%	-16,523	-8,973	-330	-39,043
60%	-29,994	1,141	-159,138	-12,869
70%	-100,525	-6,989	0	-7,932
80%	879	-12,556	-13,034	-6,344
90%	-6,294	-1,337	-23,172	8,165
Long Term				
Full Simulation Period[b]	-10,288	-23,840	-9,065	-14,052
Water Year Types[c]				
Wet (32%)	-32,211	-15,822	-19,628	296
Above Normal (16%)	42,641	-25,276	-38,477	-36,522
Below Normal (13%)	-9,917	-113,941	-16,116	-65,180
Dry (24%)	-16,187	434	20,897	5,436
Critical (15%)	-10,633	2,478	2,213	-6,413

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-12-3. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,999	1,837,941	1,839,149	1,846,924
20%	1,833,589	1,834,217	1,834,343	1,839,318
30%	1,811,962	1,829,031	1,830,698	1,834,085
40%	1,775,420	1,812,257	1,811,473	1,810,269
50%	1,766,469	1,745,795	1,661,674	1,743,299
60%	1,688,348	1,645,492	1,530,919	1,653,325
70%	1,428,559	1,311,020	1,311,020	1,311,020
80%	1,276,856	1,231,975	1,281,326	1,225,664
90%	1,183,556	1,108,337	1,220,578	1,108,003
Long Term				
Full Simulation Period[b]	1,602,491	1,590,612	1,571,611	1,583,807
Water Year Types[c]				
Wet (32%)	1,383,273	1,344,092	1,371,660	1,330,653
Above Normal (16%)	1,538,908	1,472,333	1,441,339	1,466,921
Below Normal (13%)	1,738,904	1,759,324	1,574,595	1,732,096
Dry (24%)	1,747,973	1,757,216	1,787,039	1,758,763
Critical (15%)	1,778,828	1,820,551	1,784,184	1,831,408

Alternative 5

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,851	1,838,528	1,838,896	1,846,979
20%	1,833,450	1,835,214	1,834,287	1,839,223
30%	1,812,009	1,830,011	1,830,667	1,834,028
40%	1,775,411	1,812,246	1,811,477	1,807,903
50%	1,766,497	1,745,670	1,661,720	1,743,296
60%	1,710,072	1,644,449	1,530,819	1,653,261
70%	1,449,504	1,311,020	1,311,020	1,311,020
80%	1,276,577	1,231,973	1,281,994	1,225,655
90%	1,173,452	1,108,309	1,220,576	1,110,017
Long Term				
Full Simulation Period[b]	1,605,661	1,587,990	1,571,817	1,583,496
Water Year Types[c]				
Wet (32%)	1,380,619	1,336,209	1,371,609	1,330,958
Above Normal (16%)	1,538,892	1,471,480	1,442,129	1,467,204
Below Normal (13%)	1,746,586	1,757,180	1,577,508	1,730,196
Dry (24%)	1,753,959	1,757,185	1,785,705	1,758,133
Critical (15%)	1,789,243	1,822,654	1,784,399	1,831,107

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	-148	587	-253	55
20%	-139	997	-56	-96
30%	47	980	-31	-57
40%	-9	-12	4	-2,366
50%	28	-124	46	-3
60%	21,724	-1,043	-99	-64
70%	20,945	0	0	0
80%	-279	-2	668	-9
90%	-10,103	-28	-2	2,015
Long Term				
Full Simulation Period[b]	3,170	-2,622	206	-311
Water Year Types[c]				
Wet (32%)	-2,655	-7,883	-51	305
Above Normal (16%)	-16	-853	790	283
Below Normal (13%)	7,682	-2,144	2,912	-1,900
Dry (24%)	5,986	-31	-1,334	-631
Critical (15%)	10,415	2,103	216	-301

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-12-4. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,447	1,837,875	1,839,315	1,846,944
20%	1,827,387	1,834,682	1,834,204	1,839,665
30%	1,810,323	1,829,615	1,828,499	1,833,002
40%	1,775,114	1,793,817	1,802,530	1,808,892
50%	1,760,438	1,706,232	1,673,635	1,704,154
60%	1,696,983	1,581,030	1,439,494	1,640,408
70%	1,311,416	1,303,986	1,311,020	1,300,764
80%	1,268,338	1,215,295	1,277,051	1,220,621
90%	1,177,260	1,104,493	1,197,414	1,116,350
Long Term				
Full Simulation Period[b]	1,597,909	1,557,190	1,564,976	1,570,429
Water Year Types[c]				
Wet (32%)	1,343,276	1,326,407	1,351,949	1,330,942
Above Normal (16%)	1,591,617	1,433,555	1,399,937	1,427,190
Below Normal (13%)	1,726,938	1,645,079	1,574,016	1,664,987
Dry (24%)	1,758,414	1,744,848	1,786,756	1,768,554
Critical (15%)	1,770,645	1,797,825	1,827,406	1,827,605

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,999	1,837,941	1,839,149	1,846,924
20%	1,833,589	1,834,217	1,834,343	1,839,318
30%	1,811,962	1,829,031	1,830,698	1,834,085
40%	1,775,420	1,812,257	1,811,473	1,810,269
50%	1,766,469	1,745,795	1,661,674	1,743,299
60%	1,688,348	1,645,492	1,530,919	1,653,325
70%	1,428,559	1,311,020	1,311,020	1,311,020
80%	1,276,856	1,231,975	1,281,326	1,225,664
90%	1,183,556	1,108,337	1,220,578	1,108,003
Long Term				
Full Simulation Period[b]	1,602,491	1,590,612	1,571,611	1,583,807
Water Year Types[c]				
Wet (32%)	1,383,273	1,344,092	1,371,660	1,330,653
Above Normal (16%)	1,538,908	1,472,333	1,441,339	1,466,921
Below Normal (13%)	1,738,904	1,759,324	1,574,595	1,732,096
Dry (24%)	1,747,973	1,757,216	1,787,039	1,758,763
Critical (15%)	1,778,828	1,820,551	1,784,184	1,831,408

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	552	66	-166	-20
20%	6,202	-465	139	-347
30%	1,639	-584	2,198	1,083
40%	306	18,440	8,942	1,378
50%	6,031	39,563	-11,961	39,146
60%	-8,635	64,462	91,424	12,917
70%	117,143	7,034	0	10,256
80%	8,518	16,680	4,275	5,044
90%	6,295	3,845	23,163	-8,348
Long Term				
Full Simulation Period[b]	4,582	33,423	6,635	13,378
Water Year Types[c]				
Wet (32%)	39,998	17,685	19,712	-289
Above Normal (16%)	-52,708	38,777	41,402	39,731
Below Normal (13%)	11,966	114,245	580	67,110
Dry (24%)	-10,442	12,368	283	-9,791
Critical (15%)	8,182	22,725	-43,222	3,803

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-12-5. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,447	1,837,875	1,839,315	1,846,944
20%	1,827,387	1,834,682	1,834,204	1,839,665
30%	1,810,323	1,829,615	1,828,499	1,833,002
40%	1,775,114	1,793,817	1,802,530	1,808,892
50%	1,760,438	1,706,232	1,673,635	1,704,154
60%	1,696,983	1,581,030	1,439,494	1,640,408
70%	1,311,416	1,303,986	1,311,020	1,300,764
80%	1,268,338	1,215,295	1,277,051	1,220,621
90%	1,177,260	1,104,493	1,197,414	1,116,350
Long Term				
Full Simulation Period[b]	1,597,909	1,557,190	1,564,976	1,570,429
Water Year Types[c]				
Wet (32%)	1,343,276	1,326,407	1,351,949	1,330,942
Above Normal (16%)	1,591,617	1,433,555	1,399,937	1,427,190
Below Normal (13%)	1,726,938	1,645,079	1,574,016	1,664,987
Dry (24%)	1,758,414	1,744,848	1,786,756	1,768,554
Critical (15%)	1,770,645	1,797,825	1,827,406	1,827,605

Alternative 3

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,835,974	1,838,496	1,838,677	1,847,188
20%	1,827,096	1,835,518	1,834,419	1,838,711
30%	1,811,574	1,830,317	1,830,254	1,833,185
40%	1,771,154	1,809,580	1,810,678	1,807,068
50%	1,749,945	1,736,821	1,661,344	1,704,256
60%	1,658,354	1,646,633	1,371,780	1,640,456
70%	1,328,034	1,304,031	1,311,020	1,303,088
80%	1,277,735	1,219,419	1,268,292	1,219,321
90%	1,177,261	1,107,001	1,197,406	1,116,168
Long Term				
Full Simulation Period[b]	1,592,203	1,566,772	1,562,546	1,569,754
Water Year Types[c]				
Wet (32%)	1,351,062	1,328,270	1,352,032	1,330,949
Above Normal (16%)	1,581,549	1,447,056	1,402,862	1,430,399
Below Normal (13%)	1,728,987	1,645,383	1,558,479	1,666,917
Dry (24%)	1,731,786	1,757,650	1,807,936	1,764,199
Critical (15%)	1,768,194	1,823,029	1,786,396	1,824,995

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	-473	621	-638	244
20%	-291	836	215	-954
30%	1,250	702	1,754	183
40%	-3,960	15,763	8,148	-1,824
50%	-10,493	30,590	-12,291	103
60%	-38,629	65,603	-67,714	48
70%	16,618	45	0	2,324
80%	9,397	4,123	-8,759	-1,300
90%	1	2,508	-9	-182
Long Term				
Full Simulation Period[b]	-5,706	9,583	-2,429	-674
Water Year Types[c]				
Wet (32%)	7,787	1,863	83	7
Above Normal (16%)	-10,068	13,501	2,926	3,209
Below Normal (13%)	2,049	304	-15,536	1,930
Dry (24%)	-26,629	12,802	21,180	-4,355
Critical (15%)	-2,451	25,203	-41,009	-2,610

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-12-6. Sacramento River Keswick to Battle Creek Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,447	1,837,875	1,839,315	1,846,944
20%	1,827,387	1,834,682	1,834,204	1,839,665
30%	1,810,323	1,829,615	1,828,499	1,833,002
40%	1,775,114	1,793,817	1,802,530	1,808,892
50%	1,760,438	1,706,232	1,673,635	1,704,154
60%	1,696,983	1,581,030	1,439,494	1,640,408
70%	1,311,416	1,303,986	1,311,020	1,300,764
80%	1,268,338	1,215,295	1,277,051	1,220,621
90%	1,177,260	1,104,493	1,197,414	1,116,350
Long Term				
Full Simulation Period[b]	1,597,909	1,557,190	1,564,976	1,570,429
Water Year Types[c]				
Wet (32%)	1,343,276	1,326,407	1,351,949	1,330,942
Above Normal (16%)	1,591,617	1,433,555	1,399,937	1,427,190
Below Normal (13%)	1,726,938	1,645,079	1,574,016	1,664,987
Dry (24%)	1,758,414	1,744,848	1,786,756	1,768,554
Critical (15%)	1,770,645	1,797,825	1,827,406	1,827,605

Alternative 5

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	1,836,851	1,838,528	1,838,896	1,846,979
20%	1,833,450	1,835,214	1,834,287	1,839,223
30%	1,812,009	1,830,011	1,830,667	1,834,028
40%	1,775,411	1,812,246	1,811,477	1,807,903
50%	1,766,497	1,745,670	1,661,720	1,743,296
60%	1,710,072	1,644,449	1,530,819	1,653,261
70%	1,449,504	1,311,020	1,311,020	1,311,020
80%	1,276,577	1,231,973	1,281,994	1,225,655
90%	1,173,452	1,108,309	1,220,576	1,110,017
Long Term				
Full Simulation Period[b]	1,605,661	1,587,990	1,571,817	1,583,496
Water Year Types[c]				
Wet (32%)	1,380,619	1,336,209	1,371,609	1,330,958
Above Normal (16%)	1,538,892	1,471,480	1,442,129	1,467,204
Below Normal (13%)	1,746,586	1,757,180	1,577,508	1,730,196
Dry (24%)	1,753,959	1,757,185	1,785,705	1,758,133
Critical (15%)	1,789,243	1,822,654	1,784,399	1,831,107

Alternative 5 minus Second Basis of Comparison

	Monthly WUA (Feet2)			
Statistic	Dec	Jan	Feb	Mar
Probability of Exceedance[a]				
10%	404	653	-419	35
20%	6,063	532	83	-443
30%	1,686	396	2,168	1,026
40%	297	18,429	8,947	-989
50%	6,058	39,439	-11,915	39,143
60%	13,089	63,418	91,325	12,853
70%	138,088	7,034	0	10,256
80%	8,239	16,678	4,943	5,035
90%	-3,808	3,816	23,161	-6,333
Long Term				
Full Simulation Period[b]	7,752	30,801	6,841	13,067
Water Year Types[c]				
Wet (32%)	37,343	9,802	19,660	16
Above Normal (16%)	-52,724	37,924	42,193	40,014
Below Normal (13%)	19,648	112,101	3,492	65,210
Dry (24%)	-4,456	12,337	-1,051	-10,421
Critical (15%)	18,597	24,829	-43,007	3,502

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.13. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA

Table C-13-1. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,002	723,047	704,910	656,726	503,215
20%	719,853	721,142	687,236	623,601	486,703
30%	719,092	719,722	681,874	608,235	463,339
40%	704,092	706,340	665,514	588,612	450,403
50%	676,464	687,759	638,836	561,216	436,515
60%	649,263	674,942	613,206	535,332	424,050
70%	403,624	520,710	579,902	510,050	407,806
80%	378,338	378,338	534,034	483,122	393,079
90%	369,761	366,811	424,846	452,504	373,036
Long Term					
Full Simulation Period[b]	588,471	605,418	604,728	554,973	438,314
Water Year Types[c]					
Wet (32%)	483,390	472,828	563,680	520,384	451,496
Above Normal (16%)	493,018	563,945	600,103	557,423	418,721
Below Normal (13%)	606,222	681,674	626,387	555,242	423,098
Dry (24%)	707,120	696,237	657,710	577,109	427,979
Critical (15%)	705,534	716,357	590,522	590,121	462,154

Alternative 1

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,063	723,048	705,169	640,372	502,929
20%	719,735	721,120	687,058	611,377	470,171
30%	718,516	718,835	680,612	590,416	447,187
40%	696,502	704,121	649,616	564,524	429,169
50%	678,597	682,742	623,907	547,394	413,143
60%	629,138	672,572	594,565	523,137	403,158
70%	378,338	492,577	567,452	500,925	384,743
80%	377,835	378,338	508,129	469,407	373,620
90%	366,054	366,217	425,645	436,189	357,375
Long Term					
Full Simulation Period[b]	582,690	598,696	596,103	540,655	423,270
Water Year Types[c]					
Wet (32%)	474,304	473,273	559,043	513,375	446,858
Above Normal (16%)	471,639	540,324	596,319	538,406	401,656
Below Normal (13%)	598,901	650,004	605,370	518,532	403,347
Dry (24%)	706,213	701,479	644,542	561,891	406,785
Critical (15%)	717,100	715,342	586,941	587,088	441,313

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	61	1	259	**-16,354**	**-286**
20%	**-119**	**-22**	**-178**	**-12,224**	**-16,532**
30%	**-576**	**-887**	**-1,262**	**-17,819**	**-16,152**
40%	**-7,591**	**-2,220**	**-15,898**	**-24,088**	**-21,234**
50%	2,132	**-5,017**	**-14,929**	**-13,822**	**-23,372**
60%	**-20,125**	**-2,370**	**-18,641**	**-12,195**	**-20,891**
70%	**-25,286**	**-28,133**	**-12,450**	**-9,125**	**-23,063**
80%	**-503**	0	**-25,905**	**-13,715**	**-19,459**
90%	**-3,707**	**-594**	800	**-16,315**	**-15,661**
Long Term					
Full Simulation Period[b]	**-5,781**	**-6,722**	**-8,625**	**-14,317**	**-15,045**
Water Year Types[c]					
Wet (32%)	**-9,087**	445	**-4,636**	**-7,009**	**-4,637**
Above Normal (16%)	**-21,378**	**-23,622**	**-3,783**	**-19,018**	**-17,065**
Below Normal (13%)	**-7,322**	**-31,670**	**-21,017**	**-36,710**	**-19,752**
Dry (24%)	**-907**	5,242	**-13,168**	**-15,217**	**-21,194**
Critical (15%)	11,566	**-1,015**	**-3,581**	**-3,033**	**-20,841**

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-13-2. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,002	723,047	704,910	656,726	503,215
20%	719,853	721,142	687,236	623,601	486,703
30%	719,092	719,722	681,874	608,235	463,339
40%	704,092	706,340	665,514	588,612	450,403
50%	676,464	687,759	638,836	561,216	436,515
60%	649,263	674,942	613,206	535,332	424,050
70%	403,624	520,710	579,902	510,050	407,806
80%	378,338	378,338	534,034	483,122	393,079
90%	369,761	366,811	424,846	452,504	373,036
Long Term					
Full Simulation Period[b]	588,471	605,418	604,728	554,973	438,314
Water Year Types[c]					
Wet (32%)	483,390	472,828	563,680	520,384	451,496
Above Normal (16%)	493,018	563,945	600,103	557,423	418,721
Below Normal (13%)	606,222	681,674	626,387	555,242	423,098
Dry (24%)	707,120	696,237	657,710	577,109	427,979
Critical (15%)	705,534	716,357	590,522	590,121	462,154

Alternative 3

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	720,931	723,052	705,097	638,154	503,036
20%	720,012	720,868	686,689	612,642	464,683
30%	718,976	718,827	680,616	590,012	445,085
40%	704,178	705,730	661,611	567,192	426,581
50%	676,409	682,755	631,006	548,611	417,077
60%	594,319	672,581	605,289	523,893	407,338
70%	378,338	492,690	569,762	490,963	388,230
80%	377,886	378,338	512,407	468,735	372,196
90%	366,801	366,241	425,840	434,899	362,608
Long Term					
Full Simulation Period[b]	583,588	598,451	599,703	540,668	424,375
Water Year Types[c]					
Wet (32%)	474,326	473,279	559,940	513,071	443,730
Above Normal (16%)	480,224	541,195	599,079	535,276	405,415
Below Normal (13%)	597,108	650,754	609,199	520,182	407,747
Dry (24%)	711,737	699,462	651,809	563,157	408,518
Critical (15%)	706,325	715,389	590,988	587,598	444,648

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	-71	4	186	-18,572	-178
20%	159	-274	-547	-10,959	-22,020
30%	-116	-895	-1,258	-18,224	-18,253
40%	86	-610	-3,902	-21,420	-23,822
50%	-56	-5,004	-7,830	-12,605	-19,438
60%	-54,944	-2,361	-7,917	-11,439	-16,711
70%	-25,286	-28,020	-10,140	-19,087	-19,576
80%	-452	0	-21,627	-14,387	-20,882
90%	-2,959	-570	994	-17,605	-10,428
Long Term					
Full Simulation Period[b]	-4,883	-6,967	-5,025	-14,305	-13,939
Water Year Types[c]					
Wet (32%)	-9,065	451	-3,740	-7,313	-7,765
Above Normal (16%)	-12,794	-22,750	-1,024	-22,147	-13,306
Below Normal (13%)	-9,114	-30,920	-17,187	-35,060	-15,351
Dry (24%)	4,617	3,225	-5,901	-13,952	-19,461
Critical (15%)	792	-968	466	-2,522	-17,506

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-13-3. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,002	723,047	704,910	656,726	503,215
20%	719,853	721,142	687,236	623,601	486,703
30%	719,092	719,722	681,874	608,235	463,339
40%	704,092	706,340	665,514	588,612	450,403
50%	676,464	687,759	638,836	561,216	436,515
60%	649,263	674,942	613,206	535,332	424,050
70%	403,624	520,710	579,902	510,050	407,806
80%	378,338	378,338	534,034	483,122	393,079
90%	369,761	366,811	424,846	452,504	373,036
Long Term					
Full Simulation Period[b]	588,471	605,418	604,728	554,973	438,314
Water Year Types[c]					
Wet (32%)	483,390	472,828	563,680	520,384	451,496
Above Normal (16%)	493,018	563,945	600,103	557,423	418,721
Below Normal (13%)	606,222	681,674	626,387	555,242	423,098
Dry (24%)	707,120	696,237	657,710	577,109	427,979
Critical (15%)	705,534	716,357	590,522	590,121	462,154

Alternative 5

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	720,968	723,037	704,931	655,949	505,143
20%	719,865	721,139	687,047	623,626	487,919
30%	719,082	719,715	681,784	608,786	465,855
40%	704,091	705,722	665,418	593,817	450,304
50%	676,474	687,739	639,188	564,339	442,429
60%	649,239	674,930	613,477	539,091	424,453
70%	405,773	520,685	582,039	518,983	410,505
80%	378,338	378,382	534,323	496,351	391,138
90%	368,085	366,811	425,868	463,149	374,697
Long Term					
Full Simulation Period[b]	588,544	604,926	606,746	561,148	439,824
Water Year Types[c]					
Wet (32%)	483,657	472,669	563,662	520,206	451,712
Above Normal (16%)	493,151	563,710	600,140	561,398	419,184
Below Normal (13%)	606,522	680,363	624,160	557,080	422,316
Dry (24%)	706,776	695,357	662,013	592,096	427,794
Critical (15%)	705,611	716,263	599,179	601,732	472,524

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	-34	-10	21	-776	1,928
20%	12	-3	-189	25	1,216
30%	-10	-7	-91	550	2,517
40%	-1	-618	-96	5,205	-99
50%	9	-20	352	3,123	5,914
60%	-24	-12	271	3,759	403
70%	2,149	-25	2,138	8,933	2,699
80%	0	44	289	13,229	-1,940
90%	-1,676	0	1,022	10,645	1,661
Long Term					
Full Simulation Period[b]	73	-492	2,018	6,175	1,510
Water Year Types[c]					
Wet (32%)	266	-159	-18	-178	217
Above Normal (16%)	133	-235	38	3,975	463
Below Normal (13%)	300	-1,311	-2,227	1,838	-783
Dry (24%)	-344	-880	4,303	14,988	-185
Critical (15%)	78	-95	8,658	11,611	10,370

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-13-4. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,063	723,048	705,169	640,372	502,929
20%	719,735	721,120	687,058	611,377	470,171
30%	718,516	718,835	680,612	590,416	447,187
40%	696,502	704,121	649,616	564,524	429,169
50%	678,597	682,742	623,907	547,394	413,143
60%	629,138	672,572	594,565	523,137	403,158
70%	378,338	492,577	567,452	500,925	384,743
80%	377,835	378,338	508,129	469,407	373,620
90%	366,054	366,217	425,645	436,189	357,375
Long Term					
Full Simulation Period[b]	582,690	598,696	596,103	540,655	423,270
Water Year Types[c]					
Wet (32%)	474,304	473,273	559,043	513,375	446,858
Above Normal (16%)	471,639	540,324	596,319	538,406	401,656
Below Normal (13%)	598,901	650,004	605,370	518,532	403,347
Dry (24%)	706,213	701,479	644,542	561,891	406,785
Critical (15%)	717,100	715,342	586,941	587,088	441,313

No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,002	723,047	704,910	656,726	503,215
20%	719,853	721,142	687,236	623,601	486,703
30%	719,092	719,722	681,874	608,235	463,339
40%	704,092	706,340	665,514	588,612	450,403
50%	676,464	687,759	638,836	561,216	436,515
60%	649,263	674,942	613,206	535,332	424,050
70%	403,624	520,710	579,902	510,050	407,806
80%	378,338	378,338	534,034	483,122	393,079
90%	369,761	366,811	424,846	452,504	373,036
Long Term					
Full Simulation Period[b]	588,471	605,418	604,728	554,973	438,314
Water Year Types[c]					
Wet (32%)	483,390	472,828	563,680	520,384	451,496
Above Normal (16%)	493,018	563,945	600,103	557,423	418,721
Below Normal (13%)	606,222	681,674	626,387	555,242	423,098
Dry (24%)	707,120	696,237	657,710	577,109	427,979
Critical (15%)	705,534	716,357	590,522	590,121	462,154

No Action Alternative minus Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	-61	-1	-259	16,354	286
20%	119	22	178	12,224	16,532
30%	576	887	1,262	17,819	16,152
40%	7,591	2,220	15,898	24,088	21,234
50%	-2,132	5,017	14,929	13,822	23,372
60%	20,125	2,370	18,641	12,195	20,891
70%	25,286	28,133	12,450	9,125	23,063
80%	503	0	25,905	13,715	19,459
90%	3,707	594	-800	16,315	15,661
Long Term					
Full Simulation Period[b]	5,781	6,722	8,625	14,317	15,045
Water Year Types[c]					
Wet (32%)	9,087	-445	4,636	7,009	4,637
Above Normal (16%)	21,378	23,622	3,783	19,018	17,065
Below Normal (13%)	7,322	31,670	21,017	36,710	19,752
Dry (24%)	907	-5,242	13,168	15,217	21,194
Critical (15%)	-11,566	1,015	3,581	3,033	20,841

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-13-5. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,063	723,048	705,169	640,372	502,929
20%	719,735	721,120	687,058	611,377	470,171
30%	718,516	718,835	680,612	590,416	447,187
40%	696,502	704,121	649,616	564,524	429,169
50%	678,597	682,742	623,907	547,394	413,143
60%	629,138	672,572	594,565	523,137	403,158
70%	378,338	492,577	567,452	500,925	384,743
80%	377,835	378,338	508,129	469,407	373,620
90%	366,054	366,217	425,645	436,189	357,375
Long Term					
Full Simulation Period[b]	582,690	598,696	596,103	540,655	423,270
Water Year Types[c]					
Wet (32%)	474,304	473,273	559,043	513,375	446,858
Above Normal (16%)	471,639	540,324	596,319	538,406	401,656
Below Normal (13%)	598,901	650,004	605,370	518,532	403,347
Dry (24%)	706,213	701,479	644,542	561,891	406,785
Critical (15%)	717,100	715,342	586,941	587,088	441,313

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	720,931	723,052	705,097	638,154	503,036
20%	720,012	720,868	686,689	612,642	464,683
30%	718,976	718,827	680,616	590,012	445,085
40%	704,178	705,730	661,611	567,192	426,581
50%	676,409	682,755	631,006	548,611	417,077
60%	594,319	672,581	605,289	523,893	407,338
70%	378,338	492,690	569,762	490,963	388,230
80%	377,886	378,338	512,407	468,735	372,196
90%	366,801	366,241	425,840	434,899	362,608
Long Term					
Full Simulation Period[b]	583,588	598,451	599,703	540,668	424,375
Water Year Types[c]					
Wet (32%)	474,326	473,279	559,940	513,071	443,730
Above Normal (16%)	480,224	541,195	599,079	535,276	405,415
Below Normal (13%)	597,108	650,754	609,199	520,182	407,747
Dry (24%)	711,737	699,462	651,809	563,157	408,518
Critical (15%)	706,325	715,389	590,988	587,598	444,648

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	-133	3	-73	-2,218	107
20%	277	-252	-369	1,265	-5,488
30%	460	-8	4	-405	-2,102
40%	7,677	1,609	11,996	2,669	-2,588
50%	-2,188	13	7,099	1,217	3,934
60%	-34,819	9	10,725	755	4,180
70%	0	113	2,310	-9,962	3,487
80%	50	0	4,278	-673	-1,424
90%	748	24	194	-1,290	5,233
Long Term					
Full Simulation Period[b]	898	-244	3,600	12	1,105
Water Year Types[c]					
Wet (32%)	22	6	896	-304	-3,128
Above Normal (16%)	8,584	871	2,760	-3,130	3,759
Below Normal (13%)	-1,793	750	3,829	1,650	4,400
Dry (24%)	5,524	-2,017	7,267	1,266	1,733
Critical (15%)	-10,775	47	4,047	511	3,335

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-13-6. Sacramento River Keswick to Battle Creek Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	721,063	723,048	705,169	640,372	502,929
20%	719,735	721,120	687,058	611,377	470,171
30%	718,516	718,835	680,612	590,416	447,187
40%	696,502	704,121	649,616	564,524	429,169
50%	678,597	682,742	623,907	547,394	413,143
60%	629,138	672,572	594,565	523,137	403,158
70%	378,338	492,577	567,452	500,925	384,743
80%	377,835	378,338	508,129	469,407	373,620
90%	366,054	366,217	425,645	436,189	357,375
Long Term					
Full Simulation Period[b]	582,690	598,696	596,103	540,655	423,270
Water Year Types[c]					
Wet (32%)	474,304	473,273	559,043	513,375	446,858
Above Normal (16%)	471,639	540,324	596,319	538,406	401,656
Below Normal (13%)	598,901	650,004	605,370	518,532	403,347
Dry (24%)	706,213	701,479	644,542	561,891	406,785
Critical (15%)	717,100	715,342	586,941	587,088	441,313

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	720,968	723,037	704,931	655,949	505,143
20%	719,865	721,139	687,047	623,626	487,919
30%	719,082	719,715	681,784	608,786	465,855
40%	704,091	705,722	665,418	593,817	450,304
50%	676,474	687,739	639,188	564,339	442,429
60%	649,239	674,930	613,477	539,091	424,453
70%	405,773	520,685	582,039	518,983	410,505
80%	378,338	378,382	534,323	496,351	391,138
90%	368,085	366,811	425,868	463,149	374,697
Long Term					
Full Simulation Period[b]	588,544	604,926	606,746	561,148	439,824
Water Year Types[c]					
Wet (32%)	483,657	472,669	563,662	520,206	451,712
Above Normal (16%)	493,151	563,710	600,140	561,398	419,184
Below Normal (13%)	606,522	680,363	624,160	557,080	422,316
Dry (24%)	706,776	695,357	662,013	592,096	427,794
Critical (15%)	705,611	716,263	599,179	601,732	472,524

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Feb	Mar	Apr	May	Jun
Probability of Exceedance[a]					
10%	-95	-11	-238	15,578	2,214
20%	130	18	-11	12,249	17,748
30%	566	880	1,171	18,369	18,668
40%	7,589	1,601	15,802	29,293	21,136
50%	-2,123	4,997	15,281	16,945	29,286
60%	20,102	2,358	18,913	15,954	21,294
70%	27,435	28,108	14,587	18,058	25,762
80%	503	44	26,194	26,944	17,518
90%	2,032	594	223	26,960	17,322
Long Term					
Full Simulation Period[b]	5,854	6,230	10,643	20,492	16,554
Water Year Types[c]					
Wet (32%)	9,353	-604	4,619	6,831	4,854
Above Normal (16%)	21,511	23,387	3,821	22,992	17,528
Below Normal (13%)	7,622	30,359	18,789	38,548	18,969
Dry (24%)	563	-6,121	17,472	30,205	21,009
Critical (15%)	-11,489	921	12,238	14,644	31,211

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.14. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA

Table C-14-1. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,663	1,373,957	1,372,279	1,346,058
20%	1,372,806	1,372,775	1,370,795	1,337,697
30%	1,372,163	1,371,576	1,368,337	1,332,370
40%	1,370,292	1,366,802	1,360,528	1,297,903
50%	1,352,214	1,327,455	1,343,695	1,258,711
60%	1,324,170	1,279,438	1,325,362	1,196,191
70%	964,111	749,022	995,339	1,110,692
80%	638,846	274,861	640,963	1,014,507
90%	314,049	142,068	367,831	799,017
Long Term				
Full Simulation Period[b]	1,084,735	995,045	1,093,858	1,151,806
Water Year Types[c]				
Wet (32%)	676,552	657,941	722,415	1,034,793
Above Normal (16%)	1,036,533	682,250	1,039,897	1,163,603
Below Normal (13%)	1,355,326	1,118,267	1,307,502	1,211,646
Dry (24%)	1,326,960	1,358,710	1,331,424	1,270,932
Critical (15%)	1,369,598	1,345,237	1,365,326	1,139,157

Alternative 1

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,346	1,374,047	1,372,103	1,344,717
20%	1,372,566	1,372,876	1,370,644	1,337,615
30%	1,371,579	1,371,382	1,367,225	1,326,824
40%	1,366,483	1,365,862	1,359,858	1,276,557
50%	1,338,877	1,328,598	1,333,196	1,220,222
60%	1,305,047	1,243,778	1,323,396	1,150,743
70%	878,678	587,948	936,580	1,081,824
80%	478,189	274,894	601,043	962,592
90%	308,533	140,818	360,694	801,193
Long Term				
Full Simulation Period[b]	1,040,207	980,783	1,076,918	1,134,536
Water Year Types[c]				
Wet (32%)	622,383	635,847	721,831	1,028,337
Above Normal (16%)	957,428	632,597	976,754	1,155,874
Below Normal (13%)	1,262,254	1,093,689	1,236,238	1,166,335
Dry (24%)	1,321,680	1,359,023	1,342,289	1,243,934
Critical (15%)	1,362,507	1,371,452	1,366,456	1,130,035

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	-316	90	-176	-1,341
20%	-241	101	-150	-83
30%	-584	-195	-1,113	-5,546
40%	-3,810	-941	-670	-21,346
50%	-13,337	1,143	-10,498	-38,490
60%	-19,123	-35,660	-1,965	-45,448
70%	-85,432	-161,074	-58,759	-28,869
80%	-160,657	34	-39,921	-51,915
90%	-5,516	-1,250	-7,137	2,176
Long Term				
Full Simulation Period[b]	-44,527	-14,262	-16,940	-17,270
Water Year Types[c]				
Wet (32%)	-54,169	-22,094	-584	-6,456
Above Normal (16%)	-79,105	-49,653	-63,143	-7,728
Below Normal (13%)	-93,073	-24,579	-71,265	-45,311
Dry (24%)	-5,281	313	10,865	-26,998
Critical (15%)	-7,090	26,215	1,130	-9,122

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-14-2. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,663	1,373,957	1,372,279	1,346,058
20%	1,372,806	1,372,775	1,370,795	1,337,697
30%	1,372,163	1,371,576	1,368,337	1,332,370
40%	1,370,292	1,366,802	1,360,528	1,297,903
50%	1,352,214	1,327,455	1,343,695	1,258,711
60%	1,324,170	1,279,438	1,325,362	1,196,191
70%	964,111	749,022	995,339	1,110,692
80%	638,846	274,861	640,963	1,014,507
90%	314,049	142,068	367,831	799,017
Long Term				
Full Simulation Period[b]	1,084,735	995,045	1,093,858	1,151,806
Water Year Types[c]				
Wet (32%)	676,552	657,941	722,415	1,034,793
Above Normal (16%)	1,036,533	682,250	1,039,897	1,163,603
Below Normal (13%)	1,355,326	1,118,267	1,307,502	1,211,646
Dry (24%)	1,326,960	1,358,710	1,331,424	1,270,932
Critical (15%)	1,369,598	1,345,237	1,365,326	1,139,157

Alternative 3

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,398	1,373,692	1,372,063	1,341,133
20%	1,372,679	1,372,781	1,371,039	1,337,075
30%	1,371,554	1,371,314	1,366,908	1,326,597
40%	1,369,986	1,367,043	1,356,858	1,293,435
50%	1,349,118	1,326,592	1,333,211	1,246,783
60%	1,324,343	1,155,701	1,323,404	1,179,621
70%	881,165	609,184	936,757	1,087,279
80%	479,877	274,900	601,603	969,688
90%	276,105	140,160	360,554	801,581
Long Term				
Full Simulation Period[b]	1,044,952	981,852	1,074,841	1,141,940
Water Year Types[c]				
Wet (32%)	619,462	635,884	721,838	1,029,376
Above Normal (16%)	978,283	650,283	972,042	1,161,401
Below Normal (13%)	1,263,106	1,094,324	1,235,965	1,173,958
Dry (24%)	1,326,900	1,366,202	1,338,755	1,259,055
Critical (15%)	1,369,183	1,346,970	1,363,491	1,140,203

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	-265	-265	-216	-4,925
20%	-128	6	245	-622
30%	-609	-262	-1,429	-5,772
40%	-307	241	-3,670	-4,468
50%	-3,096	-862	-10,483	-11,929
60%	174	-123,737	-1,958	-16,570
70%	-82,946	-139,838	-58,582	-23,413
80%	-158,969	39	-39,361	-44,819
90%	-37,944	-1,908	-7,278	2,564
Long Term				
Full Simulation Period[b]	-39,783	-13,193	-19,017	-9,866
Water Year Types[c]				
Wet (32%)	-57,089	-22,057	-577	-5,417
Above Normal (16%)	-58,250	-31,966	-67,855	-2,201
Below Normal (13%)	-92,220	-23,944	-71,537	-37,688
Dry (24%)	-61	7,492	7,331	-11,877
Critical (15%)	-414	1,733	-1,836	1,046

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-14-3. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,663	1,373,957	1,372,279	1,346,058
20%	1,372,806	1,372,775	1,370,795	1,337,697
30%	1,372,163	1,371,576	1,368,337	1,332,370
40%	1,370,292	1,366,802	1,360,528	1,297,903
50%	1,352,214	1,327,455	1,343,695	1,258,711
60%	1,324,170	1,279,438	1,325,362	1,196,191
70%	964,111	749,022	995,339	1,110,692
80%	638,846	274,861	640,963	1,014,507
90%	314,049	142,068	367,831	799,017
Long Term				
Full Simulation Period[b]	1,084,735	995,045	1,093,858	1,151,806
Water Year Types[c]				
Wet (32%)	676,552	657,941	722,415	1,034,793
Above Normal (16%)	1,036,533	682,250	1,039,897	1,163,603
Below Normal (13%)	1,355,326	1,118,267	1,307,502	1,211,646
Dry (24%)	1,326,960	1,358,710	1,331,424	1,270,932
Critical (15%)	1,369,598	1,345,237	1,365,326	1,139,157

Alternative 5

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,367	1,373,971	1,371,990	1,343,268
20%	1,372,688	1,372,784	1,370,189	1,337,510
30%	1,372,016	1,371,595	1,367,918	1,330,377
40%	1,369,960	1,366,769	1,360,447	1,297,745
50%	1,352,205	1,327,439	1,343,705	1,262,326
60%	1,324,011	1,279,403	1,325,352	1,196,249
70%	960,091	754,161	995,298	1,117,718
80%	640,957	274,863	641,024	1,015,128
90%	314,038	143,900	367,825	801,611
Long Term				
Full Simulation Period[b]	1,084,355	994,926	1,092,887	1,155,813
Water Year Types[c]				
Wet (32%)	676,959	658,587	721,912	1,034,767
Above Normal (16%)	1,034,519	682,434	1,038,156	1,163,679
Below Normal (13%)	1,354,300	1,117,011	1,306,596	1,206,288
Dry (24%)	1,326,967	1,357,825	1,329,768	1,280,043
Critical (15%)	1,369,235	1,345,452	1,365,256	1,156,239

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	-295	14	-289	-2,791
20%	-119	9	-606	-187
30%	-147	19	-419	-1,992
40%	-333	-33	-80	-159
50%	-9	-16	10	3,615
60%	-159	-35	-10	58
70%	-4,020	5,139	-41	7,025
80%	2,111	2	60	621
90%	-10	1,832	-7	2,594
Long Term				
Full Simulation Period[b]	-379	-119	-971	4,007
Water Year Types[c]				
Wet (32%)	407	646	-503	-27
Above Normal (16%)	-2,014	185	-1,741	76
Below Normal (13%)	-1,027	-1,257	-906	-5,358
Dry (24%)	6	-886	-1,656	9,111
Critical (15%)	-362	215	-70	17,082

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-14-4. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,346	1,374,047	1,372,103	1,344,717
20%	1,372,566	1,372,876	1,370,644	1,337,615
30%	1,371,579	1,371,382	1,367,225	1,326,824
40%	1,366,483	1,365,862	1,359,858	1,276,557
50%	1,338,877	1,328,598	1,333,196	1,220,222
60%	1,305,047	1,243,778	1,323,396	1,150,743
70%	878,678	587,948	936,580	1,081,824
80%	478,189	274,894	601,043	962,592
90%	308,533	140,818	360,694	801,193
Long Term				
Full Simulation Period[b]	1,040,207	980,783	1,076,918	1,134,536
Water Year Types[c]				
Wet (32%)	622,383	635,847	721,831	1,028,337
Above Normal (16%)	957,428	632,597	976,754	1,155,874
Below Normal (13%)	1,262,254	1,093,689	1,236,238	1,166,335
Dry (24%)	1,321,680	1,359,023	1,342,289	1,243,934
Critical (15%)	1,362,507	1,371,452	1,366,456	1,130,035

No Action Alternative

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,663	1,373,957	1,372,279	1,346,058
20%	1,372,806	1,372,775	1,370,795	1,337,697
30%	1,372,163	1,371,576	1,368,337	1,332,370
40%	1,370,292	1,366,802	1,360,528	1,297,903
50%	1,352,214	1,327,455	1,343,695	1,258,711
60%	1,324,170	1,279,438	1,325,362	1,196,191
70%	964,111	749,022	995,339	1,110,692
80%	638,846	274,861	640,963	1,014,507
90%	314,049	142,068	367,831	799,017
Long Term				
Full Simulation Period[b]	1,084,735	995,045	1,093,858	1,151,806
Water Year Types[c]				
Wet (32%)	676,552	657,941	722,415	1,034,793
Above Normal (16%)	1,036,533	682,250	1,039,897	1,163,603
Below Normal (13%)	1,355,326	1,118,267	1,307,502	1,211,646
Dry (24%)	1,326,960	1,358,710	1,331,424	1,270,932
Critical (15%)	1,369,598	1,345,237	1,365,326	1,139,157

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	316	-90	176	1,341
20%	241	-101	150	83
30%	584	195	1,113	5,546
40%	3,810	941	670	21,346
50%	13,337	-1,143	10,498	38,490
60%	19,123	35,660	1,965	45,448
70%	85,432	161,074	58,759	28,869
80%	160,657	-34	39,921	51,915
90%	5,516	1,250	7,137	-2,176
Long Term				
Full Simulation Period[b]	44,527	14,262	16,940	17,270
Water Year Types[c]				
Wet (32%)	54,169	22,094	584	6,456
Above Normal (16%)	79,105	49,653	63,143	7,728
Below Normal (13%)	93,073	24,579	71,265	45,311
Dry (24%)	5,281	-313	-10,865	26,998
Critical (15%)	7,090	-26,215	-1,130	9,122

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-14-5. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,346	1,374,047	1,372,103	1,344,717
20%	1,372,566	1,372,876	1,370,644	1,337,615
30%	1,371,579	1,371,382	1,367,225	1,326,824
40%	1,366,483	1,365,862	1,359,858	1,276,557
50%	1,338,877	1,328,598	1,333,196	1,220,222
60%	1,305,047	1,243,778	1,323,396	1,150,743
70%	878,678	587,948	936,580	1,081,824
80%	478,189	274,894	601,043	962,592
90%	308,533	140,818	360,694	801,193
Long Term				
Full Simulation Period[b]	1,040,207	980,783	1,076,918	1,134,536
Water Year Types[c]				
Wet (32%)	622,383	635,847	721,831	1,028,337
Above Normal (16%)	957,428	632,597	976,754	1,155,874
Below Normal (13%)	1,262,254	1,093,689	1,236,238	1,166,335
Dry (24%)	1,321,680	1,359,023	1,342,289	1,243,934
Critical (15%)	1,362,507	1,371,452	1,366,456	1,130,035

Alternative 3

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,398	1,373,692	1,372,063	1,341,133
20%	1,372,679	1,372,781	1,371,039	1,337,075
30%	1,371,554	1,371,314	1,366,908	1,326,597
40%	1,369,986	1,367,043	1,356,858	1,293,435
50%	1,349,118	1,326,592	1,333,211	1,246,783
60%	1,324,343	1,155,701	1,323,404	1,179,621
70%	881,165	609,184	936,757	1,087,279
80%	479,877	274,900	601,603	969,688
90%	276,105	140,160	360,554	801,581
Long Term				
Full Simulation Period[b]	1,044,952	981,852	1,074,841	1,141,940
Water Year Types[c]				
Wet (32%)	619,462	635,884	721,838	1,029,376
Above Normal (16%)	978,283	650,283	972,042	1,161,401
Below Normal (13%)	1,263,106	1,094,324	1,235,965	1,173,958
Dry (24%)	1,326,900	1,366,202	1,338,755	1,259,055
Critical (15%)	1,369,183	1,346,970	1,363,491	1,140,203

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	51	-355	-41	-3,584
20%	113	-95	395	-540
30%	-25	-67	-317	-227
40%	3,503	1,181	-3,000	16,878
50%	10,241	-2,006	15	26,561
60%	19,297	-88,077	7	28,879
70%	2,487	21,236	177	5,456
80%	1,688	6	560	7,095
90%	-32,428	-659	-140	388
Long Term				
Full Simulation Period[b]	4,745	1,069	-2,077	7,404
Water Year Types[c]				
Wet (32%)	-2,921	37	7	1,040
Above Normal (16%)	20,856	17,686	-4,712	5,527
Below Normal (13%)	852	635	-273	7,623
Dry (24%)	5,220	7,179	-3,534	15,121
Critical (15%)	6,676	-24,482	-2,965	10,168

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-14-6. Sacramento River Keswick to Battle Creek Late-Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,346	1,374,047	1,372,103	1,344,717
20%	1,372,566	1,372,876	1,370,644	1,337,615
30%	1,371,579	1,371,382	1,367,225	1,326,824
40%	1,366,483	1,365,862	1,359,858	1,276,557
50%	1,338,877	1,328,598	1,333,196	1,220,222
60%	1,305,047	1,243,778	1,323,396	1,150,743
70%	878,678	587,948	936,580	1,081,824
80%	478,189	274,894	601,043	962,592
90%	308,533	140,818	360,694	801,193
Long Term				
Full Simulation Period[b]	1,040,207	980,783	1,076,918	1,134,536
Water Year Types[c]				
Wet (32%)	622,383	635,847	721,831	1,028,337
Above Normal (16%)	957,428	632,597	976,754	1,155,874
Below Normal (13%)	1,262,254	1,093,689	1,236,238	1,166,335
Dry (24%)	1,321,680	1,359,023	1,342,289	1,243,934
Critical (15%)	1,362,507	1,371,452	1,366,456	1,130,035

Alternative 5

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	1,373,367	1,373,971	1,371,990	1,343,268
20%	1,372,688	1,372,784	1,370,189	1,337,510
30%	1,372,016	1,371,595	1,367,918	1,330,377
40%	1,369,960	1,366,769	1,360,447	1,297,745
50%	1,352,205	1,327,439	1,343,705	1,262,326
60%	1,324,011	1,279,403	1,325,352	1,196,249
70%	960,091	754,161	995,298	1,117,718
80%	640,957	274,863	641,024	1,015,128
90%	314,038	143,900	367,825	801,611
Long Term				
Full Simulation Period[b]	1,084,355	994,926	1,092,887	1,155,813
Water Year Types[c]				
Wet (32%)	676,959	658,587	721,912	1,034,767
Above Normal (16%)	1,034,519	682,434	1,038,156	1,163,679
Below Normal (13%)	1,354,300	1,117,011	1,306,596	1,206,288
Dry (24%)	1,326,967	1,357,825	1,329,768	1,280,043
Critical (15%)	1,369,235	1,345,452	1,365,256	1,156,239

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jan	Feb	Mar	Apr
Probability of Exceedance[a]				
10%	21	-76	-114	-1,450
20%	122	-92	-455	-105
30%	437	214	693	3,553
40%	3,477	908	589	21,188
50%	13,328	-1,159	10,509	42,105
60%	18,964	35,624	1,956	45,506
70%	81,412	166,213	58,718	35,894
80%	162,768	-31	39,981	52,535
90%	5,505	3,082	7,131	418
Long Term				
Full Simulation Period[b]	44,148	14,143	15,969	21,277
Water Year Types[c]				
Wet (32%)	54,576	22,741	82	6,430
Above Normal (16%)	77,092	49,837	61,402	7,805
Below Normal (13%)	92,046	23,322	70,358	39,953
Dry (24%)	5,287	-1,198	-12,520	36,109
Critical (15%)	6,728	-26,000	-1,200	26,204

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.15. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA

Table C-15-1. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,704,398	1,525,979	1,070,585
20%	1,675,996	1,373,240	1,042,603
30%	1,639,252	1,308,087	1,028,934
40%	1,561,822	1,248,326	1,015,314
50%	1,442,854	1,168,815	998,407
60%	1,314,000	1,103,230	997,255
70%	1,215,575	1,049,304	996,238
80%	1,143,655	1,026,181	995,116
90%	1,001,200	997,289	993,132
Long Term			
Full Simulation Period[b]	1,406,784	1,215,348	1,020,541
Water Year Types[c]			
Wet (32%)	1,362,874	1,143,915	1,016,440
Above Normal (16%)	1,388,023	1,207,032	1,011,268
Below Normal (13%)	1,414,040	1,186,118	1,027,313
Dry (24%)	1,527,772	1,291,345	1,020,786
Critical (15%)	1,313,945	1,279,260	1,032,854

Alternative 1

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,282	1,451,007	1,130,575
20%	1,672,062	1,309,717	1,070,494
30%	1,629,842	1,247,589	1,041,374
40%	1,488,708	1,172,513	1,028,459
50%	1,363,696	1,132,680	1,015,164
60%	1,257,370	1,076,987	997,074
70%	1,185,113	1,029,370	996,393
80%	1,115,017	1,004,746	996,075
90%	999,499	997,466	993,157
Long Term			
Full Simulation Period[b]	1,375,624	1,176,654	1,033,253
Water Year Types[c]			
Wet (32%)	1,345,856	1,131,139	1,016,301
Above Normal (16%)	1,372,136	1,152,491	1,035,900
Below Normal (13%)	1,349,078	1,100,094	1,066,930
Dry (24%)	1,479,128	1,237,536	1,031,327
Critical (15%)	1,295,729	1,270,153	1,039,453

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	-5,116	-74,972	59,990
20%	-3,934	-63,523	27,891
30%	-9,410	-60,498	12,440
40%	-73,114	-75,813	13,146
50%	-79,158	-36,135	16,757
60%	-56,630	-26,243	-181
70%	-30,462	-19,934	154
80%	-28,638	-21,435	959
90%	-1,700	177	25
Long Term			
Full Simulation Period[b]	-31,159	-38,694	12,712
Water Year Types[c]			
Wet (32%)	-17,018	-12,776	-139
Above Normal (16%)	-15,887	-54,541	24,632
Below Normal (13%)	-64,962	-86,024	39,616
Dry (24%)	-48,644	-53,809	10,541
Critical (15%)	-18,216	-9,107	6,600

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-15-2. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,704,398	1,525,979	1,070,585
20%	1,675,996	1,373,240	1,042,603
30%	1,639,252	1,308,087	1,028,934
40%	1,561,822	1,248,326	1,015,314
50%	1,442,854	1,168,815	998,407
60%	1,314,000	1,103,230	997,255
70%	1,215,575	1,049,304	996,238
80%	1,143,655	1,026,181	995,116
90%	1,001,200	997,289	993,132
Long Term			
Full Simulation Period[b]	1,406,784	1,215,348	1,020,541
Water Year Types[c]			
Wet (32%)	1,362,874	1,143,915	1,016,440
Above Normal (16%)	1,388,023	1,207,032	1,011,268
Below Normal (13%)	1,414,040	1,186,118	1,027,313
Dry (24%)	1,527,772	1,291,345	1,020,786
Critical (15%)	1,313,945	1,279,260	1,032,854

Alternative 3

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,140	1,441,600	1,109,785
20%	1,669,589	1,314,038	1,070,266
30%	1,629,868	1,246,095	1,041,475
40%	1,544,685	1,178,162	1,025,730
50%	1,404,938	1,137,924	1,011,028
60%	1,283,871	1,071,084	996,746
70%	1,191,706	1,030,315	996,309
80%	1,129,631	1,004,945	995,946
90%	999,948	996,701	993,582
Long Term			
Full Simulation Period[b]	1,389,330	1,178,084	1,031,592
Water Year Types[c]			
Wet (32%)	1,349,922	1,131,098	1,018,019
Above Normal (16%)	1,384,080	1,141,651	1,025,863
Below Normal (13%)	1,362,401	1,101,418	1,063,293
Dry (24%)	1,505,255	1,250,013	1,033,157
Critical (15%)	1,311,877	1,269,749	1,035,542

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	-5,258	-84,379	39,200
20%	-6,408	-59,202	27,663
30%	-9,384	-61,992	12,541
40%	-17,137	-70,164	10,416
50%	-37,916	-30,891	12,621
60%	-30,129	-32,147	-509
70%	-23,869	-18,989	71
80%	-14,024	-21,236	830
90%	-1,251	-588	450
Long Term			
Full Simulation Period[b]	-17,454	-37,264	11,052
Water Year Types[c]			
Wet (32%)	-12,953	-12,818	1,579
Above Normal (16%)	-3,943	-65,381	14,595
Below Normal (13%)	-51,639	-84,700	35,980
Dry (24%)	-22,518	-41,332	12,372
Critical (15%)	-2,067	-9,511	2,688

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.
b Based on the 82-year simulation period.
c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-15-3. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,704,398	1,525,979	1,070,585
20%	1,675,996	1,373,240	1,042,603
30%	1,639,252	1,308,087	1,028,934
40%	1,561,822	1,248,326	1,015,314
50%	1,442,854	1,168,815	998,407
60%	1,314,000	1,103,230	997,255
70%	1,215,575	1,049,304	996,238
80%	1,143,655	1,026,181	995,116
90%	1,001,200	997,289	993,132
Long Term			
Full Simulation Period[b]	1,406,784	1,215,348	1,020,541
Water Year Types[c]			
Wet (32%)	1,362,874	1,143,915	1,016,440
Above Normal (16%)	1,388,023	1,207,032	1,011,268
Below Normal (13%)	1,414,040	1,186,118	1,027,313
Dry (24%)	1,527,772	1,291,345	1,020,786
Critical (15%)	1,313,945	1,279,260	1,032,854

Alternative 5

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,450	1,522,613	1,068,763
20%	1,671,627	1,373,318	1,043,471
30%	1,639,255	1,308,808	1,030,261
40%	1,561,402	1,261,851	1,016,778
50%	1,443,429	1,175,321	999,758
60%	1,315,410	1,114,991	997,213
70%	1,222,612	1,072,760	996,224
80%	1,143,865	1,033,746	995,736
90%	1,019,494	1,011,013	993,137
Long Term			
Full Simulation Period[b]	1,409,320	1,225,548	1,020,719
Water Year Types[c]			
Wet (32%)	1,362,798	1,143,533	1,016,438
Above Normal (16%)	1,388,002	1,218,954	1,010,242
Below Normal (13%)	1,402,322	1,186,604	1,024,597
Dry (24%)	1,541,724	1,310,012	1,021,502
Critical (15%)	1,318,954	1,305,318	1,036,482

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	-4,949	-3,366	-1,822
20%	-4,369	78	868
30%	3	721	1,327
40%	-420	13,525	1,464
50%	575	6,506	1,351
60%	1,410	11,760	-42
70%	7,037	23,456	-14
80%	210	7,565	620
90%	18,295	13,724	5
Long Term			
Full Simulation Period[b]	2,537	10,200	178
Water Year Types[c]			
Wet (32%)	-76	-382	-2
Above Normal (16%)	-21	11,922	-1,026
Below Normal (13%)	-11,718	486	-2,717
Dry (24%)	13,952	18,667	716
Critical (15%)	5,010	26,058	3,629

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-15-4. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,282	1,451,007	1,130,575
20%	1,672,062	1,309,717	1,070,494
30%	1,629,842	1,247,589	1,041,374
40%	1,488,708	1,172,513	1,028,459
50%	1,363,696	1,132,680	1,015,164
60%	1,257,370	1,076,987	997,074
70%	1,185,113	1,029,370	996,393
80%	1,115,017	1,004,746	996,075
90%	999,499	997,466	993,157
Long Term			
Full Simulation Period[b]	1,375,624	1,176,654	1,033,253
Water Year Types[c]			
Wet (32%)	1,345,856	1,131,139	1,016,301
Above Normal (16%)	1,372,136	1,152,491	1,035,900
Below Normal (13%)	1,349,078	1,100,094	1,066,930
Dry (24%)	1,479,128	1,237,536	1,031,327
Critical (15%)	1,295,729	1,270,153	1,039,453

No Action Alternative

Statistic	Monthly WUA (Feet2)		
	Apr	May	Jun
Probability of Exceedance[a]			
10%	1,704,398	1,525,979	1,070,585
20%	1,675,996	1,373,240	1,042,603
30%	1,639,252	1,308,087	1,028,934
40%	1,561,822	1,248,326	1,015,314
50%	1,442,854	1,168,815	998,407
60%	1,314,000	1,103,230	997,255
70%	1,215,575	1,049,304	996,238
80%	1,143,655	1,026,181	995,116
90%	1,001,200	997,289	993,132
Long Term			
Full Simulation Period[b]	1,406,784	1,215,348	1,020,541
Water Year Types[c]			
Wet (32%)	1,362,874	1,143,915	1,016,440
Above Normal (16%)	1,388,023	1,207,032	1,011,268
Below Normal (13%)	1,414,040	1,186,118	1,027,313
Dry (24%)	1,527,772	1,291,345	1,020,786
Critical (15%)	1,313,945	1,279,260	1,032,854

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Apr	May	Jun
Probability of Exceedance[a]			
10%	5,116	74,972	**-59,990**
20%	3,934	63,523	**-27,891**
30%	9,410	60,498	**-12,440**
40%	73,114	75,813	**-13,146**
50%	79,158	36,135	**-16,757**
60%	56,630	26,243	181
70%	30,462	19,934	**-154**
80%	28,638	21,435	**-959**
90%	1,700	**-177**	**-25**
Long Term			
Full Simulation Period[b]	31,159	38,694	**-12,712**
Water Year Types[c]			
Wet (32%)	17,018	12,776	139
Above Normal (16%)	15,887	54,541	**-24,632**
Below Normal (13%)	64,962	86,024	**-39,616**
Dry (24%)	48,644	53,809	**-10,541**
Critical (15%)	18,216	9,107	**-6,600**

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-15-5. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)		
Statistic	Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,282	1,451,007	1,130,575
20%	1,672,062	1,309,717	1,070,494
30%	1,629,842	1,247,589	1,041,374
40%	1,488,708	1,172,513	1,028,459
50%	1,363,696	1,132,680	1,015,164
60%	1,257,370	1,076,987	997,074
70%	1,185,113	1,029,370	996,393
80%	1,115,017	1,004,746	996,075
90%	999,499	997,466	993,157
Long Term			
Full Simulation Period[b]	1,375,624	1,176,654	1,033,253
Water Year Types[c]			
Wet (32%)	1,345,856	1,131,139	1,016,301
Above Normal (16%)	1,372,136	1,152,491	1,035,900
Below Normal (13%)	1,349,078	1,100,094	1,066,930
Dry (24%)	1,479,128	1,237,536	1,031,327
Critical (15%)	1,295,729	1,270,153	1,039,453

Alternative 3

	Monthly WUA (Feet2)		
Statistic	Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,140	1,441,600	1,109,785
20%	1,669,589	1,314,038	1,070,266
30%	1,629,868	1,246,095	1,041,475
40%	1,544,685	1,178,162	1,025,730
50%	1,404,938	1,137,924	1,011,028
60%	1,283,871	1,071,084	996,746
70%	1,191,706	1,030,315	996,309
80%	1,129,631	1,004,945	995,946
90%	999,948	996,701	993,582
Long Term			
Full Simulation Period[b]	1,389,330	1,178,084	1,031,592
Water Year Types[c]			
Wet (32%)	1,349,922	1,131,098	1,018,019
Above Normal (16%)	1,384,080	1,141,651	1,025,863
Below Normal (13%)	1,362,401	1,101,418	1,063,293
Dry (24%)	1,505,255	1,250,013	1,033,157
Critical (15%)	1,311,877	1,269,749	1,035,542

Alternative 3 minus Second Basis of Comparison

	Monthly WUA (Feet2)		
Statistic	Apr	May	Jun
Probability of Exceedance[a]			
10%	-142	-9,407	-20,790
20%	-2,473	4,321	-227
30%	26	-1,494	101
40%	55,977	5,649	-2,729
50%	41,242	5,244	-4,137
60%	26,502	-5,903	-328
70%	6,593	945	-84
80%	14,614	198	-130
90%	449	-765	425
Long Term			
Full Simulation Period[b]	13,705	1,430	-1,660
Water Year Types[c]			
Wet (32%)	4,065	-42	1,718
Above Normal (16%)	11,944	-10,839	-10,038
Below Normal (13%)	13,323	1,324	-3,637
Dry (24%)	26,126	12,477	1,831
Critical (15%)	16,148	-404	-3,911

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-15-6. Sacramento River Keswick to Battle Creek Late-Fall-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,282	1,451,007	1,130,575
20%	1,672,062	1,309,717	1,070,494
30%	1,629,842	1,247,589	1,041,374
40%	1,488,708	1,172,513	1,028,459
50%	1,363,696	1,132,680	1,015,164
60%	1,257,370	1,076,987	997,074
70%	1,185,113	1,029,370	996,393
80%	1,115,017	1,004,746	996,075
90%	999,499	997,466	993,157
Long Term			
Full Simulation Period[b]	1,375,624	1,176,654	1,033,253
Water Year Types[c]			
Wet (32%)	1,345,856	1,131,139	1,016,301
Above Normal (16%)	1,372,136	1,152,491	1,035,900
Below Normal (13%)	1,349,078	1,100,094	1,066,930
Dry (24%)	1,479,128	1,237,536	1,031,327
Critical (15%)	1,295,729	1,270,153	1,039,453

Alternative 5

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	1,699,450	1,522,613	1,068,763
20%	1,671,627	1,373,318	1,043,471
30%	1,639,255	1,308,808	1,030,261
40%	1,561,402	1,261,851	1,016,778
50%	1,443,429	1,175,321	999,758
60%	1,315,410	1,114,991	997,213
70%	1,222,612	1,072,760	996,224
80%	1,143,865	1,033,746	995,736
90%	1,019,494	1,011,013	993,137
Long Term			
Full Simulation Period[b]	1,409,320	1,225,548	1,020,719
Water Year Types[c]			
Wet (32%)	1,362,798	1,143,533	1,016,438
Above Normal (16%)	1,388,002	1,218,954	1,010,242
Below Normal (13%)	1,402,322	1,186,604	1,024,597
Dry (24%)	1,541,724	1,310,012	1,021,502
Critical (15%)	1,318,954	1,305,318	1,036,482

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Apr	May	Jun
Probability of Exceedance[a]			
10%	167	71,607	-61,812
20%	-435	63,601	-27,022
30%	9,413	61,219	-11,113
40%	72,694	89,338	-11,681
50%	79,733	42,641	-15,406
60%	58,040	38,003	139
70%	37,499	43,390	-168
80%	28,848	28,999	-339
90%	19,995	13,547	-20
Long Term			
Full Simulation Period[b]	33,696	48,895	-12,534
Water Year Types[c]			
Wet (32%)	16,942	12,394	137
Above Normal (16%)	15,866	66,463	-25,658
Below Normal (13%)	53,244	86,510	-42,333
Dry (24%)	62,596	72,476	-9,825
Critical (15%)	23,225	35,165	-2,971

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.16. Sacramento River Keswick to Battle Creek Late-Fall-run Juvenile Rearing WUA

Table C-16-1. Sacramento River Keswick to Battle Creek Late-Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	623,017	640,157	652,600	652,782	653,060	654,821	638,223	598,502	468,287	396,846	487,670	631,203
20%	608,964	627,361	651,728	652,034	652,022	653,160	625,399	569,781	453,799	372,279	457,103	627,109
30%	592,596	617,768	640,097	650,917	651,309	651,873	620,307	557,249	433,121	357,876	449,228	621,851
40%	569,681	591,980	628,239	634,602	638,736	640,153	606,281	540,739	421,483	353,494	434,268	598,046
50%	553,399	550,443	627,600	625,993	615,621	625,590	582,839	516,749	408,991	346,607	419,803	562,368
60%	519,004	504,464	619,625	613,032	591,952	614,289	561,202	494,080	397,738	341,063	410,523	451,247
70%	495,388	451,681	572,193	469,580	388,749	482,898	533,465	474,076	383,427	338,001	399,485	399,889
80%	472,912	397,683	420,509	382,314	381,803	382,314	492,785	450,610	370,909	337,330	393,522	362,028
90%	448,945	369,808	365,251	357,222	365,681	357,245	398,511	423,428	353,672	337,030	378,610	337,148
Long Term												
Full Simulation Period[b]	541,118	524,717	568,224	556,400	543,976	555,952	554,329	511,414	410,786	357,892	426,691	507,331
Water Year Types[c]												
Wet (32%)	518,114	493,252	470,475	445,144	459,091	445,636	520,129	481,798	422,595	356,550	413,504	365,976
Above Normal (16%)	546,717	515,815	556,051	523,083	465,969	519,637	549,977	513,416	393,375	340,830	405,409	450,866
Below Normal (13%)	526,010	516,768	624,530	634,608	555,374	619,378	572,781	511,898	397,461	343,587	402,505	590,171
Dry (24%)	547,318	537,651	630,043	624,925	641,243	632,188	599,317	530,323	401,623	361,894	453,080	615,516
Critical (15%)	588,413	588,267	638,560	647,649	639,843	649,110	541,246	541,457	431,547	385,727	456,509	618,527

Alternative 1

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	627,314	641,040	652,512	652,733	653,080	654,822	638,489	584,219	468,041	398,186	484,130	632,785
20%	620,501	627,412	650,227	652,132	651,892	653,142	624,779	559,782	439,150	374,923	454,453	627,463
30%	598,656	624,087	633,954	651,054	650,792	651,205	619,268	542,266	418,605	355,461	442,241	623,230
40%	581,741	618,898	628,284	630,852	632,726	638,835	592,215	519,981	402,312	351,960	422,630	599,655
50%	561,184	593,820	627,200	621,443	617,490	621,027	570,216	504,502	388,150	346,185	408,810	590,877
60%	545,037	579,387	620,586	601,842	574,446	612,216	545,628	484,947	379,372	340,190	396,894	578,960
70%	491,132	561,227	544,145	431,586	382,314	458,197	522,580	466,285	363,895	337,801	388,249	564,451
80%	468,879	516,863	390,190	382,314	373,984	378,237	472,169	438,510	354,203	337,491	372,100	550,661
90%	451,961	480,391	357,486	356,586	355,544	356,789	399,242	408,705	340,207	337,033	357,605	444,323
Long Term												
Full Simulation Period[b]	548,320	574,360	562,186	541,895	539,127	550,228	546,878	499,145	397,563	357,485	416,477	572,650
Water Year Types[c]												
Wet (32%)	535,032	559,211	444,754	432,266	451,323	446,173	515,862	475,686	418,495	358,149	392,771	522,675
Above Normal (16%)	551,560	557,478	571,041	498,137	448,017	499,290	546,681	497,402	378,407	339,460	389,699	564,823
Below Normal (13%)	530,312	559,201	621,306	595,532	549,245	592,090	554,853	480,249	380,126	342,104	383,786	587,659
Dry (24%)	542,744	597,645	631,532	622,456	640,538	636,651	588,089	517,335	383,022	357,543	456,870	610,962
Critical (15%)	599,404	600,561	637,255	643,393	649,778	648,454	538,299	538,867	413,182	389,577	459,496	611,796

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	4,297	882	-88	-49	20	1	266	-14,282	-246	1,340	-3,540	1,582
20%	11,537	51	-1,501	98	-130	-19	-620	-10,000	-14,649	2,644	-2,650	353
30%	6,059	6,319	-6,144	137	-517	-668	-1,039	-14,983	-14,516	-2,415	-6,986	1,379
40%	12,061	26,918	45	-3,750	-6,009	-1,318	-14,066	-20,758	-19,171	-1,534	-11,638	1,609
50%	7,784	43,377	-400	-4,549	1,870	-4,563	-12,623	-12,247	-20,842	-422	-10,993	28,510
60%	26,033	74,923	961	-11,190	-17,507	-2,073	-15,574	-9,134	-18,367	-872	-13,630	127,712
70%	-4,256	109,546	-28,048	-37,995	-6,435	-24,700	-10,885	-7,791	-19,532	-200	-11,237	164,561
80%	-4,032	119,180	-30,319	0	-7,820	-4,077	-20,616	-12,101	-16,706	161	-21,422	188,633
90%	3,015	110,584	-7,765	-636	-10,137	-456	732	-14,723	-13,465	3	-21,005	107,175
Long Term												
Full Simulation Period[b]	7,202	49,643	-6,039	-14,505	-4,849	-5,723	-7,450	-12,269	-13,222	-407	-10,214	65,319
Water Year Types[c]												
Wet (32%)	16,918	65,959	-25,721	-12,878	-7,768	538	-4,267	-6,112	-4,100	1,599	-20,733	156,700
Above Normal (16%)	4,844	41,662	14,990	-24,946	-17,952	-20,347	-3,296	-16,014	-14,968	-1,369	-15,711	113,957
Below Normal (13%)	4,302	42,433	-3,223	-39,076	-6,129	-27,288	-17,928	-31,649	-17,335	-1,483	-18,719	-2,512
Dry (24%)	-4,574	59,994	1,490	-2,469	-706	4,463	-11,228	-12,988	-18,600	-4,351	3,790	-4,553
Critical (15%)	10,991	12,294	-1,305	-4,256	9,935	-656	-2,947	-2,590	-18,364	3,850	2,988	-6,731

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

1/0/1900

No Action Alternative

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	623,017	640,157	652,600	652,782	653,060	654,821	638,223	598,502	468,287	396,846	487,670	631,203
20%	608,964	627,361	651,728	652,034	652,022	653,160	625,399	569,781	453,799	372,279	457,103	627,109
30%	592,596	617,768	640,097	650,917	651,309	651,873	620,307	557,249	433,121	357,876	449,228	621,851
40%	569,681	591,980	628,239	634,602	638,736	640,153	606,281	540,739	421,483	353,494	434,268	598,046
50%	553,399	550,443	627,600	625,993	615,621	625,590	582,839	516,749	408,991	346,607	419,803	562,368
60%	519,004	504,464	619,625	613,032	591,952	614,289	561,202	494,080	397,738	341,063	410,523	451,247
70%	495,388	451,681	572,193	469,580	388,749	482,898	533,465	474,076	383,427	338,001	399,485	399,889
80%	472,912	397,683	420,509	382,314	381,803	382,314	492,785	450,610	370,909	337,330	393,522	362,028
90%	448,945	369,808	365,251	357,222	365,681	357,245	398,511	423,428	353,672	337,030	378,610	337,148
Long Term												
Full Simulation Period[b]	541,118	524,717	568,224	556,400	543,976	555,952	554,329	511,414	410,786	357,892	426,691	507,331
Water Year Types[c]												
Wet (32%)	518,114	493,252	470,475	445,144	459,091	445,636	520,129	481,798	422,595	356,550	413,504	365,976
Above Normal (16%)	546,717	515,815	556,051	523,083	465,969	519,637	549,977	513,416	393,375	340,830	405,409	450,866
Below Normal (13%)	526,010	516,768	624,530	634,608	555,374	619,378	572,781	511,898	397,461	343,587	402,505	590,171
Dry (24%)	547,318	537,651	630,043	624,925	641,243	632,188	599,317	530,323	401,623	361,894	453,080	615,516
Critical (15%)	588,413	588,267	638,560	647,649	639,843	649,110	541,246	541,457	431,547	385,727	456,509	618,527

Alternative 3

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	625,570	641,309	652,444	652,846	652,996	654,825	638,393	582,323	468,123	397,479	466,050	630,200
20%	614,404	627,467	649,812	652,206	652,137	652,932	624,578	560,781	434,276	373,122	454,455	627,070
30%	597,586	625,943	634,879	651,219	651,204	651,079	619,272	541,909	416,710	360,392	433,033	618,125
40%	581,893	619,639	627,956	633,765	638,809	639,429	602,830	522,451	399,977	352,796	422,905	603,775
50%	562,752	599,992	626,357	624,942	615,572	621,038	576,101	505,210	391,599	343,164	416,813	585,102
60%	531,052	584,525	615,117	613,215	545,336	612,223	554,446	485,675	383,022	339,611	399,564	573,021
70%	498,299	559,956	549,776	432,866	382,314	458,297	524,856	457,541	366,856	338,011	390,515	552,754
80%	467,395	534,288	384,267	382,314	381,812	378,234	475,919	437,895	352,898	337,495	382,017	499,503
90%	448,508	479,273	357,580	356,658	355,534	356,793	399,417	407,546	344,014	337,198	371,616	455,756
Long Term												
Full Simulation Period[b]	544,915	577,306	561,379	544,567	539,928	550,052	549,986	499,146	398,468	357,817	417,529	563,464
Water Year Types[c]												
Wet (32%)	536,885	561,677	446,693	432,550	451,342	446,178	516,714	475,365	415,742	357,023	401,044	514,123
Above Normal (16%)	546,233	554,439	569,510	505,602	455,570	500,390	549,068	494,812	381,580	340,437	398,604	565,605
Below Normal (13%)	533,793	569,799	621,726	596,109	547,839	592,724	558,253	481,818	383,782	342,955	392,182	535,271
Dry (24%)	531,911	596,784	626,880	624,926	645,199	634,917	594,273	518,348	384,515	356,723	445,670	612,401
Critical (15%)	592,757	610,361	636,566	648,305	640,551	648,351	541,680	539,247	416,052	393,812	450,085	612,329

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	2,553	1,152	-156	64	-64	4	170	-16,178	-164	633	-21,620	-1,002
20%	5,440	106	-1,916	172	114	-229	-820	-9,000	-19,522	843	-2,648	-39
30%	4,990	8,175	-5,218	302	-104	-794	-1,035	-15,340	-16,410	2,516	-16,195	-3,727
40%	12,212	27,659	-283	-836	73	-724	-3,452	-18,288	-21,506	-698	-11,363	5,729
50%	9,353	49,549	-1,243	-1,050	-49	-4,552	-6,739	-11,538	-17,392	-3,442	-2,990	22,734
60%	12,048	80,061	-4,508	183	-46,617	-2,065	-6,755	-8,405	-14,716	-1,452	-10,959	121,774
70%	2,911	108,275	-22,416	-36,714	-6,435	-24,601	-8,609	-16,536	-16,570	10	-8,970	152,864
80%	-5,516	136,604	-36,242	0	8	-4,080	-16,866	-12,716	-18,011	165	-11,505	137,475
90%	-437	109,465	-7,671	-564	-10,147	-452	906	-15,882	-9,658	168	-6,995	118,607
Long Term												
Full Simulation Period[b]	3,797	52,589	-6,846	-11,833	-4,048	-5,900	-4,343	-12,268	-12,318	-75	-9,162	56,133
Water Year Types[c]												
Wet (32%)	18,771	68,425	-23,782	-12,594	-7,749	543	-3,416	-6,433	-6,853	473	-12,460	148,147
Above Normal (16%)	-484	38,624	13,459	-17,480	-10,399	-19,246	-909	-18,604	-11,795	-392	-6,806	114,740
Below Normal (13%)	7,782	53,031	-2,804	-38,499	-7,534	-26,654	-14,528	-30,081	-13,679	-632	-10,323	-54,900
Dry (24%)	-15,408	59,133	-3,162	1	3,956	2,729	-5,045	-11,975	-17,108	-5,171	-7,410	-3,115
Critical (15%)	4,343	22,094	-1,994	656	708	-759	434	-2,210	-15,494	8,085	-6,423	-6,199

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-16-3. Sacramento River Keswick to Battle Creek Late-Fall-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly WUA (Feet2)											
Probability of Exceedance[a]												
10%	623,017	640,157	652,600	652,782	653,060	654,821	638,223	598,502	468,287	396,846	487,670	631,203
20%	608,964	627,361	651,728	652,034	652,022	653,160	625,399	569,781	453,799	372,279	457,103	627,109
30%	592,596	617,768	640,097	650,917	651,309	651,873	620,307	557,249	433,121	357,876	449,228	621,851
40%	569,681	591,980	628,239	634,602	638,736	640,153	606,281	540,739	421,483	353,494	434,268	598,046
50%	553,399	550,443	627,600	625,993	615,621	625,590	582,839	516,749	408,991	346,607	419,803	562,368
60%	519,004	504,464	619,625	613,032	591,952	614,289	561,202	494,080	397,738	341,063	410,523	451,247
70%	495,388	451,681	572,193	469,580	388,749	482,898	533,465	474,076	383,427	338,001	399,485	399,889
80%	472,912	397,683	420,509	382,314	381,803	382,314	492,785	450,610	370,909	337,330	393,522	362,028
90%	448,945	369,808	365,251	357,222	365,681	357,245	398,511	423,428	353,672	337,030	378,610	337,148
Long Term												
Full Simulation Period[b]	541,118	524,717	568,224	556,400	543,976	555,952	554,329	511,414	410,786	357,892	426,691	507,331
Water Year Types[c]												
Wet (32%)	518,114	493,252	470,475	445,144	459,091	445,636	520,129	481,798	422,595	356,550	413,504	365,976
Above Normal (16%)	546,717	515,815	556,051	523,083	465,969	519,637	549,977	513,416	393,375	340,830	405,409	450,866
Below Normal (13%)	526,010	516,768	624,530	634,608	555,374	619,378	572,781	511,898	397,461	343,587	402,505	590,171
Dry (24%)	547,318	537,651	630,043	624,925	641,243	632,188	599,317	530,323	401,623	361,894	453,080	615,516
Critical (15%)	588,413	588,267	638,560	647,649	639,843	649,110	541,246	541,457	431,547	385,727	456,509	618,527

Alternative 5

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly WUA (Feet2)											
Probability of Exceedance[a]												
10%	620,475	641,717	652,600	652,835	653,029	654,812	638,242	597,811	469,943	397,637	481,403	628,192
20%	598,750	627,402	651,696	652,087	652,025	653,157	625,050	569,803	454,857	372,652	460,452	625,345
30%	590,231	619,431	640,161	651,147	651,301	651,867	620,307	557,448	435,336	355,023	438,636	610,336
40%	567,616	596,161	628,238	634,417	638,734	639,419	606,196	544,970	421,396	352,120	430,379	592,010
50%	553,244	552,378	627,602	625,984	615,629	625,541	583,090	519,773	414,306	344,628	418,075	565,852
60%	521,700	498,542	621,940	612,864	591,932	614,278	561,427	497,067	398,085	340,068	406,771	459,908
70%	502,455	444,756	576,604	467,945	390,704	482,875	535,251	481,529	385,813	338,018	396,424	400,984
80%	478,736	398,127	423,206	382,314	381,802	382,314	493,004	462,266	369,315	337,331	390,411	366,650
90%	444,456	372,908	365,159	358,492	365,685	356,925	399,441	432,965	355,162	336,967	376,945	337,332
Long Term												
Full Simulation Period[b]	540,292	525,405	568,602	555,999	544,042	555,548	556,088	516,778	412,130	356,767	423,113	505,820
Water Year Types[c]												
Wet (32%)	520,649	490,652	470,095	444,282	459,333	445,524	520,113	481,634	422,784	356,175	413,293	366,266
Above Normal (16%)	541,815	520,202	555,014	522,790	465,999	519,415	550,010	516,937	393,772	340,687	407,234	454,981
Below Normal (13%)	526,726	517,041	625,551	633,364	555,698	618,370	570,884	513,316	396,783	343,763	407,286	584,279
Dry (24%)	548,341	540,291	630,871	624,919	640,956	631,414	602,959	543,467	401,525	360,680	442,048	613,041
Critical (15%)	580,226	589,196	640,771	648,245	639,916	649,048	548,934	551,446	440,680	380,869	444,538	612,644

Alternative 5 minus No Action Alternative

Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Monthly WUA (Feet2)											
Probability of Exceedance[a]												
10%	-2,542	1,559	0	53	-30	-9	19	-691	1,656	791	-6,266	-3,011
20%	-10,214	41	-33	53	3	-3	-349	22	1,059	373	3,349	-1,764
30%	-2,365	1,663	64	230	-7	-6	0	200	2,215	-2,853	-10,592	-11,516
40%	-2,065	4,181	-1	-185	-1	-734	-86	4,231	-87	-1,374	-3,889	-6,036
50%	-156	1,935	2	-8	8	-50	251	3,024	5,314	-1,979	-1,729	3,484
60%	2,696	-5,922	2,315	-168	-21	-10	225	2,987	347	-995	-3,752	8,660
70%	7,066	-6,925	4,411	-1,635	1,955	-22	1,786	7,453	2,386	16	-3,061	1,095
80%	5,825	444	2,698	0	-1	0	218	11,656	-1,594	1	-3,111	4,623
90%	-4,490	3,100	-92	1,270	4	-320	931	9,537	1,490	-63	-1,665	184
Long Term												
Full Simulation Period[b]	-826	688	378	-401	65	-403	1,759	5,364	1,345	-1,125	-3,579	-1,511
Water Year Types[c]												
Wet (32%)	2,535	-2,600	-380	-862	242	-112	-16	-163	189	-374	-211	290
Above Normal (16%)	-4,902	4,387	-1,037	-293	30	-222	33	3,521	397	-143	1,825	4,116
Below Normal (13%)	715	273	1,021	-1,244	324	-1,009	-1,897	1,417	-679	176	4,782	-5,892
Dry (24%)	1,022	2,640	828	-6	-288	-773	3,642	13,143	-98	-1,214	-11,032	-2,475
Critical (15%)	-8,187	929	2,211	595	73	-61	7,689	9,989	9,134	-4,858	-11,971	-5,883

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-16-4. Sacramento River Keswick to Battle Creek Late-Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	627,314	641,040	652,512	652,733	653,080	654,822	638,489	584,219	468,041	398,186	484,130	632,785
20%	620,501	627,412	650,227	652,132	651,892	653,142	624,779	559,782	439,150	374,923	454,453	627,463
30%	598,656	624,087	633,954	651,054	650,792	651,205	619,268	542,266	418,605	355,461	442,241	623,230
40%	581,741	618,898	628,284	630,852	632,726	638,835	592,215	519,981	402,312	351,960	422,630	599,655
50%	561,184	593,820	627,200	621,443	617,490	621,027	570,216	504,502	388,150	346,185	408,810	590,877
60%	545,037	579,387	620,586	601,842	574,446	612,216	545,628	484,947	379,372	340,190	396,894	578,960
70%	491,132	561,227	544,145	431,586	382,314	458,197	522,580	466,285	363,895	337,801	388,249	564,451
80%	468,879	516,863	390,190	382,314	373,984	378,237	472,169	438,510	354,203	337,491	372,100	550,661
90%	451,961	480,391	357,486	356,586	355,544	356,789	399,242	408,705	340,207	337,033	357,605	444,323
Long Term												
Full Simulation Period[b]	548,320	574,360	562,186	541,895	539,127	550,228	546,878	499,145	397,563	357,485	416,477	572,650
Water Year Types[c]												
Wet (32%)	535,032	559,211	444,754	432,266	451,323	446,173	515,862	475,686	418,495	358,149	392,771	522,675
Above Normal (16%)	551,560	557,478	571,041	498,137	448,017	499,290	546,681	497,402	378,407	339,460	389,699	564,823
Below Normal (13%)	530,312	559,201	621,306	595,532	549,245	592,090	554,853	480,249	380,126	342,104	383,786	587,659
Dry (24%)	542,744	597,645	631,532	622,456	640,538	636,651	588,089	517,335	383,022	357,543	456,870	610,962
Critical (15%)	599,404	600,561	637,255	643,393	649,778	648,454	538,299	538,867	413,182	389,577	459,496	611,796

No Action Alternative

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	623,017	640,157	652,600	652,782	653,060	654,821	638,223	598,502	468,287	396,846	487,670	631,203
20%	608,964	627,361	651,728	652,034	652,022	653,160	625,399	569,781	453,799	372,279	457,103	627,109
30%	592,596	617,768	640,097	650,917	651,309	651,873	620,307	557,249	433,121	357,876	449,228	621,851
40%	569,681	591,980	628,239	634,602	638,736	640,153	606,281	540,739	421,483	353,494	434,268	598,046
50%	553,399	550,443	627,600	625,993	615,621	625,590	582,839	516,749	408,991	346,607	419,803	562,368
60%	519,004	504,464	619,625	613,032	591,952	614,289	561,202	494,080	397,738	341,063	410,523	451,247
70%	495,388	451,681	572,193	469,580	388,749	482,898	533,465	474,076	383,427	338,001	399,485	399,889
80%	472,912	397,683	420,509	382,314	381,803	382,314	492,785	450,610	370,909	337,330	393,522	362,028
90%	448,945	369,808	365,251	357,222	365,681	357,245	398,511	423,428	353,672	337,030	378,610	337,148
Long Term												
Full Simulation Period[b]	541,118	524,717	568,224	556,400	543,976	555,952	554,329	511,414	410,786	357,892	426,691	507,331
Water Year Types[c]												
Wet (32%)	518,114	493,252	470,475	445,144	459,091	445,636	520,129	481,798	422,595	356,550	413,504	365,976
Above Normal (16%)	546,717	515,815	556,051	523,083	465,969	519,637	549,977	513,416	393,375	340,830	405,409	450,866
Below Normal (13%)	526,010	516,768	624,530	634,608	555,374	619,378	572,781	511,898	397,461	343,587	402,505	590,171
Dry (24%)	547,318	537,651	630,043	624,925	641,243	632,188	599,317	530,323	401,623	361,894	453,080	615,516
Critical (15%)	588,413	588,267	638,560	647,649	639,843	649,110	541,246	541,457	431,547	385,727	456,509	618,527

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-4,297	-882	88	49	-20	-1	-266	14,282	246	-1,340	3,540	-1,582
20%	-11,537	-51	1,501	-98	130	19	620	10,000	14,649	-2,644	2,650	-353
30%	-6,059	-6,319	6,144	-137	517	668	1,039	14,983	14,516	2,415	6,986	-1,379
40%	-12,061	-26,918	-45	3,750	6,009	1,318	14,066	20,758	19,171	1,534	11,638	-1,609
50%	-7,784	-43,377	400	4,549	-1,870	4,563	12,623	12,247	20,842	422	10,993	-28,510
60%	-26,033	-74,923	-961	11,190	17,507	2,073	15,574	9,134	18,367	872	13,630	-127,712
70%	4,256	-109,546	28,048	37,995	6,435	24,700	10,885	7,791	19,532	200	11,237	-164,561
80%	4,032	-119,180	30,319	0	7,820	4,077	20,616	12,101	16,706	-161	21,422	-188,633
90%	-3,015	-110,584	7,765	636	10,137	456	-732	14,723	13,465	-3	21,005	-107,175
Long Term												
Full Simulation Period[b]	-7,202	-49,643	6,039	14,505	4,849	5,723	7,450	12,269	13,222	407	10,214	-65,319
Water Year Types[c]												
Wet (32%)	-16,918	-65,959	25,721	12,878	7,768	-538	4,267	6,112	4,100	-1,599	20,733	-156,700
Above Normal (16%)	-4,844	-41,662	-14,990	24,946	17,952	20,347	3,296	16,014	14,968	1,369	15,711	-113,957
Below Normal (13%)	-4,302	-42,433	3,223	39,076	6,129	27,288	17,928	31,649	17,335	1,483	18,719	2,512
Dry (24%)	4,574	-59,994	-1,490	2,469	706	-4,463	11,228	12,988	18,600	4,351	-3,790	4,553
Critical (15%)	-10,991	-12,294	1,305	4,256	-9,935	656	2,947	2,590	18,364	-3,850	-2,988	6,731

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-16-5. Sacramento River Keswick to Battle Creek Late-Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	627,314	641,040	652,512	652,733	653,080	654,822	638,489	584,219	468,041	398,186	484,130	632,785
20%	620,501	627,412	650,227	652,132	651,892	653,142	624,779	559,782	439,150	374,923	454,453	627,463
30%	598,656	624,087	633,954	651,054	650,792	651,205	619,268	542,266	418,605	355,461	442,241	623,230
40%	581,741	618,898	628,284	630,852	632,726	638,835	592,215	519,981	402,312	351,960	422,630	599,655
50%	561,184	593,820	627,200	621,443	617,490	621,027	570,216	504,502	388,150	346,185	408,810	590,877
60%	545,037	579,387	620,586	601,842	574,446	612,216	545,628	484,947	379,372	340,190	396,894	578,960
70%	491,132	561,227	544,145	431,586	382,314	458,197	522,580	466,285	363,895	337,801	388,249	564,451
80%	468,879	516,863	390,190	382,314	373,984	378,237	472,169	438,510	354,203	337,491	372,100	550,661
90%	451,961	480,391	357,486	356,586	355,544	356,789	399,242	408,705	340,207	337,033	357,605	444,323
Long Term												
Full Simulation Period[b]	548,320	574,360	562,186	541,895	539,127	550,228	546,878	499,145	397,563	357,485	416,477	572,650
Water Year Types[c]												
Wet (32%)	535,032	559,211	444,754	432,266	451,323	446,173	515,862	475,686	418,495	358,149	392,771	522,675
Above Normal (16%)	551,560	557,478	571,041	498,137	448,017	499,290	546,681	497,402	378,407	339,460	389,699	564,823
Below Normal (13%)	530,312	559,201	621,306	595,532	549,245	592,090	554,853	480,249	380,126	342,104	383,786	587,659
Dry (24%)	542,744	597,645	631,532	622,456	640,538	636,651	588,089	517,335	383,022	357,543	456,870	610,962
Critical (15%)	599,404	600,561	637,255	643,393	649,778	648,454	538,299	538,867	413,182	389,577	459,496	611,796

Alternative 3

	Monthly WUA (Feet2)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	625,570	641,309	652,444	652,846	652,996	654,825	638,393	582,323	468,123	397,479	466,050	630,200
20%	614,404	627,467	649,812	652,206	652,137	652,932	624,578	560,781	434,276	373,122	454,455	627,070
30%	597,586	625,943	634,879	651,219	651,204	651,079	619,272	541,909	416,710	360,392	433,033	618,125
40%	581,893	619,639	627,956	633,765	638,809	639,429	602,830	522,451	399,977	352,796	422,905	603,775
50%	562,752	599,992	626,357	624,942	615,572	621,038	576,101	505,210	391,599	343,164	416,813	585,102
60%	531,052	584,525	615,117	613,215	545,336	612,223	554,446	485,675	383,022	339,611	399,564	573,021
70%	498,299	559,956	549,776	432,866	382,314	458,297	524,856	457,541	366,856	338,011	390,515	552,754
80%	467,395	534,288	384,267	382,314	381,812	378,234	475,919	437,895	352,898	337,495	382,017	499,503
90%	448,508	479,273	357,580	356,658	355,534	356,793	399,417	407,546	344,014	337,198	371,616	455,756
Long Term												
Full Simulation Period[b]	544,915	577,306	561,379	544,567	539,928	550,052	549,986	499,146	398,468	357,817	417,529	563,464
Water Year Types[c]												
Wet (32%)	536,885	561,677	446,693	432,550	451,342	446,178	516,714	475,365	415,742	357,023	401,044	514,123
Above Normal (16%)	546,233	554,439	569,510	505,602	455,570	500,390	549,068	494,812	381,580	340,437	398,604	565,605
Below Normal (13%)	533,793	569,799	621,726	596,109	547,839	592,724	558,253	481,818	383,782	342,955	392,182	535,271
Dry (24%)	531,911	596,784	626,880	624,926	645,199	634,917	594,273	518,348	384,515	356,723	445,670	612,401
Critical (15%)	592,757	610,361	636,566	648,305	640,551	648,351	541,680	539,247	416,052	393,812	450,085	612,329

Alternative 3 minus Second Basis of Comparison

	Monthly WUA (Feet2)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-1,744	270	-68	113	-84	3	-96	-1,896	82	-707	-18,080	-2,584
20%	-6,097	55	-415	74	244	-210	-201	999	-4,874	-1,801	1	-393
30%	-1,070	1,857	926	165	412	-126	3	-357	-1,894	4,931	-9,208	-5,106
40%	152	741	-328	2,913	6,082	594	10,615	2,470	-2,335	836	275	4,121
50%	1,569	6,173	-843	3,499	-1,919	11	5,885	708	3,450	-3,020	8,003	-5,776
60%	-13,985	5,138	-5,469	11,373	-29,110	8	8,819	728	3,650	-579	2,670	-5,939
70%	7,166	-1,272	5,632	1,280	0	99	2,276	-8,744	2,962	210	2,266	-11,697
80%	-1,484	17,425	-5,923	0	7,828	-3	3,750	-615	-1,305	3	9,918	-51,158
90%	-3,452	-1,118	94	72	-9	4	174	-1,159	3,807	165	14,010	11,433
Long Term												
Full Simulation Period[b]	-3,405	2,946	-807	2,672	801	-177	3,108	1	905	332	1,052	-9,187
Water Year Types[c]												
Wet (32%)	1,853	2,466	1,939	284	19	5	852	-321	-2,753	-1,126	8,273	-8,552
Above Normal (16%)	-5,328	-3,039	-1,531	7,465	7,553	1,101	2,387	-2,590	3,173	977	8,905	782
Below Normal (13%)	3,481	10,597	420	577	-1,405	634	3,400	1,568	3,656	851	8,396	-52,388
Dry (24%)	-10,833	-861	-4,652	2,470	4,662	-1,734	6,184	1,013	1,492	-820	-11,200	1,439
Critical (15%)	-6,648	9,800	-689	4,913	-9,227	-103	3,381	380	2,870	4,235	-9,411	532

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-16-6. Sacramento River Keswick to Battle Creek Late-Fall-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	627,314	641,040	652,512	652,733	653,080	654,822	638,489	584,219	468,041	398,186	484,130	632,785
20%	620,501	627,412	650,227	652,132	651,892	653,142	624,779	559,782	439,150	374,923	454,453	627,463
30%	598,656	624,087	633,954	651,054	650,792	651,205	619,268	542,266	418,605	355,461	442,241	623,230
40%	581,741	618,898	628,284	630,852	632,726	638,835	592,215	519,981	402,312	351,960	422,630	599,655
50%	561,184	593,820	627,200	621,443	617,490	621,027	570,216	504,502	388,150	346,185	408,810	590,877
60%	545,037	579,387	620,586	601,842	574,446	612,216	545,628	484,947	379,372	340,190	396,894	578,960
70%	491,132	561,227	544,145	431,586	382,314	458,197	522,580	466,285	363,895	337,801	388,249	564,451
80%	468,879	516,863	390,190	382,314	373,984	378,237	472,169	438,510	354,203	337,491	372,100	550,661
90%	451,961	480,391	357,486	356,586	355,544	356,789	399,242	408,705	340,207	337,033	357,605	444,323
Long Term												
Full Simulation Period[b]	548,320	574,360	562,186	541,895	539,127	550,228	546,878	499,145	397,563	357,485	416,477	572,650
Water Year Types[c]												
Wet (32%)	535,032	559,211	444,754	432,266	451,323	446,173	515,862	475,686	418,495	358,149	392,771	522,675
Above Normal (16%)	551,560	557,478	571,041	498,137	448,017	499,290	546,681	497,402	378,407	339,460	389,699	564,823
Below Normal (13%)	530,312	559,201	621,306	595,532	549,245	592,090	554,853	480,249	380,126	342,104	383,786	587,659
Dry (24%)	542,744	597,645	631,532	622,456	640,538	636,651	588,089	517,335	383,022	357,543	456,870	610,962
Critical (15%)	599,404	600,561	637,255	643,393	649,778	648,454	538,299	538,867	413,182	389,577	459,496	611,796

Alternative 5

	Monthly WUA (Feet2)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	620,475	641,717	652,600	652,835	653,029	654,812	638,242	597,811	469,943	397,637	481,403	628,192
20%	598,750	627,402	651,696	652,087	652,025	653,157	625,050	569,803	454,857	372,652	460,452	625,345
30%	590,231	619,431	640,161	651,147	651,301	651,867	620,307	557,448	435,336	355,023	438,636	610,336
40%	567,616	596,161	628,238	634,417	638,734	639,419	606,196	544,970	421,396	352,120	430,379	592,010
50%	553,244	552,378	627,602	625,984	615,629	625,541	583,090	519,773	414,306	344,628	418,075	565,852
60%	521,700	498,542	621,940	612,864	591,932	614,278	561,427	497,067	398,085	340,068	406,771	459,908
70%	502,455	444,756	576,604	467,945	390,704	482,875	535,251	481,529	385,813	338,018	396,424	400,984
80%	478,736	398,127	423,206	382,314	381,802	382,314	493,004	462,266	369,315	337,331	390,411	366,650
90%	444,456	372,908	365,159	358,492	365,685	356,925	399,441	432,965	355,162	336,967	376,945	337,332
Long Term												
Full Simulation Period[b]	540,292	525,405	568,602	555,999	544,042	555,548	556,088	516,778	412,130	356,767	423,113	505,820
Water Year Types[c]												
Wet (32%)	520,649	490,652	470,095	444,282	459,333	445,524	520,113	481,634	422,784	356,175	413,293	366,266
Above Normal (16%)	541,815	520,202	555,014	522,790	465,999	519,415	550,010	516,937	393,772	340,687	407,234	454,981
Below Normal (13%)	526,726	517,041	625,551	633,364	555,698	618,370	570,884	513,316	396,783	343,763	407,286	584,279
Dry (24%)	548,341	540,291	630,871	624,919	640,956	631,414	602,959	543,467	401,525	360,680	442,048	613,041
Critical (15%)	580,226	589,196	640,771	648,245	639,916	649,048	548,934	551,446	440,680	380,869	444,538	612,644

Alternative 5 minus Second Basis of Comparison

	Monthly WUA (Feet2)											
Statistic	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance[a]												
10%	-6,839	677	87	102	-50	-10	-246	13,591	1,902	-549	-2,727	-4,593
20%	-21,751	-10	1,468	-44	132	15	270	10,021	15,707	-2,271	5,999	-2,118
30%	-8,424	-4,656	6,208	93	509	662	1,039	15,182	16,731	-438	-3,606	-12,894
40%	-14,125	-22,737	-46	3,565	6,008	584	13,981	24,989	19,084	160	7,749	-7,645
50%	-7,940	-41,441	401	4,541	-1,861	4,513	12,874	15,271	26,156	-1,557	9,264	-25,025
60%	-23,336	-80,845	1,354	11,022	17,486	2,063	15,799	12,120	18,713	-122	9,877	-119,052
70%	11,322	-116,471	32,459	36,359	8,390	24,678	12,671	15,244	21,918	217	8,176	-163,466
80%	9,857	-118,736	33,016	0	7,819	4,077	20,835	23,757	15,112	-160	18,312	-184,011
90%	-7,505	-107,483	7,673	1,906	10,141	136	199	24,260	14,955	-66	19,340	-106,991
Long Term												
Full Simulation Period[b]	-8,028	-48,955	6,417	14,104	4,915	5,320	9,209	17,633	14,567	-718	6,635	-66,830
Water Year Types[c]												
Wet (32%)	-14,383	-68,559	25,341	12,016	8,010	-649	4,251	5,948	4,289	-1,974	20,522	-156,410
Above Normal (16%)	-9,745	-37,275	-16,027	24,653	17,982	20,125	3,329	19,535	15,365	1,226	17,536	-109,842
Below Normal (13%)	-3,587	-42,161	4,244	37,832	6,453	26,280	16,031	33,066	16,656	1,659	23,501	-3,380
Dry (24%)	5,597	-57,354	-661	2,463	418	-5,237	14,870	26,132	18,502	3,137	-14,822	2,078
Critical (15%)	-19,178	-11,365	3,516	4,852	-9,862	594	10,635	12,579	27,498	-8,708	-14,959	847

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.17. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA

Table C-17-1. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,913	1,402,880	1,348,779	1,247,288	1,367,607
20%	1,397,234	1,398,995	1,330,501	1,151,512	1,331,580
30%	1,383,804	1,396,483	1,304,899	1,076,028	1,319,609
40%	1,361,660	1,387,544	1,284,770	1,025,646	1,301,422
50%	1,324,052	1,380,781	1,273,387	958,494	1,285,083
60%	1,302,499	1,356,884	1,257,377	910,240	1,273,275
70%	1,285,673	1,337,467	1,200,325	877,392	1,255,269
80%	1,209,817	1,317,403	1,147,542	871,333	1,236,598
90%	1,110,877	1,269,393	1,034,226	869,188	1,177,234
Long Term					
Full Simulation Period[b]	1,279,022	1,347,771	1,228,845	1,007,482	1,270,063
Water Year Types[c]					
Wet (32%)	1,208,241	1,322,121	1,258,600	1,017,390	1,253,869
Above Normal (16%)	1,321,724	1,358,993	1,202,350	899,621	1,252,481
Below Normal (13%)	1,342,980	1,370,832	1,183,951	932,527	1,195,328
Dry (24%)	1,280,462	1,339,410	1,204,846	1,029,261	1,315,141
Critical (15%)	1,325,090	1,383,981	1,274,231	1,135,274	1,317,574

Alternative 1

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,405,324	1,404,630	1,349,285	1,253,699	1,364,744
20%	1,396,981	1,400,993	1,314,712	1,159,614	1,326,667
30%	1,390,559	1,395,902	1,284,018	1,048,761	1,313,107
40%	1,370,422	1,384,675	1,269,628	1,007,144	1,288,359
50%	1,320,969	1,375,661	1,220,534	953,500	1,271,188
60%	1,303,778	1,353,332	1,187,322	903,226	1,249,593
70%	1,289,429	1,326,846	1,111,983	875,530	1,214,612
80%	1,209,970	1,303,044	1,037,608	872,770	1,150,449
90%	1,110,468	1,259,168	900,913	868,689	1,073,928
Long Term					
Full Simulation Period[b]	1,284,304	1,344,150	1,175,993	1,004,101	1,235,735
Water Year Types[c]					
Wet (32%)	1,214,079	1,317,062	1,249,372	1,029,435	1,204,658
Above Normal (16%)	1,323,531	1,352,103	1,124,654	891,173	1,184,894
Below Normal (13%)	1,341,241	1,351,347	1,079,799	913,397	1,120,010
Dry (24%)	1,292,959	1,346,626	1,140,705	1,002,248	1,326,201
Critical (15%)	1,327,342	1,383,498	1,219,615	1,157,785	1,313,449

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,411	1,750	506	6,411	-2,863
20%	-253	1,998	-15,789	8,101	-4,913
30%	6,755	-581	-20,881	-27,267	-6,502
40%	8,763	-2,869	-15,143	-18,502	-13,063
50%	-3,083	-5,120	-52,854	-4,994	-13,894
60%	1,278	-3,552	-70,055	-7,014	-23,681
70%	3,756	-10,621	-88,341	-1,863	-40,658
80%	152	-14,359	-109,934	1,437	-86,150
90%	-409	-10,225	-133,312	-500	-103,306
Long Term					
Full Simulation Period[b]	5,282	-3,621	-52,852	-3,381	-34,328
Water Year Types[c]					
Wet (32%)	5,837	-5,059	-9,228	12,045	-49,211
Above Normal (16%)	1,807	-6,890	-77,696	-8,448	-67,587
Below Normal (13%)	-1,739	-19,485	-104,152	-19,130	-75,318
Dry (24%)	12,497	7,216	-64,141	-27,013	11,060
Critical (15%)	2,253	-483	-54,616	22,511	-4,125

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-17-2. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,913	1,402,880	1,348,779	1,247,288	1,367,607
20%	1,397,234	1,398,995	1,330,501	1,151,512	1,331,580
30%	1,383,804	1,396,483	1,304,899	1,076,028	1,319,609
40%	1,361,660	1,387,544	1,284,770	1,025,646	1,301,422
50%	1,324,052	1,380,781	1,273,387	958,494	1,285,083
60%	1,302,499	1,356,884	1,257,377	910,240	1,273,275
70%	1,285,673	1,337,467	1,200,325	877,392	1,255,269
80%	1,209,817	1,317,403	1,147,542	871,333	1,236,598
90%	1,110,877	1,269,393	1,034,226	869,188	1,177,234
Long Term					
Full Simulation Period[b]	1,279,022	1,347,771	1,228,845	1,007,482	1,270,063
Water Year Types[c]					
Wet (32%)	1,208,241	1,322,121	1,258,600	1,017,390	1,253,869
Above Normal (16%)	1,321,724	1,358,993	1,202,350	899,621	1,252,481
Below Normal (13%)	1,342,980	1,370,832	1,183,951	932,527	1,195,328
Dry (24%)	1,280,462	1,339,410	1,204,846	1,029,261	1,315,141
Critical (15%)	1,325,090	1,383,981	1,274,231	1,135,274	1,317,574

Alternative 3

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,847	1,404,936	1,349,165	1,248,654	1,347,291
20%	1,397,388	1,401,376	1,309,945	1,153,043	1,327,681
30%	1,387,079	1,394,573	1,282,169	1,089,259	1,301,074
40%	1,355,751	1,386,531	1,265,635	1,017,782	1,290,269
50%	1,324,261	1,375,293	1,231,937	928,638	1,281,086
60%	1,307,204	1,351,627	1,196,594	895,467	1,254,206
70%	1,292,343	1,328,229	1,128,461	877,400	1,221,431
80%	1,209,731	1,303,176	1,024,198	872,846	1,193,903
90%	1,110,594	1,251,007	940,203	870,160	1,145,752
Long Term					
Full Simulation Period[b]	1,282,458	1,343,002	1,182,749	1,005,743	1,251,126
Water Year Types[c]					
Wet (32%)	1,212,391	1,316,850	1,241,020	1,021,763	1,222,330
Above Normal (16%)	1,321,765	1,351,764	1,144,651	897,331	1,223,088
Below Normal (13%)	1,340,244	1,352,936	1,101,790	918,585	1,191,118
Dry (24%)	1,289,949	1,341,107	1,145,755	999,319	1,305,669
Critical (15%)	1,326,234	1,384,222	1,233,635	1,179,081	1,307,994

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	-67	2,057	385	1,366	-20,316
20%	154	2,380	-20,556	1,531	-3,898
30%	3,275	-1,910	-22,730	13,231	-18,535
40%	-5,909	-1,013	-19,135	-7,864	-11,153
50%	210	-5,488	-41,450	-29,856	-3,997
60%	4,704	-5,257	-60,784	-14,773	-19,069
70%	6,671	-9,237	-71,863	8	-33,838
80%	-87	-14,227	-123,344	1,512	-42,696
90%	-283	-18,386	-94,023	972	-31,483
Long Term					
Full Simulation Period[b]	3,436	-4,769	-46,096	-1,739	-18,937
Water Year Types[c]					
Wet (32%)	4,149	-5,271	-17,580	4,373	-31,539
Above Normal (16%)	40	-7,229	-57,699	-2,291	-29,393
Below Normal (13%)	-2,735	-17,895	-82,161	-13,943	-4,210
Dry (24%)	9,487	1,697	-59,091	-29,941	-9,472
Critical (15%)	1,144	240	-40,595	43,807	-9,580

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-17-3. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,913	1,402,880	1,348,779	1,247,288	1,367,607
20%	1,397,234	1,398,995	1,330,501	1,151,512	1,331,580
30%	1,383,804	1,396,483	1,304,899	1,076,028	1,319,609
40%	1,361,660	1,387,544	1,284,770	1,025,646	1,301,422
50%	1,324,052	1,380,781	1,273,387	958,494	1,285,083
60%	1,302,499	1,356,884	1,257,377	910,240	1,273,275
70%	1,285,673	1,337,467	1,200,325	877,392	1,255,269
80%	1,209,817	1,317,403	1,147,542	871,333	1,236,598
90%	1,110,877	1,269,393	1,034,226	869,188	1,177,234
Long Term					
Full Simulation Period[b]	1,279,022	1,347,771	1,228,845	1,007,482	1,270,063
Water Year Types[c]					
Wet (32%)	1,208,241	1,322,121	1,258,600	1,017,390	1,253,869
Above Normal (16%)	1,321,724	1,358,993	1,202,350	899,621	1,252,481
Below Normal (13%)	1,342,980	1,370,832	1,183,951	932,527	1,195,328
Dry (24%)	1,280,462	1,339,410	1,204,846	1,029,261	1,315,141
Critical (15%)	1,325,090	1,383,981	1,274,231	1,135,274	1,317,574

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,791	1,402,801	1,350,780	1,252,313	1,357,205
20%	1,397,937	1,400,938	1,333,003	1,153,273	1,334,527
30%	1,383,430	1,397,141	1,305,454	1,044,551	1,310,720
40%	1,362,747	1,388,451	1,287,646	1,011,128	1,297,967
50%	1,328,004	1,381,449	1,276,882	940,783	1,281,811
60%	1,308,213	1,366,765	1,257,049	902,840	1,267,554
70%	1,292,294	1,345,468	1,210,126	877,459	1,245,717
80%	1,209,824	1,332,896	1,139,222	871,342	1,223,345
90%	1,110,707	1,292,590	1,050,095	868,102	1,174,413
Long Term					
Full Simulation Period[b]	1,280,939	1,352,263	1,232,517	1,001,043	1,267,903
Water Year Types[c]					
Wet (32%)	1,208,260	1,322,053	1,259,471	1,013,803	1,252,971
Above Normal (16%)	1,321,807	1,359,027	1,204,844	897,679	1,254,190
Below Normal (13%)	1,344,630	1,373,097	1,189,342	932,859	1,212,358
Dry (24%)	1,281,672	1,354,165	1,204,076	1,020,532	1,303,214
Critical (15%)	1,334,529	1,388,120	1,291,075	1,115,393	1,307,177

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	-122	-79	2,000	5,025	-10,402
20%	703	1,943	2,502	1,760	2,947
30%	-374	659	555	-31,477	-8,889
40%	1,087	907	2,876	-14,518	-3,455
50%	3,952	668	3,494	-17,710	-3,272
60%	5,714	9,881	-329	-7,400	-5,720
70%	6,621	8,002	9,801	67	-9,552
80%	7	15,493	-8,320	9	-13,253
90%	-170	23,197	15,870	-1,086	-2,821
Long Term					
Full Simulation Period[b]	1,917	4,492	3,672	-6,439	-2,160
Water Year Types[c]					
Wet (32%)	19	-68	871	-3,587	-899
Above Normal (16%)	82	34	2,494	-1,942	1,709
Below Normal (13%)	1,650	2,265	5,391	331	17,029
Dry (24%)	1,210	14,756	-770	-8,728	-11,927
Critical (15%)	9,439	4,138	16,844	-19,881	-10,397

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-17-4. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,405,324	1,404,630	1,349,285	1,253,699	1,364,744
20%	1,396,981	1,400,993	1,314,712	1,159,614	1,326,667
30%	1,390,559	1,395,902	1,284,018	1,048,761	1,313,107
40%	1,370,422	1,384,675	1,269,628	1,007,144	1,288,359
50%	1,320,969	1,375,661	1,220,534	953,500	1,271,188
60%	1,303,778	1,353,332	1,187,322	903,226	1,249,593
70%	1,289,429	1,326,846	1,111,983	875,530	1,214,612
80%	1,209,970	1,303,044	1,037,608	872,770	1,150,449
90%	1,110,468	1,259,168	900,913	868,689	1,073,928
Long Term					
Full Simulation Period[b]	1,284,304	1,344,150	1,175,993	1,004,101	1,235,735
Water Year Types[c]					
Wet (32%)	1,214,079	1,317,062	1,249,372	1,029,435	1,204,658
Above Normal (16%)	1,323,531	1,352,103	1,124,654	891,173	1,184,894
Below Normal (13%)	1,341,241	1,351,347	1,079,799	913,397	1,120,010
Dry (24%)	1,292,959	1,346,626	1,140,705	1,002,248	1,326,201
Critical (15%)	1,327,342	1,383,498	1,219,615	1,157,785	1,313,449

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,913	1,402,880	1,348,779	1,247,288	1,367,607
20%	1,397,234	1,398,995	1,330,501	1,151,512	1,331,580
30%	1,383,804	1,396,483	1,304,899	1,076,028	1,319,609
40%	1,361,660	1,387,544	1,284,770	1,025,646	1,301,422
50%	1,324,052	1,380,781	1,273,387	958,494	1,285,083
60%	1,302,499	1,356,884	1,257,377	910,240	1,273,275
70%	1,285,673	1,337,467	1,200,325	877,392	1,255,269
80%	1,209,817	1,317,403	1,147,542	871,333	1,236,598
90%	1,110,877	1,269,393	1,034,226	869,188	1,177,234
Long Term					
Full Simulation Period[b]	1,279,022	1,347,771	1,228,845	1,007,482	1,270,063
Water Year Types[c]					
Wet (32%)	1,208,241	1,322,121	1,258,600	1,017,390	1,253,869
Above Normal (16%)	1,321,724	1,358,993	1,202,350	899,621	1,252,481
Below Normal (13%)	1,342,980	1,370,832	1,183,951	932,527	1,195,328
Dry (24%)	1,280,462	1,339,410	1,204,846	1,029,261	1,315,141
Critical (15%)	1,325,090	1,383,981	1,274,231	1,135,274	1,317,574

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	-1,411	-1,750	-506	-6,411	2,863
20%	253	-1,998	15,789	-8,101	4,913
30%	-6,755	581	20,881	27,267	6,502
40%	-8,763	2,869	15,143	18,502	13,063
50%	3,083	5,120	52,854	4,994	13,894
60%	-1,278	3,552	70,055	7,014	23,681
70%	-3,756	10,621	88,341	1,863	40,658
80%	-152	14,359	109,934	-1,437	86,150
90%	409	10,225	133,312	500	103,306
Long Term					
Full Simulation Period[b]	-5,282	3,621	52,852	3,381	34,328
Water Year Types[c]					
Wet (32%)	-5,837	5,059	9,228	-12,045	49,211
Above Normal (16%)	-1,807	6,890	77,696	8,448	67,587
Below Normal (13%)	1,739	19,485	104,152	19,130	75,318
Dry (24%)	-12,497	-7,216	64,141	27,013	-11,060
Critical (15%)	-2,253	483	54,616	-22,511	4,125

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-17-5. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,405,324	1,404,630	1,349,285	1,253,699	1,364,744
20%	1,396,981	1,400,993	1,314,712	1,159,614	1,326,667
30%	1,390,559	1,395,902	1,284,018	1,048,761	1,313,107
40%	1,370,422	1,384,675	1,269,628	1,007,144	1,288,359
50%	1,320,969	1,375,661	1,220,534	953,500	1,271,188
60%	1,303,778	1,353,332	1,187,322	903,226	1,249,593
70%	1,289,429	1,326,846	1,111,983	875,530	1,214,612
80%	1,209,970	1,303,044	1,037,608	872,770	1,150,449
90%	1,110,468	1,259,168	900,913	868,689	1,073,928
Long Term					
Full Simulation Period[b]	1,284,304	1,344,150	1,175,993	1,004,101	1,235,735
Water Year Types[c]					
Wet (32%)	1,214,079	1,317,062	1,249,372	1,029,435	1,204,658
Above Normal (16%)	1,323,531	1,352,103	1,124,654	891,173	1,184,894
Below Normal (13%)	1,341,241	1,351,347	1,079,799	913,397	1,120,010
Dry (24%)	1,292,959	1,346,626	1,140,705	1,002,248	1,326,201
Critical (15%)	1,327,342	1,383,498	1,219,615	1,157,785	1,313,449

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,847	1,404,936	1,349,165	1,248,654	1,347,291
20%	1,397,388	1,401,376	1,309,945	1,153,043	1,327,681
30%	1,387,079	1,394,573	1,282,169	1,089,259	1,301,074
40%	1,355,751	1,386,531	1,265,635	1,017,782	1,290,269
50%	1,324,261	1,375,293	1,231,937	928,638	1,281,086
60%	1,307,204	1,351,627	1,196,594	895,467	1,254,206
70%	1,292,343	1,328,229	1,128,461	877,400	1,221,431
80%	1,209,731	1,303,176	1,024,198	872,846	1,193,903
90%	1,110,594	1,251,007	940,203	870,160	1,145,752
Long Term					
Full Simulation Period[b]	1,282,458	1,343,002	1,182,749	1,005,743	1,251,126
Water Year Types[c]					
Wet (32%)	1,212,391	1,316,850	1,241,020	1,021,763	1,222,330
Above Normal (16%)	1,321,765	1,351,764	1,144,651	897,331	1,223,088
Below Normal (13%)	1,340,244	1,352,936	1,101,790	918,585	1,191,118
Dry (24%)	1,289,949	1,341,107	1,145,755	999,319	1,305,669
Critical (15%)	1,326,234	1,384,222	1,233,635	1,179,081	1,307,994

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	-1,478	306	-120	-5,044	-17,453
20%	407	382	-4,767	-6,571	1,014
30%	-3,480	-1,329	-1,849	40,498	-12,033
40%	-14,672	1,856	-3,992	10,637	1,910
50%	3,292	-368	11,404	-24,862	9,898
60%	3,426	-1,705	9,272	-7,759	4,613
70%	2,915	1,383	16,478	1,870	6,820
80%	-239	132	-13,410	76	43,454
90%	126	-8,162	39,290	1,472	71,824
Long Term					
Full Simulation Period[b]	-1,845	-1,148	6,755	1,642	15,391
Water Year Types[c]					
Wet (32%)	-1,688	-212	-8,352	-7,672	17,672
Above Normal (16%)	-1,767	-338	19,997	6,158	38,194
Below Normal (13%)	-996	1,589	21,991	5,188	71,108
Dry (24%)	-3,010	-5,519	5,050	-2,928	-20,532
Critical (15%)	-1,108	724	14,021	21,296	-5,456

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-17-6. Sacramento River Keswick to Battle Creek Winter-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,405,324	1,404,630	1,349,285	1,253,699	1,364,744
20%	1,396,981	1,400,993	1,314,712	1,159,614	1,326,667
30%	1,390,559	1,395,902	1,284,018	1,048,761	1,313,107
40%	1,370,422	1,384,675	1,269,628	1,007,144	1,288,359
50%	1,320,969	1,375,661	1,220,534	953,500	1,271,188
60%	1,303,778	1,353,332	1,187,322	903,226	1,249,593
70%	1,289,429	1,326,846	1,111,983	875,530	1,214,612
80%	1,209,970	1,303,044	1,037,608	872,770	1,150,449
90%	1,110,468	1,259,168	900,913	868,689	1,073,928
Long Term					
Full Simulation Period[b]	1,284,304	1,344,150	1,175,993	1,004,101	1,235,735
Water Year Types[c]					
Wet (32%)	1,214,079	1,317,062	1,249,372	1,029,435	1,204,658
Above Normal (16%)	1,323,531	1,352,103	1,124,654	891,173	1,184,894
Below Normal (13%)	1,341,241	1,351,347	1,079,799	913,397	1,120,010
Dry (24%)	1,292,959	1,346,626	1,140,705	1,002,248	1,326,201
Critical (15%)	1,327,342	1,383,498	1,219,615	1,157,785	1,313,449

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	1,403,791	1,402,801	1,350,780	1,252,313	1,357,205
20%	1,397,937	1,400,938	1,333,003	1,153,273	1,334,527
30%	1,383,430	1,397,141	1,305,454	1,044,551	1,310,720
40%	1,362,747	1,388,451	1,287,646	1,011,128	1,297,967
50%	1,328,004	1,381,449	1,276,882	940,783	1,281,811
60%	1,308,213	1,366,765	1,257,049	902,840	1,267,554
70%	1,292,294	1,345,468	1,210,126	877,459	1,245,717
80%	1,209,824	1,332,896	1,139,222	871,342	1,223,345
90%	1,110,707	1,292,590	1,050,095	868,102	1,174,413
Long Term					
Full Simulation Period[b]	1,280,939	1,352,263	1,232,517	1,001,043	1,267,903
Water Year Types[c]					
Wet (32%)	1,208,260	1,322,053	1,259,471	1,013,803	1,252,971
Above Normal (16%)	1,321,807	1,359,027	1,204,844	897,679	1,254,190
Below Normal (13%)	1,344,630	1,373,097	1,189,342	932,859	1,212,358
Dry (24%)	1,281,672	1,354,165	1,204,076	1,020,532	1,303,214
Critical (15%)	1,334,529	1,388,120	1,291,075	1,115,393	1,307,177

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Apr	May	Jun	Jul	Aug
Probability of Exceedance[a]					
10%	-1,533	-1,829	1,495	-1,386	-7,539
20%	956	-55	18,291	-6,341	7,860
30%	-7,129	1,239	21,437	-4,210	-2,386
40%	-7,676	3,776	18,019	3,984	9,608
50%	7,034	5,788	56,348	-12,716	10,622
60%	4,435	13,433	69,727	-386	17,961
70%	2,865	18,622	98,143	1,929	31,106
80%	-146	29,851	101,615	-1,428	72,896
90%	239	33,422	149,182	-586	100,485
Long Term					
Full Simulation Period[b]	-3,365	8,113	56,524	-3,059	32,168
Water Year Types[c]					
Wet (32%)	-5,818	4,991	10,099	-15,633	48,313
Above Normal (16%)	-1,725	6,924	80,189	6,506	69,296
Below Normal (13%)	3,389	21,750	109,543	19,462	92,348
Dry (24%)	-11,287	7,539	63,372	18,285	-22,987
Critical (15%)	7,187	4,622	71,460	-42,393	-6,273

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.18. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA

Table C-18-1. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	777,036	901,193	717,563	899,837	795,997
20%	718,973	898,195	692,261	798,837	787,634
30%	693,440	891,503	677,361	797,442	774,643
40%	676,866	861,731	669,826	793,205	751,689
50%	669,540	822,528	662,686	784,323	723,566
60%	663,027	780,278	658,055	764,027	718,470
70%	657,088	757,268	654,511	737,209	697,825
80%	649,166	716,756	649,701	714,498	675,164
90%	645,961	672,058	645,272	664,827	659,406
Long Term					
Full Simulation Period[b]	693,557	808,507	677,515	773,481	730,930
Water Year Types[c]					
Wet (32%)	681,264	798,706	671,961	814,689	716,090
Above Normal (16%)	695,288	877,818	667,580	672,509	737,636
Below Normal (13%)	714,092	853,837	706,305	770,540	720,160
Dry (24%)	700,321	793,075	673,307	779,975	730,735
Critical (15%)	688,221	738,826	680,932	785,458	766,013

Alternative 1

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	876,406	901,160	773,332	797,548	796,157
20%	776,331	896,584	725,284	795,630	795,690
30%	738,290	893,490	699,551	789,641	775,842
40%	697,773	869,905	681,701	776,581	765,083
50%	691,922	825,433	672,996	773,012	733,306
60%	675,636	788,743	662,654	752,858	720,847
70%	668,666	770,034	656,655	741,165	691,102
80%	655,558	709,353	652,439	731,472	673,098
90%	648,377	666,917	647,931	683,460	659,990
Long Term					
Full Simulation Period[b]	721,892	809,850	693,890	757,176	734,070
Water Year Types[c]					
Wet (32%)	684,230	790,092	690,232	736,710	727,056
Above Normal (16%)	742,799	882,394	699,981	745,101	736,594
Below Normal (13%)	781,782	866,782	748,090	765,601	721,622
Dry (24%)	731,750	807,978	667,680	777,057	726,140
Critical (15%)	709,514	725,002	689,215	773,742	771,159

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	99,370	-33	55,769	-102,290	160
20%	57,358	-1,611	33,022	-3,207	8,056
30%	44,850	1,987	22,189	-7,801	1,199
40%	20,907	8,174	11,875	-16,623	13,394
50%	22,382	2,905	10,310	-11,310	9,740
60%	12,609	8,465	4,599	-11,169	2,377
70%	11,578	12,766	2,144	3,956	-6,723
80%	6,391	-7,403	2,738	16,974	-2,066
90%	2,416	-5,140	2,658	18,633	584
Long Term					
Full Simulation Period[b]	28,334	1,343	16,375	-16,305	3,140
Water Year Types[c]					
Wet (32%)	2,966	-8,614	18,271	-77,979	10,966
Above Normal (16%)	47,511	4,576	32,401	72,592	-1,042
Below Normal (13%)	67,690	12,945	41,785	-4,939	1,462
Dry (24%)	31,428	14,903	-5,626	-2,918	-4,595
Critical (15%)	21,292	-13,824	8,282	-11,716	5,146

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-18-2. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	777,036	901,193	717,563	899,837	795,997
20%	718,973	898,195	692,261	798,837	787,634
30%	693,440	891,503	677,361	797,442	774,643
40%	676,866	861,731	669,826	793,205	751,689
50%	669,540	822,528	662,686	784,323	723,566
60%	663,027	780,278	658,055	764,027	718,470
70%	657,088	757,268	654,511	737,209	697,825
80%	649,166	716,756	649,701	714,498	675,164
90%	645,961	672,058	645,272	664,827	659,406
Long Term					
Full Simulation Period[b]	693,557	808,507	677,515	773,481	730,930
Water Year Types[c]					
Wet (32%)	681,264	798,706	671,961	814,689	716,090
Above Normal (16%)	695,288	877,818	667,580	672,509	737,636
Below Normal (13%)	714,092	853,837	706,305	770,540	720,160
Dry (24%)	700,321	793,075	673,307	779,975	730,735
Critical (15%)	688,221	738,826	680,932	785,458	766,013

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	836,741	899,510	727,605	797,468	796,324
20%	781,724	896,550	703,158	796,434	794,109
30%	729,833	891,393	686,225	791,912	779,591
40%	695,713	875,296	678,223	781,233	765,717
50%	686,914	846,791	667,843	765,786	736,791
60%	675,468	784,215	659,052	742,936	719,822
70%	669,424	748,909	654,472	734,900	702,328
80%	659,182	714,469	649,448	718,903	670,559
90%	649,327	668,704	644,087	681,410	659,313
Long Term					
Full Simulation Period[b]	717,540	810,069	681,516	753,158	734,416
Water Year Types[c]					
Wet (32%)	688,352	796,318	681,089	728,495	729,723
Above Normal (16%)	725,393	879,251	680,452	746,488	733,224
Below Normal (13%)	768,531	863,925	703,989	741,636	724,975
Dry (24%)	731,434	811,551	670,579	782,547	723,409
Critical (15%)	702,373	713,077	681,222	775,404	772,877

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	59,705	-1,683	10,042	-102,369	327
20%	62,751	-1,645	10,896	-2,403	6,475
30%	36,392	-110	8,863	-5,530	4,947
40%	18,847	13,564	8,398	-11,971	14,028
50%	17,375	24,264	5,157	-18,537	13,225
60%	12,441	3,938	997	-21,091	1,353
70%	12,336	-8,360	-38	-2,309	4,503
80%	10,016	-2,287	-253	4,406	-4,605
90%	3,367	-3,354	-1,185	16,583	-93
Long Term					
Full Simulation Period[b]	23,983	1,562	4,001	-20,323	3,487
Water Year Types[c]					
Wet (32%)	7,089	-2,388	9,128	-86,194	13,633
Above Normal (16%)	30,105	1,433	12,872	73,979	-4,413
Below Normal (13%)	54,439	10,088	-2,316	-28,904	4,815
Dry (24%)	31,112	18,476	-2,727	2,572	-7,326
Critical (15%)	14,152	-25,749	290	-10,054	6,863

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-18-3. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	777,036	901,193	717,563	899,837	795,997
20%	718,973	898,195	692,261	798,837	787,634
30%	693,440	891,503	677,361	797,442	774,643
40%	676,866	861,731	669,826	793,205	751,689
50%	669,540	822,528	662,686	784,323	723,566
60%	663,027	780,278	658,055	764,027	718,470
70%	657,088	757,268	654,511	737,209	697,825
80%	649,166	716,756	649,701	714,498	675,164
90%	645,961	672,058	645,272	664,827	659,406
Long Term					
Full Simulation Period[b]	693,557	808,507	677,515	773,481	730,930
Water Year Types[c]					
Wet (32%)	681,264	798,706	671,961	814,689	716,090
Above Normal (16%)	695,288	877,818	667,580	672,509	737,636
Below Normal (13%)	714,092	853,837	706,305	770,540	720,160
Dry (24%)	700,321	793,075	673,307	779,975	730,735
Critical (15%)	688,221	738,826	680,932	785,458	766,013

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	770,134	901,817	711,676	898,008	794,117
20%	724,855	898,185	695,895	798,763	780,450
30%	690,734	891,327	678,859	796,831	772,523
40%	676,812	870,404	673,090	792,899	750,487
50%	669,716	836,404	666,341	784,390	723,241
60%	663,144	788,345	658,547	765,741	717,918
70%	656,993	771,884	654,679	735,475	706,659
80%	649,854	716,101	649,439	717,944	678,833
90%	646,076	666,579	643,874	663,729	659,127
Long Term					
Full Simulation Period[b]	692,635	812,012	676,616	772,849	730,814
Water Year Types[c]					
Wet (32%)	680,868	800,227	672,396	811,606	716,996
Above Normal (16%)	693,934	879,555	669,258	677,001	736,147
Below Normal (13%)	711,870	853,587	698,826	768,514	721,756
Dry (24%)	700,592	799,785	671,768	782,232	732,190
Critical (15%)	685,828	746,640	681,449	781,048	760,986

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	-6,901	625	-5,887	-1,829	-1,880
20%	5,882	-10	3,633	-74	-7,185
30%	-2,706	-176	1,497	-611	-2,120
40%	-54	8,673	3,264	-306	-1,202
50%	176	13,876	3,656	67	-325
60%	117	8,068	492	1,714	-551
70%	-95	14,616	169	-1,735	8,834
80%	688	-655	-262	3,447	3,670
90%	116	-5,479	-1,399	-1,098	-279
Long Term					
Full Simulation Period[b]	-922	3,504	-899	-632	-116
Water Year Types[c]					
Wet (32%)	-395	1,521	435	-3,082	906
Above Normal (16%)	-1,354	1,737	1,678	4,493	-1,490
Below Normal (13%)	-2,221	-250	-7,479	-2,026	1,596
Dry (24%)	271	6,710	-1,539	2,257	1,455
Critical (15%)	-2,393	7,814	517	-4,410	-5,028

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-18-4. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	876,406	901,160	773,332	797,548	796,157
20%	776,331	896,584	725,284	795,630	795,690
30%	738,290	893,490	699,551	789,641	775,842
40%	697,773	869,905	681,701	776,581	765,083
50%	691,922	825,433	672,996	773,012	733,306
60%	675,636	788,743	662,654	752,858	720,847
70%	668,666	770,034	656,655	741,165	691,102
80%	655,558	709,353	652,439	731,472	673,098
90%	648,377	666,917	647,931	683,460	659,990
Long Term					
Full Simulation Period[b]	721,892	809,850	693,890	757,176	734,070
Water Year Types[c]					
Wet (32%)	684,230	790,092	690,232	736,710	727,056
Above Normal (16%)	742,799	882,394	699,981	745,101	736,594
Below Normal (13%)	781,782	866,782	748,090	765,601	721,622
Dry (24%)	731,750	807,978	667,680	777,057	726,140
Critical (15%)	709,514	725,002	689,215	773,742	771,159

No Action Alternative

Statistic	Monthly WUA (Feet2) Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	777,036	901,193	717,563	899,837	795,997
20%	718,973	898,195	692,261	798,837	787,634
30%	693,440	891,503	677,361	797,442	774,643
40%	676,866	861,731	669,826	793,205	751,689
50%	669,540	822,528	662,686	784,323	723,566
60%	663,027	780,278	658,055	764,027	718,470
70%	657,088	757,268	654,511	737,209	697,825
80%	649,166	716,756	649,701	714,498	675,164
90%	645,961	672,058	645,272	664,827	659,406
Long Term					
Full Simulation Period[b]	693,557	808,507	677,515	773,481	730,930
Water Year Types[c]					
Wet (32%)	681,264	798,706	671,961	814,689	716,090
Above Normal (16%)	695,288	877,818	667,580	672,509	737,636
Below Normal (13%)	714,092	853,837	706,305	770,540	720,160
Dry (24%)	700,321	793,075	673,307	779,975	730,735
Critical (15%)	688,221	738,826	680,932	785,458	766,013

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	-99,370	33	-55,769	102,290	-160
20%	-57,358	1,611	-33,022	3,207	-8,056
30%	-44,850	-1,987	-22,189	7,801	-1,199
40%	-20,907	-8,174	-11,875	16,623	-13,394
50%	-22,382	-2,905	-10,310	11,310	-9,740
60%	-12,609	-8,465	-4,599	11,169	-2,377
70%	-11,578	-12,766	-2,144	-3,956	6,723
80%	-6,391	7,403	-2,738	-16,974	2,066
90%	-2,416	5,140	-2,658	-18,633	-584
Long Term					
Full Simulation Period[b]	-28,334	-1,343	-16,375	16,305	-3,140
Water Year Types[c]					
Wet (32%)	-2,966	8,614	-18,271	77,979	-10,966
Above Normal (16%)	-47,511	-4,576	-32,401	-72,592	1,042
Below Normal (13%)	-67,690	-12,945	-41,785	4,939	-1,462
Dry (24%)	-31,428	-14,903	5,626	2,918	4,595
Critical (15%)	-21,292	13,824	-8,282	11,716	-5,146

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-18-5. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	876,406	901,160	773,332	797,548	796,157
20%	776,331	896,584	725,284	795,630	795,690
30%	738,290	893,490	699,551	789,641	775,842
40%	697,773	869,905	681,701	776,581	765,083
50%	691,922	825,433	672,996	773,012	733,306
60%	675,636	788,743	662,654	752,858	720,847
70%	668,666	770,034	656,655	741,165	691,102
80%	655,558	709,353	652,439	731,472	673,098
90%	648,377	666,917	647,931	683,460	659,990
Long Term					
Full Simulation Period[b]	721,892	809,850	693,890	757,176	734,070
Water Year Types[c]					
Wet (32%)	684,230	790,092	690,232	736,710	727,056
Above Normal (16%)	742,799	882,394	699,981	745,101	736,594
Below Normal (13%)	781,782	866,782	748,090	765,601	721,622
Dry (24%)	731,750	807,978	667,680	777,057	726,140
Critical (15%)	709,514	725,002	689,215	773,742	771,159

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	836,741	899,510	727,605	797,468	796,324
20%	781,724	896,550	703,158	796,434	794,109
30%	729,833	891,393	686,225	791,912	779,591
40%	695,713	875,296	678,223	781,233	765,717
50%	686,914	846,791	667,843	765,786	736,791
60%	675,468	784,215	659,052	742,936	719,822
70%	669,424	748,909	654,472	734,900	702,328
80%	659,182	714,469	649,448	718,903	670,559
90%	649,327	668,704	644,087	681,410	659,313
Long Term					
Full Simulation Period[b]	717,540	810,069	681,516	753,158	734,416
Water Year Types[c]					
Wet (32%)	688,352	796,318	681,089	728,495	729,723
Above Normal (16%)	725,393	879,251	680,452	746,488	733,224
Below Normal (13%)	768,531	863,925	703,989	741,636	724,975
Dry (24%)	731,434	811,551	670,579	782,547	723,409
Critical (15%)	702,373	713,077	681,222	775,404	772,877

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	-39,665	-1,650	-45,728	-79	167
20%	5,393	-34	-22,126	804	-1,581
30%	-8,458	-2,097	-13,326	2,272	3,749
40%	-2,060	5,390	-3,477	4,652	634
50%	-5,007	21,359	-5,153	-7,226	3,485
60%	-168	-4,528	-3,602	-9,922	-1,024
70%	758	-21,125	-2,182	-6,265	11,226
80%	3,624	5,116	-2,991	-12,568	-2,539
90%	950	1,787	-3,843	-2,050	-677
Long Term					
Full Simulation Period[b]	-4,352	219	-12,374	-4,018	346
Water Year Types[c]					
Wet (32%)	4,123	6,226	-9,143	-8,215	2,667
Above Normal (16%)	-17,406	-3,143	-19,529	1,387	-3,371
Below Normal (13%)	-13,251	-2,857	-44,100	-23,965	3,352
Dry (24%)	-316	3,573	2,899	5,490	-2,731
Critical (15%)	-7,141	-11,925	-7,992	1,662	1,718

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-18-6. Sacramento River Keswick to Battle Creek Winter-run Fry Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	876,406	901,160	773,332	797,548	796,157
20%	776,331	896,584	725,284	795,630	795,690
30%	738,290	893,490	699,551	789,641	775,842
40%	697,773	869,905	681,701	776,581	765,083
50%	691,922	825,433	672,996	773,012	733,306
60%	675,636	788,743	662,654	752,858	720,847
70%	668,666	770,034	656,655	741,165	691,102
80%	655,558	709,353	652,439	731,472	673,098
90%	648,377	666,917	647,931	683,460	659,990
Long Term					
Full Simulation Period[b]	721,892	809,850	693,890	757,176	734,070
Water Year Types[c]					
Wet (32%)	684,230	790,092	690,232	736,710	727,056
Above Normal (16%)	742,799	882,394	699,981	745,101	736,594
Below Normal (13%)	781,782	866,782	748,090	765,601	721,622
Dry (24%)	731,750	807,978	667,680	777,057	726,140
Critical (15%)	709,514	725,002	689,215	773,742	771,159

Alternative 5

Statistic	Monthly WUA (Feet2) Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	770,134	901,817	711,676	898,008	794,117
20%	724,855	898,185	695,895	798,763	780,450
30%	690,734	891,327	678,859	796,831	772,523
40%	676,812	870,404	673,090	792,899	750,487
50%	669,716	836,404	666,341	784,390	723,241
60%	663,144	788,345	658,547	765,741	717,918
70%	656,993	771,884	654,679	735,475	706,659
80%	649,854	716,101	649,439	717,944	678,833
90%	646,076	666,579	643,874	663,729	659,127
Long Term					
Full Simulation Period[b]	692,635	812,012	676,616	772,849	730,814
Water Year Types[c]					
Wet (32%)	680,868	800,227	672,396	811,606	716,996
Above Normal (16%)	693,934	879,555	669,258	677,001	736,147
Below Normal (13%)	711,870	853,587	698,826	768,514	721,756
Dry (24%)	700,592	799,785	671,768	782,232	732,190
Critical (15%)	685,828	746,640	681,449	781,048	760,986

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Jun	Jul	Aug	Sep	Oct
Probability of Exceedance[a]					
10%	-106,271	657	-61,656	100,461	-2,040
20%	-51,476	1,601	-29,389	3,133	-15,240
30%	-47,556	-2,163	-20,692	7,191	-3,319
40%	-20,961	499	-8,611	16,317	-14,596
50%	-22,206	10,971	-6,655	11,378	-10,065
60%	-12,492	-398	-4,107	12,883	-2,928
70%	-11,673	1,850	-1,975	-5,691	15,557
80%	-5,704	6,748	-3,000	-13,527	5,735
90%	-2,301	-339	-4,057	-19,731	-863
Long Term					
Full Simulation Period[b]	-29,257	2,162	-17,274	15,673	-3,256
Water Year Types[c]					
Wet (32%)	-3,361	10,135	-17,836	74,897	-10,060
Above Normal (16%)	-48,865	-2,839	-30,723	-68,100	-448
Below Normal (13%)	-69,911	-13,195	-49,263	2,913	133
Dry (24%)	-31,157	-8,193	4,088	5,174	6,050
Critical (15%)	-23,686	21,638	-7,765	7,306	-10,174

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.19. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA

Table C-19-1. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)										
Statistic	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,409	310,548	333,866	332,325	333,147	334,345	343,635	406,001	337,232	333,331	327,278
20%	275,553	304,116	333,613	329,892	332,381	333,897	334,074	345,721	334,537	332,947	320,140
30%	273,347	301,490	333,204	324,327	331,691	333,630	333,823	334,173	334,164	331,465	318,857
40%	271,058	296,100	325,708	319,153	325,671	333,011	333,510	333,834	333,782	327,257	317,814
50%	270,255	290,552	318,898	317,858	317,290	332,534	332,839	333,548	333,053	321,915	314,448
60%	269,605	286,716	302,253	314,069	311,767	332,361	332,294	333,096	332,276	319,453	310,951
70%	269,298	282,110	282,624	310,607	301,862	332,133	330,936	332,329	330,796	317,580	308,312
80%	268,669	280,522	275,260	307,905	283,840	319,063	330,384	330,323	316,822	312,690	302,041
90%	267,972	276,033	270,850	299,056	276,503	294,114	295,991	313,048	277,019	290,194	292,622
Long Term											
Full Simulation Period[b]	273,329	292,177	307,770	316,470	312,474	328,615	331,119	339,565	327,071	320,338	311,336
Water Year Types[c]											
Wet (32%)	272,361	288,310	276,743	312,401	309,295	323,698	336,149	351,851	326,362	319,734	305,516
Above Normal (16%)	269,796	285,110	298,518	317,662	308,331	328,318	319,568	348,458	315,498	317,233	311,676
Below Normal (13%)	270,444	286,371	326,567	314,953	310,253	331,533	332,329	321,114	328,121	323,284	312,272
Dry (24%)	273,990	300,321	330,631	316,127	314,960	331,492	329,935	332,518	331,233	325,539	314,892
Critical (15%)	280,799	299,959	329,688	325,958	321,745	332,123	333,597	331,969	333,247	313,644	316,790

Alternative 1

	Monthly WUA (Feet2)										
Statistic	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,861	310,030	333,916	332,462	333,251	343,398	343,713	407,678	337,747	333,424	322,687
20%	275,528	303,298	333,677	332,262	332,422	333,942	334,139	345,715	334,450	332,945	319,420
30%	271,975	298,945	333,445	326,577	332,262	333,598	333,805	334,195	334,169	331,224	318,162
40%	270,836	291,693	327,495	321,166	332,033	332,602	333,617	333,764	333,829	324,649	315,156
50%	269,910	286,071	324,919	318,776	324,963	332,433	332,740	333,331	333,016	320,063	312,731
60%	269,393	281,520	321,632	316,937	320,479	332,284	332,316	333,015	332,315	318,349	309,902
70%	269,168	278,857	320,301	310,233	317,892	332,146	330,865	332,257	330,122	316,027	307,003
80%	268,792	275,515	319,024	307,164	313,820	319,033	311,693	329,961	316,821	311,002	297,967
90%	268,269	273,309	299,287	300,948	309,156	307,873	286,720	306,586	275,987	288,344	286,561
Long Term											
Full Simulation Period[b]	273,191	289,077	321,770	317,799	323,011	330,202	329,440	339,047	326,400	318,751	308,886
Water Year Types[c]											
Wet (32%)	272,674	281,693	311,734	316,396	323,673	326,669	336,654	350,402	327,521	317,836	304,182
Above Normal (16%)	269,483	280,972	320,951	319,012	318,055	332,067	316,180	346,866	312,237	316,414	309,380
Below Normal (13%)	269,903	280,714	324,984	315,941	320,277	331,020	324,511	320,633	322,170	320,081	306,012
Dry (24%)	272,778	301,767	330,140	314,509	325,926	332,000	329,325	332,534	331,944	323,790	311,766
Critical (15%)	282,030	300,373	327,505	326,712	324,592	332,086	332,887	333,706	333,948	313,645	316,378

Alternative 1 minus No Action Alternative

	Monthly WUA (Feet2)										
Statistic	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	452	-518	50	137	104	9,054	78	1,677	515	92	-4,591
20%	-25	-818	65	2,370	41	45	65	-6	-87	-1	-720
30%	-1,373	-2,545	241	2,250	571	-32	-18	22	5	-241	-695
40%	-222	-4,407	1,787	2,013	6,362	-410	107	-71	47	-2,608	-2,657
50%	-346	-4,480	6,020	919	7,673	-101	-99	-217	-37	-1,852	-1,717
60%	-212	-5,196	19,379	2,868	8,712	-78	22	-81	38	-1,104	-1,049
70%	-129	-3,253	37,677	-374	16,030	13	-71	-72	-674	-1,552	-1,309
80%	123	-5,007	43,763	-741	29,980	-30	-18,691	-362	-1	-1,688	-4,074
90%	298	-2,723	28,437	1,892	32,652	13,759	-9,272	-6,462	-1,032	-1,850	-6,061
Long Term											
Full Simulation Period[b]	-138	-3,099	14,000	1,329	10,537	1,586	-1,679	-518	-672	-1,588	-2,450
Water Year Types[c]											
Wet (32%)	313	-6,616	34,991	3,995	14,379	2,971	504	-1,449	1,159	-1,899	-1,334
Above Normal (16%)	-313	-4,138	22,434	1,350	9,725	3,749	-3,388	-1,593	-3,261	-818	-2,296
Below Normal (13%)	-540	-5,657	-1,582	988	10,025	-513	-7,818	-480	-5,951	-3,203	-6,261
Dry (24%)	-1,211	1,446	-491	-1,618	10,967	508	-610	16	711	-1,748	-3,126
Critical (15%)	1,231	414	-2,183	754	2,847	-36	-710	1,737	701	1	-412

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-19-2. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)										
Statistic	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,409	310,548	333,866	332,325	333,147	334,345	343,635	406,001	337,232	333,331	327,278
20%	275,553	304,116	333,613	329,892	332,381	333,897	334,074	345,721	334,537	332,947	320,140
30%	273,347	301,490	333,204	324,327	331,691	333,630	333,823	334,173	334,164	331,465	318,857
40%	271,058	296,100	325,708	319,153	325,671	333,011	333,510	333,834	333,782	327,257	317,814
50%	270,255	290,552	318,898	317,858	317,290	332,534	332,839	333,548	333,053	321,915	314,448
60%	269,605	286,716	302,253	314,069	311,767	332,361	332,294	333,096	332,276	319,453	310,951
70%	269,298	282,110	282,624	310,607	301,862	332,133	330,936	332,329	330,796	317,580	308,312
80%	268,669	280,522	275,260	307,905	283,840	319,063	330,384	330,323	316,822	312,690	302,041
90%	267,972	276,033	270,850	299,056	276,503	294,114	295,991	313,048	277,019	290,194	292,622
Long Term											
Full Simulation Period[b]	273,329	292,177	307,770	316,470	312,474	328,615	331,119	339,565	327,071	320,338	311,336
Water Year Types[c]											
Wet (32%)	272,361	288,310	276,743	312,401	309,295	323,698	336,149	351,851	326,362	319,734	305,516
Above Normal (16%)	269,796	285,110	298,518	317,662	308,331	328,318	319,568	348,458	315,498	317,233	311,676
Below Normal (13%)	270,444	286,371	326,567	314,953	310,253	331,533	332,329	321,114	328,121	323,284	312,272
Dry (24%)	273,990	300,321	330,631	316,127	314,960	331,492	329,935	332,518	331,233	325,539	314,892
Critical (15%)	280,799	299,959	329,688	325,958	321,745	332,123	333,597	331,969	333,247	313,644	316,790

Alternative 3

	Monthly WUA (Feet2)										
Statistic	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,548	306,963	333,805	332,323	333,602	342,915	345,788	408,067	337,808	333,426	322,181
20%	275,511	303,288	333,638	331,230	332,429	333,955	334,158	345,716	334,451	332,869	319,374
30%	273,778	295,705	333,364	326,457	332,317	333,634	333,865	334,108	334,183	331,604	318,125
40%	270,719	291,787	328,825	321,318	332,039	332,602	333,617	333,807	333,766	326,289	315,598
50%	269,805	289,384	322,723	318,089	328,566	332,381	332,947	333,536	332,924	320,368	312,735
60%	269,405	282,507	320,687	315,120	322,132	332,255	332,368	333,082	332,035	318,759	310,043
70%	269,239	279,447	318,959	310,972	318,054	332,037	331,005	332,140	329,953	316,628	304,355
80%	268,649	277,139	310,908	306,464	316,630	318,232	313,664	329,969	316,335	311,042	297,645
90%	267,841	275,321	302,839	300,568	310,263	309,357	287,114	308,295	275,987	288,602	286,112
Long Term											
Full Simulation Period[b]	273,315	289,425	320,558	317,225	323,890	329,958	330,105	339,427	326,624	319,463	308,895
Water Year Types[c]											
Wet (32%)	272,651	284,467	310,731	316,511	324,124	326,847	337,561	350,404	327,524	318,259	304,066
Above Normal (16%)	269,576	283,384	321,533	317,898	318,247	331,592	316,716	349,512	314,660	317,016	309,106
Below Normal (13%)	270,117	282,030	316,413	316,212	321,720	330,987	324,678	320,744	322,213	320,989	306,539
Dry (24%)	272,529	298,461	330,348	312,928	325,860	331,104	329,962	333,292	331,672	325,077	311,754
Critical (15%)	283,046	298,427	328,275	326,133	328,202	332,073	333,669	332,070	333,264	313,965	316,526

Alternative 3 minus No Action Alternative

	Monthly WUA (Feet2)										
Statistic	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	139	-3,585	-61	-2	455	8,570	2,152	2,066	576	95	-5,097
20%	-42	-829	25	1,337	48	57	84	-5	-87	-78	-766
30%	431	-5,785	160	2,131	626	4	42	-65	19	139	-731
40%	-338	-4,312	3,117	2,165	6,367	-409	107	-27	-17	-968	-2,216
50%	-450	-1,168	3,825	231	11,276	-154	108	-12	-129	-1,547	-1,713
60%	-200	-4,208	18,434	1,051	10,365	-106	74	-14	-242	-694	-909
70%	-58	-2,662	36,335	365	16,192	-96	69	-189	-843	-952	-3,956
80%	-20	-3,383	35,648	-1,440	32,790	-831	-16,721	-354	-487	-1,648	-4,397
90%	-130	-712	31,989	1,511	33,759	15,242	-8,878	-4,753	-1,032	-1,592	-6,510
Long Term											
Full Simulation Period[b]	-14	-2,752	12,788	754	11,416	1,342	-1,014	-138	-448	-875	-2,440
Water Year Types[c]											
Wet (32%)	290	-3,843	33,988	4,109	14,829	3,149	1,411	-1,447	1,162	-1,475	-1,450
Above Normal (16%)	-220	-1,726	23,015	236	9,917	3,274	-2,852	1,053	-839	-216	-2,570
Below Normal (13%)	-327	-4,340	-10,154	1,258	11,467	-546	-7,651	-369	-5,909	-2,296	-5,734
Dry (24%)	-1,460	-1,860	-283	-3,200	10,901	-388	27	774	439	-462	-3,138
Critical (15%)	2,248	-1,532	-1,413	175	6,457	-50	72	100	18	321	-264

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-19-3. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,409	310,548	333,866	332,325	333,147	334,345	343,635	406,001	337,232	333,331	327,278
20%	275,553	304,116	333,613	329,892	332,381	333,897	334,074	345,721	334,537	332,947	320,140
30%	273,347	301,490	333,204	324,327	331,691	333,630	333,823	334,173	334,164	331,465	318,857
40%	271,058	296,100	325,708	319,153	325,671	333,011	333,510	333,834	333,782	327,257	317,814
50%	270,255	290,552	318,898	317,858	317,290	332,534	332,839	333,548	333,053	321,915	314,448
60%	269,605	286,716	302,253	314,069	311,767	332,361	332,294	333,096	332,276	319,453	310,951
70%	269,298	282,110	282,624	310,607	301,862	332,133	330,936	332,329	330,796	317,580	308,312
80%	268,669	280,522	275,260	307,905	283,840	319,063	330,384	330,323	316,822	312,690	302,041
90%	267,972	276,033	270,850	299,056	276,503	294,114	295,991	313,048	277,019	290,194	292,622
Long Term											
Full Simulation Period[b]	273,329	292,177	307,770	316,470	312,474	328,615	331,119	339,565	327,071	320,338	311,336
Water Year Types[c]											
Wet (32%)	272,361	288,310	276,743	312,401	309,295	323,698	336,149	351,851	326,362	319,734	305,516
Above Normal (16%)	269,796	285,110	298,518	317,662	308,331	328,318	319,568	348,458	315,498	317,233	311,676
Below Normal (13%)	270,444	286,371	326,567	314,953	310,253	331,533	332,329	321,114	328,121	323,284	312,272
Dry (24%)	273,990	300,321	330,631	316,127	314,960	331,492	329,935	332,518	331,233	325,539	314,892
Critical (15%)	280,799	299,959	329,688	325,958	321,745	332,123	333,597	331,969	333,247	313,644	316,790

Alternative 5

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,614	309,760	333,644	332,324	333,248	334,335	343,636	404,698	337,234	333,331	327,047
20%	275,546	305,085	333,530	326,377	332,395	333,889	334,131	345,858	334,536	332,947	320,076
30%	271,881	297,690	331,233	323,695	332,056	333,638	333,818	334,165	334,160	331,462	319,158
40%	270,896	294,640	324,022	318,911	325,408	333,025	333,529	333,827	333,780	327,527	318,043
50%	269,993	289,826	319,077	317,828	317,393	332,534	332,767	333,550	332,901	322,687	314,900
60%	269,522	285,237	303,604	314,451	311,105	332,386	332,296	333,105	332,292	319,462	311,269
70%	269,127	281,290	283,038	311,554	302,699	332,164	330,813	332,326	330,800	317,595	309,406
80%	268,430	279,532	275,283	308,452	284,296	319,923	324,619	330,321	316,824	312,705	305,843
90%	267,935	275,908	270,849	299,072	276,548	293,411	295,987	313,022	277,018	294,681	296,195
Long Term											
Full Simulation Period[b]	273,023	291,158	307,533	316,163	312,649	328,449	331,075	339,618	327,024	320,862	312,618
Water Year Types[c]											
Wet (32%)	272,131	288,249	276,894	312,809	308,867	323,073	335,856	351,959	326,489	319,729	305,490
Above Normal (16%)	270,004	285,571	299,452	316,353	308,887	327,918	319,903	348,226	315,369	317,233	312,228
Below Normal (13%)	270,444	287,598	325,805	314,908	310,401	331,677	332,253	321,556	328,058	322,983	312,751
Dry (24%)	273,852	297,208	330,152	316,163	315,514	331,644	329,932	332,499	330,991	326,277	318,479
Critical (15%)	279,206	296,694	328,224	324,373	322,201	332,386	333,646	331,977	333,254	316,278	318,592

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	204	-788	-222	-1	101	-10	0	-1,303	2	0	-231
20%	-7	969	-83	-3,515	14	-8	57	137	-1	1	-64
30%	-1,466	-3,799	-1,971	-632	365	8	-5	-8	-3	-3	301
40%	-162	-1,459	-1,686	-242	-264	13	19	-8	-2	270	230
50%	-263	-725	179	-30	103	0	-72	2	-152	772	452
60%	-83	-1,479	1,351	382	-662	25	2	8	16	10	318
70%	-171	-819	413	948	837	31	-123	-3	4	15	1,094
80%	-239	-989	23	547	456	860	-5,766	-2	2	15	3,802
90%	-37	-125	0	16	45	-703	-4	-26	0	4,486	3,573
Long Term											
Full Simulation Period[b]	-307	-1,019	-237	-308	175	-167	-44	53	-47	524	1,282
Water Year Types[c]											
Wet (32%)	-230	-60	151	407	-428	-625	-294	108	127	-5	-26
Above Normal (16%)	208	461	934	-1,309	556	-400	335	-232	-130	0	552
Below Normal (13%)	0	1,227	-762	-45	148	145	-76	443	-64	-301	479
Dry (24%)	-138	-3,113	-479	36	555	152	-3	-19	-242	738	3,587
Critical (15%)	-1,593	-3,265	-1,464	-1,585	457	263	49	8	7	2,635	1,802

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-19-4. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,861	310,030	333,916	332,462	333,251	343,398	343,713	407,678	337,747	333,424	322,687
20%	275,528	303,298	333,677	332,262	332,422	333,942	334,139	345,715	334,450	332,945	319,420
30%	271,975	298,945	333,445	326,577	332,262	333,598	333,805	334,195	334,169	331,224	318,162
40%	270,836	291,693	327,495	321,166	332,033	332,602	333,617	333,764	333,829	324,649	315,156
50%	269,910	286,071	324,919	318,776	324,963	332,433	332,740	333,331	333,016	320,063	312,731
60%	269,393	281,520	321,632	316,937	320,479	332,284	332,316	333,015	332,315	318,349	309,902
70%	269,168	278,857	320,301	310,233	317,892	332,146	330,865	332,257	330,122	316,027	307,003
80%	268,792	275,515	319,024	307,164	313,820	319,033	311,693	329,961	316,821	311,002	297,967
90%	268,269	273,309	299,287	300,948	309,156	307,873	286,720	306,586	275,987	288,344	286,561
Long Term											
Full Simulation Period[b]	273,191	289,077	321,770	317,799	323,011	330,202	329,440	339,047	326,400	318,751	308,886
Water Year Types[c]											
Wet (32%)	272,674	281,693	311,734	316,396	323,673	326,669	336,654	350,402	327,521	317,836	304,182
Above Normal (16%)	269,483	280,972	320,951	319,012	318,055	332,067	316,180	346,866	312,237	316,414	309,380
Below Normal (13%)	269,903	280,714	324,984	315,941	320,277	331,020	324,511	320,633	322,170	320,081	306,012
Dry (24%)	272,778	301,767	330,140	314,509	325,926	332,000	329,325	332,534	331,944	323,790	311,766
Critical (15%)	282,030	300,373	327,505	326,712	324,592	332,086	332,887	333,706	333,948	313,645	316,378

No Action Alternative

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,409	310,548	333,866	332,325	333,147	334,345	343,635	406,001	337,232	333,331	327,278
20%	275,553	304,116	333,613	329,892	332,381	333,897	334,074	345,721	334,537	332,947	320,140
30%	273,347	301,490	333,204	324,327	331,691	333,630	333,823	334,173	334,164	331,465	318,857
40%	271,058	296,100	325,708	319,153	325,671	333,011	333,510	333,834	333,782	327,257	317,814
50%	270,255	290,552	318,898	317,858	317,290	332,534	332,839	333,548	333,053	321,915	314,448
60%	269,605	286,716	302,253	314,069	311,767	332,361	332,294	333,096	332,276	319,453	310,951
70%	269,298	282,110	282,624	310,607	301,862	332,133	330,936	332,329	330,796	317,580	308,312
80%	268,669	280,522	275,260	307,905	283,840	319,063	330,384	330,323	316,822	312,690	302,041
90%	267,972	276,033	270,850	299,056	276,503	294,114	295,991	313,048	277,019	290,194	292,622
Long Term											
Full Simulation Period[b]	273,329	292,177	307,770	316,470	312,474	328,615	331,119	339,565	327,071	320,338	311,336
Water Year Types[c]											
Wet (32%)	272,361	288,310	276,743	312,401	309,295	323,698	336,149	351,851	326,362	319,734	305,516
Above Normal (16%)	269,796	285,110	298,518	317,662	308,331	328,318	319,568	348,458	315,498	317,233	311,676
Below Normal (13%)	270,444	286,371	326,567	314,953	310,253	331,533	332,329	321,114	328,121	323,284	312,272
Dry (24%)	273,990	300,321	330,631	316,127	314,960	331,492	329,935	332,518	331,233	325,539	314,892
Critical (15%)	280,799	299,959	329,688	325,958	321,745	332,123	333,597	331,969	333,247	313,644	316,790

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	-452	518	-50	-137	-104	-9,054	-78	-1,677	-515	-92	4,591
20%	25	818	-65	-2,370	-41	-45	-65	6	87	1	720
30%	1,373	2,545	-241	-2,250	-571	32	18	-22	-5	241	695
40%	222	4,407	-1,787	-2,013	-6,362	410	-107	71	-47	2,608	2,657
50%	346	4,480	-6,020	-919	-7,673	101	99	217	37	1,852	1,717
60%	212	5,196	-19,379	-2,868	-8,712	78	-22	81	-38	1,104	1,049
70%	129	3,253	-37,677	374	-16,030	-13	71	72	674	1,552	1,309
80%	-123	5,007	-43,763	741	-29,980	30	18,691	362	1	1,688	4,074
90%	-298	2,723	-28,437	-1,892	-32,652	-13,759	9,272	6,462	1,032	1,850	6,061
Long Term											
Full Simulation Period[b]	138	3,099	-14,000	-1,329	-10,537	-1,586	1,679	518	672	1,588	2,450
Water Year Types[c]											
Wet (32%)	-313	6,616	-34,991	-3,995	-14,379	-2,971	-504	1,449	-1,159	1,899	1,334
Above Normal (16%)	313	4,138	-22,434	-1,350	-9,725	-3,749	3,388	1,593	3,261	818	2,296
Below Normal (13%)	540	5,657	1,582	-988	-10,025	513	7,818	480	5,951	3,203	6,261
Dry (24%)	1,211	-1,446	491	1,618	-10,967	-508	610	-16	-711	1,748	3,126
Critical (15%)	-1,231	-414	2,183	-754	-2,847	36	710	-1,737	-701	-1	412

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-19-5. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,861	310,030	333,916	332,462	333,251	343,398	343,713	407,678	337,747	333,424	322,687
20%	275,528	303,298	333,677	332,262	332,422	333,942	334,139	345,715	334,450	332,945	319,420
30%	271,975	298,945	333,445	326,577	332,262	333,598	333,805	334,195	334,169	331,224	318,162
40%	270,836	291,693	327,495	321,166	332,033	332,602	333,617	333,764	333,829	324,649	315,156
50%	269,910	286,071	324,919	318,776	324,963	332,433	332,740	333,331	333,016	320,063	312,731
60%	269,393	281,520	321,632	316,937	320,479	332,284	332,316	333,015	332,315	318,349	309,902
70%	269,168	278,857	320,301	310,233	317,892	332,146	330,865	332,257	330,122	316,027	307,003
80%	268,792	275,515	319,024	307,164	313,820	319,033	311,693	329,961	316,821	311,002	297,967
90%	268,269	273,309	299,287	300,948	309,156	307,873	286,720	306,586	275,987	288,344	286,561
Long Term											
Full Simulation Period[b]	273,191	289,077	321,770	317,799	323,011	330,202	329,440	339,047	326,400	318,751	308,886
Water Year Types[c]											
Wet (32%)	272,674	281,693	311,734	316,396	323,673	326,669	336,654	350,402	327,521	317,836	304,182
Above Normal (16%)	269,483	280,972	320,951	319,012	318,055	332,067	316,180	346,866	312,237	316,414	309,380
Below Normal (13%)	269,903	280,714	324,984	315,941	320,277	331,020	324,511	320,633	322,170	320,081	306,012
Dry (24%)	272,778	301,767	330,140	314,509	325,926	332,000	329,325	332,534	331,944	323,790	311,766
Critical (15%)	282,030	300,373	327,505	326,712	324,592	332,086	332,887	333,706	333,948	313,645	316,378

Alternative 3

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,548	306,963	333,805	332,323	333,602	342,915	345,788	408,067	337,808	333,426	322,181
20%	275,511	303,288	333,638	331,230	332,429	333,955	334,158	345,716	334,451	332,869	319,374
30%	273,778	295,705	333,364	326,457	332,317	333,634	333,865	334,108	334,183	331,604	318,125
40%	270,719	291,787	328,825	321,318	332,039	332,602	333,617	333,807	333,766	326,289	315,598
50%	269,805	289,384	322,723	318,089	328,566	332,381	332,947	333,536	332,924	320,368	312,735
60%	269,405	282,507	320,687	315,120	322,132	332,255	332,368	333,082	332,035	318,759	310,043
70%	269,239	279,447	318,959	310,972	318,054	332,037	331,005	332,140	329,953	316,628	304,355
80%	268,649	277,139	310,908	306,464	316,630	318,232	313,664	329,969	316,335	311,042	297,645
90%	267,841	275,321	302,839	300,568	310,263	309,357	287,114	308,295	275,987	288,602	286,112
Long Term											
Full Simulation Period[b]	273,315	289,425	320,558	317,225	323,890	329,958	330,105	339,427	326,624	319,463	308,895
Water Year Types[c]											
Wet (32%)	272,651	284,467	310,731	316,511	324,124	326,847	337,561	350,404	327,524	318,259	304,066
Above Normal (16%)	269,576	283,384	321,533	317,898	318,247	331,592	316,716	349,512	314,660	317,016	309,106
Below Normal (13%)	270,117	282,030	316,413	316,212	321,720	330,987	324,678	320,744	322,213	320,989	306,539
Dry (24%)	272,529	298,461	330,348	312,928	325,860	331,104	329,962	333,292	331,672	325,077	311,754
Critical (15%)	283,046	298,427	328,275	326,133	328,202	332,073	333,669	332,070	333,264	313,965	316,526

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	-313	-3,067	-111	-139	352	-483	2,074	389	61	2	-507
20%	-17	-11	-40	-1,033	8	13	19	1	0	-77	-46
30%	1,804	-3,240	-81	-120	56	36	60	-87	14	380	-37
40%	-117	94	1,330	152	5	0	0	43	-63	1,640	441
50%	-104	3,312	-2,196	-687	3,603	-53	208	205	-92	304	5
60%	12	988	-945	-1,818	1,653	-28	52	67	-280	410	141
70%	71	591	-1,341	739	162	-109	140	-117	-168	600	-2,648
80%	-143	1,624	-8,116	-699	2,810	-801	1,971	8	-486	40	-323
90%	-428	2,011	3,552	-380	1,107	1,484	394	1,709	0	258	-449
Long Term											
Full Simulation Period[b]	124	347	-1,212	-575	879	-244	665	380	224	712	9
Water Year Types[c]											
Wet (32%)	-23	2,773	-1,003	114	450	178	907	2	3	424	-116
Above Normal (16%)	93	2,412	582	-1,114	192	-475	535	2,646	2,423	602	-274
Below Normal (13%)	213	1,317	-8,572	271	1,442	-33	168	111	42	908	527
Dry (24%)	-249	-3,306	208	-1,582	-66	-896	637	758	-273	1,287	-12
Critical (15%)	1,016	-1,946	770	-579	3,610	-13	782	-1,637	-684	320	149

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-19-6. Sacramento River Keswick to Battle Creek Winter-run Juvenile Rearing WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,861	310,030	333,916	332,462	333,251	343,398	343,713	407,678	337,747	333,424	322,687
20%	275,528	303,298	333,677	332,262	332,422	333,942	334,139	345,715	334,450	332,945	319,420
30%	271,975	298,945	333,445	326,577	332,262	333,598	333,805	334,195	334,169	331,224	318,162
40%	270,836	291,693	327,495	321,166	332,033	332,602	333,617	333,764	333,829	324,649	315,156
50%	269,910	286,071	324,919	318,776	324,963	332,433	332,740	333,331	333,016	320,063	312,731
60%	269,393	281,520	321,632	316,937	320,479	332,284	332,316	333,015	332,315	318,349	309,902
70%	269,168	278,857	320,301	310,233	317,892	332,146	330,865	332,257	330,122	316,027	307,003
80%	268,792	275,515	319,024	307,164	313,820	319,033	311,693	329,961	316,821	311,002	297,967
90%	268,269	273,309	299,287	300,948	309,156	307,873	286,720	306,586	275,987	288,344	286,561
Long Term											
Full Simulation Period[b]	273,191	289,077	321,770	317,799	323,011	330,202	329,440	339,047	326,400	318,751	308,886
Water Year Types[c]											
Wet (32%)	272,674	281,693	311,734	316,396	323,673	326,669	336,654	350,402	327,521	317,836	304,182
Above Normal (16%)	269,483	280,972	320,951	319,012	318,055	332,067	316,180	346,866	312,237	316,414	309,380
Below Normal (13%)	269,903	280,714	324,984	315,941	320,277	331,020	324,511	320,633	322,170	320,081	306,012
Dry (24%)	272,778	301,767	330,140	314,509	325,926	332,000	329,325	332,534	331,944	323,790	311,766
Critical (15%)	282,030	300,373	327,505	326,712	324,592	332,086	332,887	333,706	333,948	313,645	316,378

Alternative 5

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	281,614	309,760	333,644	332,324	333,248	334,335	343,636	404,698	337,234	333,331	327,047
20%	275,546	305,085	333,530	326,377	332,395	333,889	334,131	345,858	334,536	332,947	320,076
30%	271,881	297,690	331,233	323,695	332,056	333,638	333,818	334,165	334,160	331,462	319,158
40%	270,896	294,640	324,022	318,911	325,408	333,025	333,529	333,827	333,780	327,527	318,043
50%	269,993	289,826	319,077	317,828	317,393	332,534	332,767	333,550	332,901	322,687	314,900
60%	269,522	285,237	303,604	314,451	311,105	332,386	332,296	333,105	332,292	319,462	311,269
70%	269,127	281,290	283,038	311,554	302,699	332,164	330,813	332,326	330,800	317,595	309,406
80%	268,430	279,532	275,283	308,452	284,296	319,923	324,619	330,321	316,824	312,705	305,843
90%	267,935	275,908	270,849	299,072	276,548	293,411	295,987	313,022	277,018	294,681	296,195
Long Term											
Full Simulation Period[b]	273,023	291,158	307,533	316,163	312,649	328,449	331,075	339,618	327,024	320,862	312,618
Water Year Types[c]											
Wet (32%)	272,131	288,249	276,894	312,809	308,867	323,073	335,856	351,959	326,489	319,729	305,490
Above Normal (16%)	270,004	285,571	299,452	316,353	308,887	327,918	319,903	348,226	315,369	317,233	312,228
Below Normal (13%)	270,444	287,598	325,805	314,908	310,401	331,677	332,253	321,556	328,058	322,983	312,751
Dry (24%)	273,852	297,208	330,152	316,163	315,514	331,644	329,932	332,499	330,991	326,277	318,479
Critical (15%)	279,206	296,694	328,224	324,373	322,201	332,386	333,646	331,977	333,254	316,278	318,592

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)										
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Probability of Exceedance[a]											
10%	-248	-270	-272	-138	-3	-9,063	-78	-2,979	-513	-93	4,360
20%	18	1,787	-148	-5,885	-27	-53	-8	144	86	2	656
30%	-93	-1,255	-2,212	-2,882	-206	40	13	-31	-8	238	996
40%	60	2,948	-3,473	-2,255	-6,625	423	-88	63	-49	2,878	2,887
50%	83	3,755	-5,842	-949	-7,569	101	28	219	-115	2,624	2,169
60%	129	3,717	-18,028	-2,486	-9,374	102	-20	89	-22	1,114	1,367
70%	-42	2,433	-37,263	1,322	-15,193	18	-53	69	678	1,567	2,403
80%	-362	4,018	-43,741	1,288	-29,524	890	12,925	360	3	1,703	7,876
90%	-334	2,598	-28,438	-1,876	-32,608	-14,462	9,268	6,436	1,031	6,336	9,633
Long Term											
Full Simulation Period[b]	-168	2,081	-14,237	-1,637	-10,362	-1,753	1,635	572	625	2,111	3,732
Water Year Types[c]											
Wet (32%)	-543	6,556	-34,840	-3,588	-14,806	-3,596	-798	1,557	-1,032	1,894	1,308
Above Normal (16%)	521	4,599	-21,499	-2,659	-9,169	-4,149	3,723	1,360	3,132	819	2,849
Below Normal (13%)	541	6,884	820	-1,033	-9,877	657	7,742	923	5,887	2,902	6,739
Dry (24%)	1,073	-4,559	12	1,654	-10,412	-356	608	-35	-953	2,486	6,713
Critical (15%)	-2,824	-3,679	719	-2,339	-2,390	299	759	-1,729	-694	2,633	2,215

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.20. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA

Table C-20-1. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA, Monthly WUA

No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	284,003	283,850	283,906	283,720	288,661
20%	283,181	282,795	282,695	282,397	287,127
30%	282,459	282,332	279,490	281,396	284,250
40%	282,376	278,850	278,481	277,972	283,373
50%	282,141	278,118	277,975	277,095	282,287
60%	278,213	277,481	277,014	275,560	280,816
70%	277,640	267,834	211,869	264,478	277,970
80%	244,866	184,430	55,367	185,310	265,132
90%	107,093	64,327	32,581	79,382	229,156
Long Term					
Full Simulation Period[b]	247,895	233,554	212,942	237,022	265,821
Water Year Types[c]					
Wet (32%)	192,399	159,564	152,615	171,965	241,241
Above Normal (16%)	247,134	234,295	145,325	237,752	271,943
Below Normal (13%)	283,008	281,449	242,651	273,115	282,683
Dry (24%)	281,745	275,791	279,846	277,609	279,748
Critical (15%)	280,361	278,767	278,161	276,459	273,780

Alternative 1

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	283,825	283,692	283,688	283,752	288,534
20%	283,110	282,670	282,430	282,403	287,353
30%	282,562	282,084	280,077	281,381	285,527
40%	282,388	278,318	278,535	277,864	282,953
50%	282,032	277,926	277,845	277,120	281,603
60%	278,253	277,179	276,604	275,295	280,577
70%	277,460	251,254	166,379	260,748	277,249
80%	198,591	121,599	55,376	172,463	261,272
90%	66,294	63,045	32,413	76,741	229,829
Long Term					
Full Simulation Period[b]	240,825	226,093	210,150	234,149	265,878
Water Year Types[c]					
Wet (32%)	168,495	147,240	149,720	171,420	242,092
Above Normal (16%)	250,290	218,468	138,235	225,962	271,985
Below Normal (13%)	283,338	272,964	236,455	263,040	279,616
Dry (24%)	281,639	276,021	279,970	279,003	280,203
Critical (15%)	280,295	279,024	278,508	277,688	274,335

Alternative 1 minus No Action Alternative

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	-178	-158	-219	32	-127
20%	-72	-125	-265	6	226
30%	103	-248	587	-15	1,277
40%	12	-532	54	-108	-419
50%	-109	-192	-130	25	-684
60%	40	-302	-410	-265	-239
70%	-180	-16,580	-45,490	-3,730	-721
80%	-46,276	-62,830	9	-12,847	-3,861
90%	-40,799	-1,282	-169	-2,641	672
Long Term					
Full Simulation Period[b]	-7,070	-7,461	-2,792	-2,874	57
Water Year Types[c]					
Wet (32%)	-23,903	-12,323	-2,895	-545	851
Above Normal (16%)	3,156	-15,827	-7,090	-11,790	42
Below Normal (13%)	330	-8,485	-6,195	-10,075	-3,067
Dry (24%)	-106	230	124	1,394	455
Critical (15%)	-66	257	347	1,230	555

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-20-2. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	284,003	283,850	283,906	283,720	288,661
20%	283,181	282,795	282,695	282,397	287,127
30%	282,459	282,332	279,490	281,396	284,250
40%	282,376	278,850	278,481	277,972	283,373
50%	282,141	278,118	277,975	277,095	282,287
60%	278,213	277,481	277,014	275,560	280,816
70%	277,640	267,834	211,869	264,478	277,970
80%	244,866	184,430	55,367	185,310	265,132
90%	107,093	64,327	32,581	79,382	229,156
Long Term					
Full Simulation Period[b]	247,895	233,554	212,942	237,022	265,821
Water Year Types[c]					
Wet (32%)	192,399	159,564	152,615	171,965	241,241
Above Normal (16%)	247,134	234,295	145,325	237,752	271,943
Below Normal (13%)	283,008	281,449	242,651	273,115	282,683
Dry (24%)	281,745	275,791	279,846	277,609	279,748
Critical (15%)	280,361	278,767	278,161	276,459	273,780

Alternative 3

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	284,086	283,694	283,700	283,704	288,883
20%	283,245	282,654	282,435	282,378	287,252
30%	282,724	282,080	279,196	280,380	284,215
40%	282,459	278,345	278,348	277,833	283,083
50%	282,147	277,802	277,801	276,976	282,043
60%	278,265	277,210	276,618	275,187	280,823
70%	277,537	251,649	175,771	260,051	277,242
80%	197,415	122,335	55,377	172,624	261,399
90%	65,797	55,625	32,308	76,698	229,934
Long Term					
Full Simulation Period[b]	240,753	226,253	211,064	233,536	265,789
Water Year Types[c]					
Wet (32%)	168,150	146,128	149,722	171,421	241,868
Above Normal (16%)	249,835	222,219	143,070	223,943	271,783
Below Normal (13%)	283,380	273,509	238,589	262,750	279,640
Dry (24%)	282,007	275,752	279,462	278,712	280,243
Critical (15%)	280,392	278,414	278,402	276,442	274,339

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	84	-157	-206	-16	221
20%	64	-141	-260	-19	125
30%	265	-252	-294	-1,016	-35
40%	83	-505	-133	-139	-289
50%	6	-316	-174	-119	-243
60%	52	-272	-397	-374	7
70%	-103	-16,185	-36,098	-4,428	-729
80%	-47,452	-62,095	10	-12,686	-3,734
90%	-41,296	-8,702	-273	-2,685	778
Long Term					
Full Simulation Period[b]	-7,142	-7,301	-1,878	-3,486	-32
Water Year Types[c]					
Wet (32%)	-24,249	-13,436	-2,893	-544	627
Above Normal (16%)	2,701	-12,076	-2,255	-13,809	-160
Below Normal (13%)	372	-7,940	-4,062	-10,365	-3,043
Dry (24%)	262	-39	-384	1,103	495
Critical (15%)	31	-354	240	-17	560

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-20-3. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	284,003	283,850	283,906	283,720	288,661
20%	283,181	282,795	282,695	282,397	287,127
30%	282,459	282,332	279,490	281,396	284,250
40%	282,376	278,850	278,481	277,972	283,373
50%	282,141	278,118	277,975	277,095	282,287
60%	278,213	277,481	277,014	275,560	280,816
70%	277,640	267,834	211,869	264,478	277,970
80%	244,866	184,430	55,367	185,310	265,132
90%	107,093	64,327	32,581	79,382	229,156
Long Term					
Full Simulation Period[b]	247,895	233,554	212,942	237,022	265,821
Water Year Types[c]					
Wet (32%)	192,399	159,564	152,615	171,965	241,241
Above Normal (16%)	247,134	234,295	145,325	237,752	271,943
Below Normal (13%)	283,008	281,449	242,651	273,115	282,683
Dry (24%)	281,745	275,791	279,846	277,609	279,748
Critical (15%)	280,361	278,767	278,161	276,459	273,780

Alternative 5

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	283,695	283,872	283,905	283,719	288,857
20%	283,071	282,793	282,644	282,397	287,345
30%	282,458	282,342	279,474	281,412	284,024
40%	282,387	278,745	278,479	277,976	283,374
50%	282,150	278,033	277,977	277,096	282,292
60%	278,212	277,370	277,020	275,566	280,871
70%	277,590	267,152	213,137	264,485	278,054
80%	246,462	185,037	55,368	184,434	266,196
90%	112,101	64,324	32,936	79,380	229,953
Long Term					
Full Simulation Period[b]	247,897	233,696	212,856	236,783	266,445
Water Year Types[c]					
Wet (32%)	192,944	160,365	152,776	171,721	241,242
Above Normal (16%)	246,417	233,814	145,163	237,223	271,959
Below Normal (13%)	282,882	281,513	241,731	273,125	283,015
Dry (24%)	281,699	275,796	279,874	277,282	279,778
Critical (15%)	280,159	278,454	278,199	276,460	277,667

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	-308	22	-1	0	195
20%	-110	-2	-51	0	218
30%	-1	11	-17	17	-226
40%	11	-105	-2	4	1
50%	10	-85	2	1	5
60%	-2	-111	6	6	55
70%	-50	-682	1,268	7	84
80%	1,596	607	1	-876	1,063
90%	5,007	-3	355	-2	797
Long Term					
Full Simulation Period[b]	1	142	-86	-240	623
Water Year Types[c]					
Wet (32%)	545	801	161	-245	1
Above Normal (16%)	-717	-481	-162	-529	16
Below Normal (13%)	-126	64	-920	10	331
Dry (24%)	-46	5	28	-327	30
Critical (15%)	-203	-313	37	1	3,888

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-20-4. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	283,825	283,692	283,688	283,752	288,534
20%	283,110	282,670	282,430	282,403	287,353
30%	282,562	282,084	280,077	281,381	285,527
40%	282,388	278,318	278,535	277,864	282,953
50%	282,032	277,926	277,845	277,120	281,603
60%	278,253	277,179	276,604	275,295	280,577
70%	277,460	251,254	166,379	260,748	277,249
80%	198,591	121,599	55,376	172,463	261,272
90%	66,294	63,045	32,413	76,741	229,829
Long Term					
Full Simulation Period[b]	240,825	226,093	210,150	234,149	265,878
Water Year Types[c]					
Wet (32%)	168,495	147,240	149,720	171,420	242,092
Above Normal (16%)	250,290	218,468	138,235	225,962	271,985
Below Normal (13%)	283,338	272,964	236,455	263,040	279,616
Dry (24%)	281,639	276,021	279,970	279,003	280,203
Critical (15%)	280,295	279,024	278,508	277,688	274,335

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	284,003	283,850	283,906	283,720	288,661
20%	283,181	282,795	282,695	282,397	287,127
30%	282,459	282,332	279,490	281,396	284,250
40%	282,376	278,850	278,481	277,972	283,373
50%	282,141	278,118	277,975	277,095	282,287
60%	278,213	277,481	277,014	275,560	280,816
70%	277,640	267,834	211,869	264,478	277,970
80%	244,866	184,430	55,367	185,310	265,132
90%	107,093	64,327	32,581	79,382	229,156
Long Term					
Full Simulation Period[b]	247,895	233,554	212,942	237,022	265,821
Water Year Types[c]					
Wet (32%)	192,399	159,564	152,615	171,965	241,241
Above Normal (16%)	247,134	234,295	145,325	237,752	271,943
Below Normal (13%)	283,008	281,449	242,651	273,115	282,683
Dry (24%)	281,745	275,791	279,846	277,609	279,748
Critical (15%)	280,361	278,767	278,161	276,459	273,780

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	178	158	219	-32	127
20%	72	125	265	-6	-226
30%	-103	248	-587	15	-1,277
40%	-12	532	-54	108	419
50%	109	192	130	-25	684
60%	-40	302	410	265	239
70%	180	16,580	45,490	3,730	721
80%	46,276	62,830	-9	12,847	3,861
90%	40,799	1,282	169	2,641	-672
Long Term					
Full Simulation Period[b]	7,070	7,461	2,792	2,874	-57
Water Year Types[c]					
Wet (32%)	23,903	12,323	2,895	545	-851
Above Normal (16%)	-3,156	15,827	7,090	11,790	-42
Below Normal (13%)	-330	8,485	6,195	10,075	3,067
Dry (24%)	106	-230	-124	-1,394	-455
Critical (15%)	66	-257	-347	-1,230	-555

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-20-5. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	283,825	283,692	283,688	283,752	288,534
20%	283,110	282,670	282,430	282,403	287,353
30%	282,562	282,084	280,077	281,381	285,527
40%	282,388	278,318	278,535	277,864	282,953
50%	282,032	277,926	277,845	277,120	281,603
60%	278,253	277,179	276,604	275,295	280,577
70%	277,460	251,254	166,379	260,748	277,249
80%	198,591	121,599	55,376	172,463	261,272
90%	66,294	63,045	32,413	76,741	229,829
Long Term					
Full Simulation Period[b]	240,825	226,093	210,150	234,149	265,878
Water Year Types[c]					
Wet (32%)	168,495	147,240	149,720	171,420	242,092
Above Normal (16%)	250,290	218,468	138,235	225,962	271,985
Below Normal (13%)	283,338	272,964	236,455	263,040	279,616
Dry (24%)	281,639	276,021	279,970	279,003	280,203
Critical (15%)	280,295	279,024	278,508	277,688	274,335

Alternative 3

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	284,086	283,694	283,700	283,704	288,883
20%	283,245	282,654	282,435	282,378	287,252
30%	282,724	282,080	279,196	280,380	284,215
40%	282,459	278,345	278,348	277,833	283,083
50%	282,147	277,802	277,801	276,976	282,043
60%	278,265	277,210	276,618	275,187	280,823
70%	277,537	251,649	175,771	260,051	277,242
80%	197,415	122,335	55,377	172,624	261,399
90%	65,797	55,625	32,308	76,698	229,934
Long Term					
Full Simulation Period[b]	240,753	226,253	211,064	233,536	265,789
Water Year Types[c]					
Wet (32%)	168,150	146,128	149,722	171,421	241,868
Above Normal (16%)	249,835	222,219	143,070	223,943	271,783
Below Normal (13%)	283,380	273,509	238,589	262,750	279,640
Dry (24%)	282,007	275,752	279,462	278,712	280,243
Critical (15%)	280,392	278,414	278,402	276,442	274,339

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	262	1	12	-48	349
20%	136	-16	5	-25	-101
30%	162	-4	-881	-1,001	-1,312
40%	71	27	-187	-31	130
50%	115	-124	-44	-144	441
60%	12	31	14	-108	246
70%	78	395	9,392	-697	-7
80%	-1,176	736	2	161	127
90%	-497	-7,420	-104	-43	106
Long Term					
Full Simulation Period[b]	-72	160	914	-612	-89
Water Year Types[c]					
Wet (32%)	-346	-1,113	2	1	-224
Above Normal (16%)	-455	3,751	4,835	-2,019	-202
Below Normal (13%)	42	546	2,133	-290	24
Dry (24%)	368	-269	-508	-291	40
Critical (15%)	97	-611	-106	-1,247	5

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-20-6. Sacramento River Keswick to Battle Creek Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	283,825	283,692	283,688	283,752	288,534
20%	283,110	282,670	282,430	282,403	287,353
30%	282,562	282,084	280,077	281,381	285,527
40%	282,388	278,318	278,535	277,864	282,953
50%	282,032	277,926	277,845	277,120	281,603
60%	278,253	277,179	276,604	275,295	280,577
70%	277,460	251,254	166,379	260,748	277,249
80%	198,591	121,599	55,376	172,463	261,272
90%	66,294	63,045	32,413	76,741	229,829
Long Term					
Full Simulation Period[b]	240,825	226,093	210,150	234,149	265,878
Water Year Types[c]					
Wet (32%)	168,495	147,240	149,720	171,420	242,092
Above Normal (16%)	250,290	218,468	138,235	225,962	271,985
Below Normal (13%)	283,338	272,964	236,455	263,040	279,616
Dry (24%)	281,639	276,021	279,970	279,003	280,203
Critical (15%)	280,295	279,024	278,508	277,688	274,335

Alternative 5

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	283,695	283,872	283,905	283,719	288,857
20%	283,071	282,793	282,644	282,397	287,345
30%	282,458	282,342	279,474	281,412	284,024
40%	282,387	278,745	278,479	277,976	283,374
50%	282,150	278,033	277,977	277,096	282,292
60%	278,212	277,370	277,020	275,566	280,871
70%	277,590	267,152	213,137	264,485	278,054
80%	246,462	185,037	55,368	184,434	266,196
90%	112,101	64,324	32,936	79,380	229,953
Long Term					
Full Simulation Period[b]	247,897	233,696	212,856	236,783	266,445
Water Year Types[c]					
Wet (32%)	192,944	160,365	152,776	171,721	241,242
Above Normal (16%)	246,417	233,814	145,163	237,223	271,959
Below Normal (13%)	282,882	281,513	241,731	273,125	283,015
Dry (24%)	281,699	275,796	279,874	277,282	279,778
Critical (15%)	280,159	278,454	278,199	276,460	277,667

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	-130	180	218	-33	323
20%	-39	123	214	-6	-8
30%	-104	259	-603	31	-1,503
40%	-1	427	-56	112	420
50%	119	108	132	-24	689
60%	-42	191	416	271	294
70%	130	15,898	46,758	3,737	805
80%	47,872	63,437	-8	11,971	4,924
90%	45,806	1,279	523	2,639	124
Long Term					
Full Simulation Period[b]	7,071	7,603	2,706	2,634	566
Water Year Types[c]					
Wet (32%)	24,448	13,125	3,056	301	-850
Above Normal (16%)	-3,873	15,346	6,928	11,261	-26
Below Normal (13%)	-456	8,549	5,275	10,085	3,399
Dry (24%)	61	-225	-96	-1,721	-425
Critical (15%)	-136	-570	-309	-1,228	3,333

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.21. Feather River Low Flow Channel Steelhead Spawning WUA

Table C-21-1. Feather River Low Flow Channel Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 1

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-21-2. Feather River Low Flow Channel Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-21-3. Feather River Low Flow Channel Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-21-4. Feather River Low Flow Channel Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-21-5. Feather River Low Flow Channel Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-21-6. Feather River Low Flow Channel Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	989,930	989,930	989,930	989,930	1,031,830
20%	989,930	989,930	989,930	989,930	1,031,830
30%	989,930	989,930	989,930	989,930	1,031,830
40%	989,930	989,930	989,930	989,930	1,031,830
50%	989,930	989,930	989,930	989,930	1,031,830
60%	989,930	989,930	989,930	989,930	1,031,830
70%	989,930	989,930	989,930	989,930	1,031,830
80%	989,930	989,930	989,930	989,930	1,031,830
90%	989,930	989,930	989,930	989,930	1,031,830
Long Term					
Full Simulation Period[b]	989,930	989,930	989,930	989,930	1,031,830
Water Year Types[c]					
Wet (32%)	989,930	989,930	989,930	989,930	1,031,830
Above Normal (16%)	989,930	989,930	989,930	989,930	1,031,830
Below Normal (13%)	989,930	989,930	989,930	989,930	1,031,830
Dry (24%)	989,930	989,930	989,930	989,930	1,031,830
Critical (15%)	989,930	989,930	989,930	989,930	1,031,830

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	0
60%	0	0	0	0	0
70%	0	0	0	0	0
80%	0	0	0	0	0
90%	0	0	0	0	0
Long Term					
Full Simulation Period[b]	0	0	0	0	0
Water Year Types[c]					
Wet (32%)	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0
Dry (24%)	0	0	0	0	0
Critical (15%)	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.22. Feather River below Thermalito Steelhead Spawning WUA

Table C-22-1. Feather River Below Thermalito Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,720,766	12,721,614	12,721,614	12,779,678	12,803,513
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	9,023,130	12,186,561
60%	9,023,130	9,023,130	9,023,130	2,838,055	8,393,389
70%	8,290,557	9,023,130	3,272,385	1,496,381	4,954,680
80%	3,348,126	7,376,589	1,243,430	1,243,430	3,384,015
90%	2,485,131	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,080,119	8,683,292	7,368,326	6,446,685	8,791,643
Water Year Types[c]					
Wet (32%)	7,195,939	5,088,091	2,722,063	1,636,105	4,687,997
Above Normal (16%)	7,457,219	9,151,953	7,423,853	3,543,420	9,577,740
Below Normal (13%)	7,921,910	9,535,341	9,564,818	9,047,043	11,082,428
Dry (24%)	8,704,412	10,677,103	10,202,343	10,867,037	11,180,445
Critical (15%)	9,775,191	11,861,114	10,638,263	10,263,894	10,750,046

Alternative 1

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,693,583	12,721,614	12,721,614	12,779,678	12,682,284
20%	10,812,258	11,745,270	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	5,358,559	11,441,060
60%	9,023,130	9,023,130	6,386,814	2,234,946	8,119,357
70%	6,351,528	9,023,130	1,686,441	1,243,430	4,795,349
80%	3,557,354	4,321,929	1,243,430	1,243,430	3,301,748
90%	2,584,419	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	7,875,580	8,488,265	7,049,394	6,165,565	8,656,926
Water Year Types[c]					
Wet (32%)	6,475,224	4,660,130	2,557,186	1,540,475	4,698,637
Above Normal (16%)	7,237,916	8,821,531	6,536,707	2,312,091	8,936,674
Below Normal (13%)	9,201,788	9,606,823	8,113,263	8,711,821	10,746,662
Dry (24%)	8,682,666	10,677,103	10,207,501	10,769,606	11,471,039
Critical (15%)	9,039,653	11,748,115	11,099,196	10,353,716	10,324,375

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	-27,183	0	0	0	-121,229
20%	-933,012	-781,075	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	-3,664,571	-745,501
60%	0	0	-2,636,316	-603,110	-274,032
70%	-1,939,029	0	-1,585,943	-252,951	-159,331
80%	209,229	-3,054,660	0	0	-82,267
90%	99,288	0	0	0	0
Long Term					
Full Simulation Period[b]	-204,540	-195,027	-318,932	-281,120	-134,717
Water Year Types[c]					
Wet (32%)	-720,715	-427,961	-164,877	-95,630	10,640
Above Normal (16%)	-219,302	-330,423	-887,146	-1,231,329	-641,066
Below Normal (13%)	1,279,878	71,482	-1,451,555	-335,223	-335,766
Dry (24%)	-21,746	0	5,158	-97,431	290,595
Critical (15%)	-735,538	-113,000	460,933	89,822	-425,671

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-22-2. Feather River Below Thermalito Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,720,766	12,721,614	12,721,614	12,779,678	12,803,513
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	9,023,130	12,186,561
60%	9,023,130	9,023,130	9,023,130	2,838,055	8,393,389
70%	8,290,557	9,023,130	3,272,385	1,496,381	4,954,680
80%	3,348,126	7,376,589	1,243,430	1,243,430	3,384,015
90%	2,485,131	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,080,119	8,683,292	7,368,326	6,446,685	8,791,643
Water Year Types[c]					
Wet (32%)	7,195,939	5,088,091	2,722,063	1,636,105	4,687,997
Above Normal (16%)	7,457,219	9,151,953	7,423,853	3,543,420	9,577,740
Below Normal (13%)	7,921,910	9,535,341	9,564,818	9,047,043	11,082,428
Dry (24%)	8,704,412	10,677,103	10,202,343	10,867,037	11,180,445
Critical (15%)	9,775,191	11,861,114	10,638,263	10,263,894	10,750,046

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,719,142	12,721,614	12,721,614	12,779,678	12,748,644
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	5,444,748	11,551,617
60%	9,023,130	9,023,130	7,934,121	2,534,677	8,110,754
70%	8,693,663	9,023,130	1,877,599	1,243,430	4,626,720
80%	4,254,028	8,333,530	1,243,430	1,243,430	3,285,783
90%	2,414,288	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,226,149	8,652,317	7,099,831	6,225,156	8,597,852
Water Year Types[c]					
Wet (32%)	6,429,745	5,049,478	2,786,381	1,540,145	4,696,149
Above Normal (16%)	7,576,597	9,101,209	6,744,972	2,502,286	8,934,733
Below Normal (13%)	9,120,473	9,472,604	8,192,332	8,711,680	10,528,263
Dry (24%)	9,173,842	10,667,791	10,202,404	10,878,178	11,196,576
Critical (15%)	10,422,755	11,861,114	10,657,654	10,374,774	10,585,839

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	-1,624	0	0	0	-54,869
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	-3,578,382	-634,944
60%	0	0	-1,089,009	-303,379	-282,635
70%	403,106	0	-1,394,786	-252,951	-327,960
80%	905,902	956,941	0	0	-98,232
90%	-70,843	0	0	0	0
Long Term					
Full Simulation Period[b]	146,030	-30,975	-268,495	-221,528	-193,790
Water Year Types[c]					
Wet (32%)	-766,194	-38,613	64,319	-95,960	8,152
Above Normal (16%)	119,379	-50,744	-678,881	-1,041,134	-643,008
Below Normal (13%)	1,198,564	-62,737	-1,372,486	-335,363	-554,165
Dry (24%)	469,430	-9,312	61	11,141	16,132
Critical (15%)	647,564	0	19,391	110,880	-164,207

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-22-3. Feather River Below Thermalito Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,720,766	12,721,614	12,721,614	12,779,678	12,803,513
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	9,023,130	12,186,561
60%	9,023,130	9,023,130	9,023,130	2,838,055	8,393,389
70%	8,290,557	9,023,130	3,272,385	1,496,381	4,954,680
80%	3,348,126	7,376,589	1,243,430	1,243,430	3,384,015
90%	2,485,131	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,080,119	8,683,292	7,368,326	6,446,685	8,791,643
Water Year Types[c]					
Wet (32%)	7,195,939	5,088,091	2,722,063	1,636,105	4,687,997
Above Normal (16%)	7,457,219	9,151,953	7,423,853	3,543,420	9,577,740
Below Normal (13%)	7,921,910	9,535,341	9,564,818	9,047,043	11,082,428
Dry (24%)	8,704,412	10,677,103	10,202,343	10,867,037	11,180,445
Critical (15%)	9,775,191	11,861,114	10,638,263	10,263,894	10,750,046

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,720,769	12,721,614	12,721,614	12,779,678	12,808,150
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	9,023,130	12,377,121
60%	9,023,130	9,023,130	9,023,130	2,836,521	8,397,087
70%	8,257,271	9,023,130	3,247,076	1,776,306	5,245,762
80%	3,353,537	7,359,046	1,243,430	1,243,430	3,383,285
90%	2,477,496	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,071,006	8,663,984	7,392,916	6,450,056	8,847,069
Water Year Types[c]					
Wet (32%)	7,206,473	5,027,012	2,721,565	1,635,752	4,686,956
Above Normal (16%)	7,458,894	9,152,014	7,588,980	3,593,140	9,581,406
Below Normal (13%)	7,922,494	9,535,703	9,564,818	9,043,537	11,083,289
Dry (24%)	8,685,408	10,677,103	10,202,389	10,867,086	11,242,206
Critical (15%)	9,719,413	11,861,114	10,628,407	10,236,963	11,023,351

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	3	0	0	0	4,637
20%	0	0	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	0	190,560
60%	0	0	0	**-1,535**	3,698
70%	**-33,287**	0	**-25,309**	279,924	291,082
80%	5,412	**-17,543**	0	0	**-730**
90%	**-7,636**	0	0	0	0
Long Term					
Full Simulation Period[b]	**-9,114**	**-19,308**	24,590	3,371	55,426
Water Year Types[c]					
Wet (32%)	10,534	**-61,079**	**-498**	**-353**	**-1,042**
Above Normal (16%)	1,675	61	165,127	49,720	3,666
Below Normal (13%)	584	362	0	**-3,507**	861
Dry (24%)	**-19,004**	0	46	49	61,762
Critical (15%)	**-55,778**	0	**-9,856**	**-26,931**	273,305

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-22-4. Feather River Below Thermalito Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,693,583	12,721,614	12,721,614	12,779,678	12,682,284
20%	10,812,258	11,745,270	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	5,358,559	11,441,060
60%	9,023,130	9,023,130	6,386,814	2,234,946	8,119,357
70%	6,351,528	9,023,130	1,686,441	1,243,430	4,795,349
80%	3,557,354	4,321,929	1,243,430	1,243,430	3,301,748
90%	2,584,419	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	7,875,580	8,488,265	7,049,394	6,165,565	8,656,926
Water Year Types[c]					
Wet (32%)	6,475,224	4,660,130	2,557,186	1,540,475	4,698,637
Above Normal (16%)	7,237,916	8,821,531	6,536,707	2,312,091	8,936,674
Below Normal (13%)	9,201,788	9,606,823	8,113,263	8,711,821	10,746,662
Dry (24%)	8,682,666	10,677,103	10,207,501	10,769,606	11,471,039
Critical (15%)	9,039,653	11,748,115	11,099,196	10,353,716	10,324,375

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,720,766	12,721,614	12,721,614	12,779,678	12,803,513
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	9,023,130	12,186,561
60%	9,023,130	9,023,130	9,023,130	2,838,055	8,393,389
70%	8,290,557	9,023,130	3,272,385	1,496,381	4,954,680
80%	3,348,126	7,376,589	1,243,430	1,243,430	3,384,015
90%	2,485,131	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,080,119	8,683,292	7,368,326	6,446,685	8,791,643
Water Year Types[c]					
Wet (32%)	7,195,939	5,088,091	2,722,063	1,636,105	4,687,997
Above Normal (16%)	7,457,219	9,151,953	7,423,853	3,543,420	9,577,740
Below Normal (13%)	7,921,910	9,535,341	9,564,818	9,047,043	11,082,428
Dry (24%)	8,704,412	10,677,103	10,202,343	10,867,037	11,180,445
Critical (15%)	9,775,191	11,861,114	10,638,263	10,263,894	10,750,046

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	27,183	0	0	0	121,229
20%	933,012	781,075	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	3,664,571	745,501
60%	0	0	2,636,316	603,110	274,032
70%	1,939,029	0	1,585,943	252,951	159,331
80%	-209,229	3,054,660	0	0	82,267
90%	-99,288	0	0	0	0
Long Term					
Full Simulation Period[b]	204,540	195,027	318,932	281,120	134,717
Water Year Types[c]					
Wet (32%)	720,715	427,961	164,877	95,630	-10,640
Above Normal (16%)	219,302	330,423	887,146	1,231,329	641,066
Below Normal (13%)	-1,279,878	-71,482	1,451,555	335,223	335,766
Dry (24%)	21,746	0	-5,158	97,431	-290,595
Critical (15%)	735,538	113,000	-460,933	-89,822	425,671

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification

(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-22-5. Feather River Below Thermalito Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,693,583	12,721,614	12,721,614	12,779,678	12,682,284
20%	10,812,258	11,745,270	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	5,358,559	11,441,060
60%	9,023,130	9,023,130	6,386,814	2,234,946	8,119,357
70%	6,351,528	9,023,130	1,686,441	1,243,430	4,795,349
80%	3,557,354	4,321,929	1,243,430	1,243,430	3,301,748
90%	2,584,419	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	7,875,580	8,488,265	7,049,394	6,165,565	8,656,926
Water Year Types[c]					
Wet (32%)	6,475,224	4,660,130	2,557,186	1,540,475	4,698,637
Above Normal (16%)	7,237,916	8,821,531	6,536,707	2,312,091	8,936,674
Below Normal (13%)	9,201,788	9,606,823	8,113,263	8,711,821	10,746,662
Dry (24%)	8,682,666	10,677,103	10,207,501	10,769,606	11,471,039
Critical (15%)	9,039,653	11,748,115	11,099,196	10,353,716	10,324,375

Alternative 3

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,719,142	12,721,614	12,721,614	12,779,678	12,748,644
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	5,444,748	11,551,617
60%	9,023,130	9,023,130	7,934,121	2,534,677	8,110,754
70%	8,693,663	9,023,130	1,877,599	1,243,430	4,626,720
80%	4,254,028	8,333,530	1,243,430	1,243,430	3,285,783
90%	2,414,288	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,226,149	8,652,317	7,099,831	6,225,156	8,597,852
Water Year Types[c]					
Wet (32%)	6,429,745	5,049,478	2,786,381	1,540,145	4,696,149
Above Normal (16%)	7,576,597	9,101,209	6,744,972	2,502,286	8,934,733
Below Normal (13%)	9,120,473	9,472,604	8,192,332	8,711,680	10,528,263
Dry (24%)	9,173,842	10,667,791	10,202,404	10,878,178	11,196,576
Critical (15%)	10,422,755	11,861,114	10,657,654	10,374,774	10,585,839

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	25,559	0	0	0	66,361
20%	933,012	781,075	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	86,189	110,557
60%	0	0	1,547,307	299,731	-8,604
70%	2,342,135	0	191,158	0	-168,629
80%	696,673	4,011,601	0	0	-15,965
90%	-170,131	0	0	0	0
Long Term					
Full Simulation Period[b]	350,570	164,051	50,437	59,592	-59,073
Water Year Types[c]					
Wet (32%)	-45,479	389,348	229,196	-330	-2,488
Above Normal (16%)	338,681	279,679	208,265	190,194	-1,942
Below Normal (13%)	-81,314	-134,219	79,069	-141	-218,399
Dry (24%)	491,176	-9,312	-5,098	108,573	-274,463
Critical (15%)	1,383,102	113,000	-441,542	21,057	261,464

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-22-6. Feather River Below Thermalito Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,693,583	12,721,614	12,721,614	12,779,678	12,682,284
20%	10,812,258	11,745,270	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	5,358,559	11,441,060
60%	9,023,130	9,023,130	6,386,814	2,234,946	8,119,357
70%	6,351,528	9,023,130	1,686,441	1,243,430	4,795,349
80%	3,557,354	4,321,929	1,243,430	1,243,430	3,301,748
90%	2,584,419	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	7,875,580	8,488,265	7,049,394	6,165,565	8,656,926
Water Year Types[c]					
Wet (32%)	6,475,224	4,660,130	2,557,186	1,540,475	4,698,637
Above Normal (16%)	7,237,916	8,821,531	6,536,707	2,312,091	8,936,674
Below Normal (13%)	9,201,788	9,606,823	8,113,263	8,711,821	10,746,662
Dry (24%)	8,682,666	10,677,103	10,207,501	10,769,606	11,471,039
Critical (15%)	9,039,653	11,748,115	11,099,196	10,353,716	10,324,375

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	12,720,769	12,721,614	12,721,614	12,779,678	12,808,150
20%	11,745,270	12,526,345	11,745,270	12,663,550	12,663,550
30%	9,023,130	11,745,270	9,023,130	9,023,130	12,663,550
40%	9,023,130	9,023,130	9,023,130	9,023,130	12,663,550
50%	9,023,130	9,023,130	9,023,130	9,023,130	12,377,121
60%	9,023,130	9,023,130	9,023,130	2,836,521	8,397,087
70%	8,257,271	9,023,130	3,247,076	1,776,306	5,245,762
80%	3,353,537	7,359,046	1,243,430	1,243,430	3,383,285
90%	2,477,496	1,243,430	1,243,430	1,243,430	1,243,430
Long Term					
Full Simulation Period[b]	8,071,006	8,663,984	7,392,916	6,450,056	8,847,069
Water Year Types[c]					
Wet (32%)	7,206,473	5,027,012	2,721,565	1,635,752	4,686,956
Above Normal (16%)	7,458,894	9,152,014	7,588,980	3,593,140	9,581,406
Below Normal (13%)	7,922,494	9,535,703	9,564,818	9,043,537	11,083,289
Dry (24%)	8,685,408	10,677,103	10,202,389	10,867,086	11,242,206
Critical (15%)	9,719,413	11,861,114	10,628,407	10,236,963	11,023,351

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	27,186	0	0	0	125,867
20%	933,012	781,075	0	0	0
30%	0	0	0	0	0
40%	0	0	0	0	0
50%	0	0	0	3,664,571	936,061
60%	0	0	2,636,316	601,575	277,730
70%	1,905,743	0	1,560,634	532,876	450,413
80%	-203,817	3,037,118	0	0	81,537
90%	-106,923	0	0	0	0
Long Term					
Full Simulation Period[b]	195,426	175,718	343,522	284,491	190,143
Water Year Types[c]					
Wet (32%)	731,249	366,882	164,379	95,277	-11,681
Above Normal (16%)	220,977	330,484	1,052,273	1,281,049	644,732
Below Normal (13%)	-1,279,294	-71,120	1,451,555	331,716	336,627
Dry (24%)	2,742	0	-5,112	97,480	-228,833
Critical (15%)	679,761	113,000	-470,789	-116,753	698,976

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.23. Feather River Low Flow Channel Fall-run Spawning WUA

Table C-23-1. Feather River Low Flow Channel Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 1

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0
Long Term							
Full Simulation Period[b]	0	0	0	0	0	0	0
Water Year Types[c]							
Wet (32%)	0	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0	0
Dry (24%)	0	0	0	0	0	0	0
Critical (15%)	0	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-23-2. Feather River Low Flow Channel Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 3

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0
Long Term							
Full Simulation Period[b]	0	0	0	0	0	0	0
Water Year Types[c]							
Wet (32%)	0	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0	0
Dry (24%)	0	0	0	0	0	0	0
Critical (15%)	0	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-23-3. Feather River Low Flow Channel Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 5

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0
Long Term							
Full Simulation Period[b]	0	0	0	0	0	0	0
Water Year Types[c]							
Wet (32%)	0	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0	0
Dry (24%)	0	0	0	0	0	0	0
Critical (15%)	0	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-23-4. Feather River Low Flow Channel Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0
Long Term							
Full Simulation Period[b]	0	0	0	0	0	0	0
Water Year Types[c]							
Wet (32%)	0	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0	0
Dry (24%)	0	0	0	0	0	0	0
Critical (15%)	0	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-23-5. Feather River Low Flow Channel Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 3

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0
Long Term							
Full Simulation Period[b]	0	0	0	0	0	0	0
Water Year Types[c]							
Wet (32%)	0	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0	0
Dry (24%)	0	0	0	0	0	0	0
Critical (15%)	0	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-23-6. Feather River Low Flow Channel Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 5

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
20%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
30%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
40%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
50%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
60%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
70%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
80%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
90%	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Long Term							
Full Simulation Period[b]	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Water Year Types[c]							
Wet (32%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Above Normal (16%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Below Normal (13%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Dry (24%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140
Critical (15%)	24,623,964	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140	24,736,140

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	0	0	0	0	0	0	0
20%	0	0	0	0	0	0	0
30%	0	0	0	0	0	0	0
40%	0	0	0	0	0	0	0
50%	0	0	0	0	0	0	0
60%	0	0	0	0	0	0	0
70%	0	0	0	0	0	0	0
80%	0	0	0	0	0	0	0
90%	0	0	0	0	0	0	0
Long Term							
Full Simulation Period[b]	0	0	0	0	0	0	0
Water Year Types[c]							
Wet (32%)	0	0	0	0	0	0	0
Above Normal (16%)	0	0	0	0	0	0	0
Below Normal (13%)	0	0	0	0	0	0	0
Dry (24%)	0	0	0	0	0	0	0
Critical (15%)	0	0	0	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.24. Feather River below Thermalito Fall-run Spawning WUA

Table C-24-1. Feather River Below Thermalito Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,333,011	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	31,341,881	34,796,595	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,204,290	32,691,770	33,836,271	35,198,088	35,198,088	35,198,088	30,531,317
40%	21,675,598	30,248,751	32,691,770	35,109,485	35,198,088	32,691,770	27,907,015
50%	13,576,541	28,651,642	30,408,820	32,837,847	32,691,770	28,651,642	27,098,994
60%	10,224,170	19,214,760	30,408,820	32,231,619	30,267,693	28,651,642	16,558,498
70%	10,224,170	19,214,760	30,408,820	28,651,642	28,651,642	20,558,706	11,222,561
80%	10,224,170	19,214,760	28,910,482	21,186,712	28,651,642	10,224,170	10,224,170
90%	10,224,170	19,214,760	28,651,642	14,768,679	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	19,493,864	26,772,026	31,264,010	29,332,133	29,033,129	25,980,815	22,918,722
Water Year Types[c]							
Wet (32%)	11,062,074	26,281,951	30,818,674	29,293,814	22,111,836	15,211,071	11,943,327
Above Normal (16%)	10,224,170	28,726,415	31,820,384	27,290,181	30,975,948	26,807,422	18,238,581
Below Normal (13%)	23,523,311	24,198,199	31,762,781	29,604,012	34,493,702	34,365,349	31,966,805
Dry (24%)	26,889,930	25,357,801	31,261,534	30,018,605	32,732,891	32,309,264	31,860,294
Critical (15%)	31,784,477	30,432,982	31,173,088	30,233,929	30,752,748	30,186,534	28,572,199

Alternative 1

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,706,952	34,938,319	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	32,430,525	33,448,191	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,802,749	30,707,394	35,198,088	35,198,088	35,198,088	34,871,693	30,204,290
40%	30,204,290	28,651,642	34,431,241	35,196,517	35,198,088	32,691,770	27,098,994
50%	28,046,601	22,379,746	32,691,770	32,847,639	32,691,770	28,651,642	27,098,994
60%	20,241,358	19,345,841	30,447,453	29,997,845	29,180,786	27,840,395	13,899,774
70%	16,962,984	19,214,760	30,408,820	28,651,642	28,651,642	11,990,462	10,224,170
80%	14,685,529	19,214,760	30,408,820	22,517,048	25,686,778	10,224,170	10,224,170
90%	13,743,977	19,214,760	28,651,642	15,221,904	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	24,392,133	25,520,412	32,031,555	29,332,859	28,591,614	24,627,737	22,139,012
Water Year Types[c]							
Wet (32%)	23,110,223	25,465,715	31,806,280	26,883,379	20,884,575	14,520,956	11,573,794
Above Normal (16%)	17,898,191	27,096,493	32,757,766	27,492,250	30,383,035	23,248,973	14,277,054
Below Normal (13%)	23,677,135	22,580,278	32,461,765	33,633,302	34,375,109	29,963,337	31,465,154
Dry (24%)	26,681,930	25,839,785	31,800,234	30,689,805	32,732,891	32,353,485	32,137,042
Critical (15%)	31,043,793	26,094,337	31,724,101	30,430,409	31,145,831	30,252,214	28,335,089

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	373,941	-259,769	0	0	0	0	0
20%	1,088,644	-1,348,404	0	0	0	0	0
30%	598,459	-1,984,376	1,361,817	0	0	-326,395	-327,027
40%	8,528,692	-1,597,109	1,739,471	87,032	0	0	-808,021
50%	14,470,061	-6,271,896	2,282,950	9,792	0	0	0
60%	10,017,188	131,081	38,633	-2,233,774	-1,086,907	-811,247	-2,658,724
70%	6,738,814	0	0	0	0	-8,568,244	-998,391
80%	4,461,359	0	1,498,338	1,330,336	-2,964,864	0	0
90%	3,519,807	0	0	453,224	0	0	0
Long Term							
Full Simulation Period[b]	4,898,268	-1,251,613	767,545	726	-441,515	-1,353,078	-779,710
Water Year Types[c]							
Wet (32%)	12,048,149	-816,235	987,606	-2,410,435	-1,227,262	-690,115	-369,533
Above Normal (16%)	7,674,021	-1,629,922	937,382	202,069	-592,912	-3,558,449	-3,961,527
Below Normal (13%)	153,824	-1,617,921	698,984	4,029,289	-118,592	-4,402,013	-501,652
Dry (24%)	-208,001	481,984	538,699	671,200	0	44,221	276,748
Critical (15%)	-740,684	-4,338,645	551,014	196,480	393,082	65,680	-237,110

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-24-2. Feather River Below Thermalito Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,333,011	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	31,341,881	34,796,595	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,204,290	32,691,770	33,836,271	35,198,088	35,198,088	35,198,088	30,531,317
40%	21,675,598	30,248,751	32,691,770	35,109,485	35,198,088	32,691,770	27,907,015
50%	13,576,541	28,651,642	30,408,820	32,837,847	32,691,770	28,651,642	27,098,994
60%	10,224,170	19,214,760	30,408,820	32,231,619	30,267,693	28,651,642	16,558,498
70%	10,224,170	19,214,760	30,408,820	28,651,642	28,651,642	20,558,706	11,222,561
80%	10,224,170	19,214,760	28,910,482	21,186,712	28,651,642	10,224,170	10,224,170
90%	10,224,170	19,214,760	28,651,642	14,768,679	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	19,493,864	26,772,026	31,264,010	29,332,133	29,033,129	25,980,815	22,918,722
Water Year Types[c]							
Wet (32%)	11,062,074	26,281,951	30,818,674	29,293,814	22,111,836	15,211,071	11,943,327
Above Normal (16%)	10,224,170	28,726,415	31,820,384	27,290,181	30,975,948	26,807,422	18,238,581
Below Normal (13%)	23,523,311	24,198,199	31,762,781	29,604,012	34,493,702	34,365,349	31,966,805
Dry (24%)	26,889,930	25,357,801	31,261,534	30,018,605	32,732,891	32,309,264	31,860,294
Critical (15%)	31,784,477	30,432,982	31,173,088	30,233,929	30,752,748	30,186,534	28,572,199

Alternative 3

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,777,304	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	32,485,908	35,110,630	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,815,896	32,779,690	35,198,088	35,198,088	35,198,088	35,198,088	30,204,290
40%	30,204,290	31,083,556	34,007,312	35,198,088	35,198,088	32,691,770	27,098,994
50%	29,870,769	28,651,642	32,691,770	33,312,011	32,691,770	28,651,642	27,098,994
60%	26,684,954	22,345,634	30,408,820	32,691,770	30,267,693	28,651,642	15,022,238
70%	20,325,531	19,214,760	30,408,820	28,651,642	28,651,642	12,690,134	10,224,170
80%	15,989,853	19,214,760	28,706,794	25,706,241	28,651,642	10,224,170	10,224,170
90%	14,282,070	19,214,760	28,651,642	14,626,163	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	25,697,720	27,238,854	31,755,575	29,653,744	28,860,880	25,189,774	22,174,847
Water Year Types[c]							
Wet (32%)	25,123,354	26,579,504	31,294,094	26,714,836	21,582,367	15,207,515	11,573,668
Above Normal (16%)	18,163,474	28,551,699	32,389,360	27,961,666	30,966,711	25,642,082	15,051,212
Below Normal (13%)	25,953,862	25,518,911	32,624,077	33,279,166	34,475,983	29,834,397	31,464,643
Dry (24%)	27,532,535	27,944,987	31,911,673	31,764,503	32,730,727	32,309,964	31,769,600
Critical (15%)	31,811,457	27,644,926	31,012,559	31,013,227	30,752,748	30,203,445	28,354,439

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	444,294	0	0	0	0	0	0
20%	1,144,027	314,035	0	0	0	0	0
30%	611,606	87,920	1,361,817	0	0	0	-327,027
40%	8,528,692	834,805	1,315,542	88,603	0	0	-808,021
50%	16,294,229	0	2,282,950	474,164	0	0	0
60%	16,460,784	3,130,874	0	460,151	0	0	-1,536,260
70%	10,101,361	0	0	0	0	-7,868,573	-998,391
80%	5,765,683	0	-203,688	4,519,529	0	0	0
90%	4,057,900	0	0	-142,517	0	0	0
Long Term							
Full Simulation Period[b]	6,203,855	466,829	491,564	321,611	-172,249	-791,042	-743,875
Water Year Types[c]							
Wet (32%)	14,061,280	297,553	475,420	-2,578,978	-529,469	-3,556	-369,659
Above Normal (16%)	7,939,304	-174,717	568,976	671,484	-9,237	-1,165,339	-3,187,369
Below Normal (13%)	2,430,551	1,320,712	861,296	3,675,154	-17,719	-4,530,952	-502,162
Dry (24%)	642,604	2,587,186	650,139	1,745,897	-2,164	700	-90,694
Critical (15%)	26,980	-2,788,056	-160,529	779,298	0	16,910	-217,760

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-24-3. Feather River Below Thermalito Fall-run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,333,011	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	31,341,881	34,796,595	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,204,290	32,691,770	33,836,271	35,198,088	35,198,088	35,198,088	30,531,317
40%	21,675,598	30,248,751	32,691,770	35,109,485	35,198,088	32,691,770	27,907,015
50%	13,576,541	28,651,642	30,408,820	32,837,847	32,691,770	28,651,642	27,098,994
60%	10,224,170	19,214,760	30,408,820	32,231,619	30,267,693	28,651,642	16,558,498
70%	10,224,170	19,214,760	30,408,820	28,651,642	28,651,642	20,558,706	11,222,561
80%	10,224,170	19,214,760	28,910,482	21,186,712	28,651,642	10,224,170	10,224,170
90%	10,224,170	19,214,760	28,651,642	14,768,679	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	19,493,864	26,772,026	31,264,010	29,332,133	29,033,129	25,980,815	22,918,722
Water Year Types[c]							
Wet (32%)	11,062,074	26,281,951	30,818,674	29,293,814	22,111,836	15,211,071	11,943,327
Above Normal (16%)	10,224,170	28,726,415	31,820,384	27,290,181	30,975,948	26,807,422	18,238,581
Below Normal (13%)	23,523,311	24,198,199	31,762,781	29,604,012	34,493,702	34,365,349	31,966,805
Dry (24%)	26,889,930	25,357,801	31,261,534	30,018,605	32,732,891	32,309,264	31,860,294
Critical (15%)	31,784,477	30,432,982	31,173,088	30,233,929	30,752,748	30,186,534	28,572,199

Alternative 5

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,865,465	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	31,372,250	34,798,753	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,204,290	32,691,770	33,939,911	35,198,088	35,198,088	35,198,088	30,533,003
40%	24,815,466	30,440,840	32,691,770	35,087,554	35,198,088	32,778,926	27,597,049
50%	13,460,109	28,651,642	30,408,820	32,837,442	32,691,770	30,671,706	27,098,994
60%	10,224,170	19,214,760	30,408,820	32,401,804	30,267,693	28,651,642	16,549,156
70%	10,224,170	19,214,760	30,408,820	28,651,642	28,651,642	20,368,760	12,334,457
80%	10,224,170	19,214,760	29,386,480	21,227,294	28,651,642	10,224,170	10,224,170
90%	10,224,170	19,214,760	28,651,642	14,734,634	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	19,547,683	26,775,449	31,310,168	29,317,610	28,943,166	26,104,257	22,938,320
Water Year Types[c]							
Wet (32%)	11,076,085	26,159,579	30,814,718	29,324,948	21,828,184	15,211,109	11,941,464
Above Normal (16%)	10,224,170	28,750,622	32,185,751	27,296,663	30,976,207	27,656,337	18,474,607
Below Normal (13%)	23,225,254	24,198,277	31,762,781	29,607,819	34,493,209	34,365,349	31,955,180
Dry (24%)	27,221,390	25,486,065	31,223,266	29,970,496	32,732,891	32,309,793	31,857,927
Critical (15%)	31,842,668	30,481,444	31,165,034	30,136,903	30,752,748	30,109,432	28,469,065

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	532,454	0	0	0	0	0	0
20%	30,369	2,158	0	0	0	0	0
30%	0	0	103,640	0	0	0	1,686
40%	3,139,868	192,089	0	-21,930	0	87,156	-309,966
50%	-116,432	0	0	-405	0	2,020,064	0
60%	0	0	0	170,185	0	0	-9,342
70%	0	0	0	0	0	-189,946	1,111,896
80%	0	0	475,999	40,582	0	0	0
90%	0	0	0	-34,046	0	0	0
Long Term							
Full Simulation Period[b]	53,819	3,423	46,157	-14,523	-89,963	123,442	19,598
Water Year Types[c]							
Wet (32%)	14,011	-122,372	-3,956	31,134	-283,652	38	-1,863
Above Normal (16%)	0	24,207	365,367	6,482	259	848,915	236,026
Below Normal (13%)	-298,057	78	0	3,806	-493	0	-11,626
Dry (24%)	331,460	128,264	-38,268	-48,110	0	529	-2,368
Critical (15%)	58,191	48,462	-8,054	-97,026	0	-77,103	-103,134

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-24-4. Feather River Below Thermalito Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,706,952	34,938,319	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	32,430,525	33,448,191	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,802,749	30,707,394	35,198,088	35,198,088	35,198,088	34,871,693	30,204,290
40%	30,204,290	28,651,642	34,431,241	35,196,517	35,198,088	32,691,770	27,098,994
50%	28,046,601	22,379,746	32,691,770	32,847,639	32,691,770	28,651,642	27,098,994
60%	20,241,358	19,345,841	30,447,453	29,997,845	29,180,786	27,840,395	13,899,774
70%	16,962,984	19,214,760	30,408,820	28,651,642	28,651,642	11,990,462	10,224,170
80%	14,685,529	19,214,760	30,408,820	22,517,048	25,686,778	10,224,170	10,224,170
90%	13,743,977	19,214,760	28,651,642	15,221,904	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	24,392,133	25,520,412	32,031,555	29,332,859	28,591,614	24,627,737	22,139,012
Water Year Types[c]							
Wet (32%)	23,110,223	25,465,715	31,806,280	26,883,379	20,884,575	14,520,956	11,573,794
Above Normal (16%)	17,898,191	27,096,493	32,757,766	27,492,250	30,383,035	23,248,973	14,277,054
Below Normal (13%)	23,677,135	22,580,278	32,461,765	33,633,302	34,375,109	29,963,337	31,465,154
Dry (24%)	26,681,930	25,839,785	31,800,234	30,689,805	32,732,891	32,353,485	32,137,042
Critical (15%)	31,043,793	26,094,337	31,724,101	30,430,409	31,145,831	30,252,214	28,335,089

No Action Alternative

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,333,011	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	31,341,881	34,796,595	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,204,290	32,691,770	33,836,271	35,198,088	35,198,088	35,198,088	30,531,317
40%	21,675,598	30,248,751	32,691,770	35,109,485	35,198,088	32,691,770	27,907,015
50%	13,576,541	28,651,642	30,408,820	32,837,847	32,691,770	28,651,642	27,098,994
60%	10,224,170	19,214,760	30,408,820	32,231,619	30,267,693	28,651,642	16,558,498
70%	10,224,170	19,214,760	30,408,820	28,651,642	28,651,642	20,558,706	11,222,561
80%	10,224,170	19,214,760	28,910,482	21,186,712	28,651,642	10,224,170	10,224,170
90%	10,224,170	19,214,760	28,651,642	14,768,679	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	19,493,864	26,772,026	31,264,010	29,332,133	29,033,129	25,980,815	22,918,722
Water Year Types[c]							
Wet (32%)	11,062,074	26,281,951	30,818,674	29,293,814	22,111,836	15,211,071	11,943,327
Above Normal (16%)	10,224,170	28,726,415	31,820,384	27,290,181	30,975,948	26,807,422	18,238,581
Below Normal (13%)	23,523,311	24,198,199	31,762,781	29,604,012	34,493,702	34,365,349	31,966,805
Dry (24%)	26,889,930	25,357,801	31,261,534	30,018,605	32,732,891	32,309,264	31,860,294
Critical (15%)	31,784,477	30,432,982	31,173,088	30,233,929	30,752,748	30,186,534	28,572,199

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	-373,941	259,769	0	0	0	0	0
20%	-1,088,644	1,348,404	0	0	0	0	0
30%	-598,459	1,984,376	-1,361,817	0	0	326,395	327,027
40%	-8,528,692	1,597,109	-1,739,471	-87,032	0	0	808,021
50%	-14,470,061	6,271,896	-2,282,950	-9,792	0	0	0
60%	-10,017,188	-131,081	-38,633	2,233,774	1,086,907	811,247	2,658,724
70%	-6,738,814	0	0	0	0	8,568,244	998,391
80%	-4,461,359	0	-1,498,338	-1,330,336	2,964,864	0	0
90%	-3,519,807	0	0	-453,224	0	0	0
Long Term							
Full Simulation Period[b]	-4,898,268	1,251,613	-767,545	-726	441,515	1,353,078	779,710
Water Year Types[c]							
Wet (32%)	-12,048,149	816,235	-987,606	2,410,435	1,227,262	690,115	369,533
Above Normal (16%)	-7,674,021	1,629,922	-937,382	-202,069	592,912	3,558,449	3,961,527
Below Normal (13%)	-153,824	1,617,921	-698,984	-4,029,289	118,592	4,402,013	501,652
Dry (24%)	208,001	-481,984	-538,699	-671,200	0	-44,221	-276,748
Critical (15%)	740,684	4,338,645	-551,014	-196,480	-393,082	-65,680	237,110

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-24-5. Feather River Below Thermalito Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,706,952	34,938,319	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	32,430,525	33,448,191	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,802,749	30,707,394	35,198,088	35,198,088	35,198,088	34,871,693	30,204,290
40%	30,204,290	28,651,642	34,431,241	35,196,517	35,198,088	32,691,770	27,098,994
50%	28,046,601	22,379,746	32,691,770	32,847,639	32,691,770	28,651,642	27,098,994
60%	20,241,358	19,345,841	30,447,453	29,997,845	29,180,786	27,840,395	13,899,774
70%	16,962,984	19,214,760	30,408,820	28,651,642	28,651,642	11,990,462	10,224,170
80%	14,685,529	19,214,760	30,408,820	22,517,048	25,686,778	10,224,170	10,224,170
90%	13,743,977	19,214,760	28,651,642	15,221,904	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	24,392,133	25,520,412	32,031,555	29,332,859	28,591,614	24,627,737	22,139,012
Water Year Types[c]							
Wet (32%)	23,110,223	25,465,715	31,806,280	26,883,379	20,884,575	14,520,956	11,573,794
Above Normal (16%)	17,898,191	27,096,493	32,757,766	27,492,250	30,383,035	23,248,973	14,277,054
Below Normal (13%)	23,677,135	22,580,278	32,461,765	33,633,302	34,375,109	29,963,337	31,465,154
Dry (24%)	26,681,930	25,839,785	31,800,234	30,689,805	32,732,891	32,353,485	32,137,042
Critical (15%)	31,043,793	26,094,337	31,724,101	30,430,409	31,145,831	30,252,214	28,335,089

Alternative 3

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,777,304	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	32,485,908	35,110,630	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,815,896	32,779,690	35,198,088	35,198,088	35,198,088	35,198,088	30,204,290
40%	30,204,290	31,083,556	34,007,312	35,198,088	35,198,088	32,691,770	27,098,994
50%	29,870,769	28,651,642	32,691,770	33,312,011	32,691,770	28,651,642	27,098,994
60%	26,684,954	22,345,634	30,408,820	32,691,770	30,267,693	28,651,642	15,022,238
70%	20,325,531	19,214,760	30,408,820	28,651,642	28,651,642	12,690,134	10,224,170
80%	15,989,853	19,214,760	28,706,794	25,706,241	28,651,642	10,224,170	10,224,170
90%	14,282,070	19,214,760	28,651,642	14,626,163	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	25,697,720	27,238,854	31,755,575	29,653,744	28,860,880	25,189,774	22,174,847
Water Year Types[c]							
Wet (32%)	25,123,354	26,579,504	31,294,094	26,714,836	21,582,367	15,207,515	11,573,668
Above Normal (16%)	18,163,474	28,551,699	32,389,360	27,961,666	30,966,711	25,642,082	15,051,212
Below Normal (13%)	25,953,862	25,518,911	32,624,077	33,279,166	34,475,983	29,834,397	31,464,643
Dry (24%)	27,532,535	27,944,987	31,911,673	31,764,503	32,730,727	32,309,964	31,769,600
Critical (15%)	31,811,457	27,644,926	31,012,559	31,013,227	30,752,748	30,203,445	28,354,439

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	70,352	259,769	0	0	0	0	0
20%	55,383	1,662,440	0	0	0	0	0
30%	13,147	2,072,296	0	0	0	326,395	0
40%	0	2,431,914	-423,929	1,571	0	0	0
50%	1,824,168	6,271,896	0	464,372	0	0	0
60%	6,443,596	2,999,794	-38,633	2,693,925	1,086,907	811,247	1,122,464
70%	3,362,547	0	0	0	0	699,672	0
80%	1,304,324	0	-1,702,026	3,189,193	2,964,864	0	0
90%	538,093	0	0	-595,741	0	0	0
Long Term							
Full Simulation Period[b]	1,305,587	1,718,442	-275,981	320,885	269,265	562,036	35,835
Water Year Types[c]							
Wet (32%)	2,013,131	1,113,788	-512,187	-168,543	697,793	686,559	-126
Above Normal (16%)	265,283	1,455,206	-368,405	469,416	583,676	2,393,110	774,158
Below Normal (13%)	2,276,727	2,938,633	162,312	-354,136	100,874	-128,939	-511
Dry (24%)	850,605	2,105,202	111,440	1,074,697	-2,164	-43,521	-367,442
Critical (15%)	767,664	1,550,589	-711,543	582,818	-393,082	-48,770	19,350

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-24-6. Feather River Below Thermalito Fall-run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,706,952	34,938,319	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	32,430,525	33,448,191	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,802,749	30,707,394	35,198,088	35,198,088	35,198,088	34,871,693	30,204,290
40%	30,204,290	28,651,642	34,431,241	35,196,517	35,198,088	32,691,770	27,098,994
50%	28,046,601	22,379,746	32,691,770	32,847,639	32,691,770	28,651,642	27,098,994
60%	20,241,358	19,345,841	30,447,453	29,997,845	29,180,786	27,840,395	13,899,774
70%	16,962,984	19,214,760	30,408,820	28,651,642	28,651,642	11,990,462	10,224,170
80%	14,685,529	19,214,760	30,408,820	22,517,048	25,686,778	10,224,170	10,224,170
90%	13,743,977	19,214,760	28,651,642	15,221,904	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	24,392,133	25,520,412	32,031,555	29,332,859	28,591,614	24,627,737	22,139,012
Water Year Types[c]							
Wet (32%)	23,110,223	25,465,715	31,806,280	26,883,379	20,884,575	14,520,956	11,573,794
Above Normal (16%)	17,898,191	27,096,493	32,757,766	27,492,250	30,383,035	23,248,973	14,277,054
Below Normal (13%)	23,677,135	22,580,278	32,461,765	33,633,302	34,375,109	29,963,337	31,465,154
Dry (24%)	26,681,930	25,839,785	31,800,234	30,689,805	32,732,891	32,353,485	32,137,042
Critical (15%)	31,043,793	26,094,337	31,724,101	30,430,409	31,145,831	30,252,214	28,335,089

Alternative 5

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	33,865,465	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
20%	31,372,250	34,798,753	35,198,088	35,198,088	35,198,088	35,198,088	35,198,088
30%	30,204,290	32,691,770	33,939,911	35,198,088	35,198,088	35,198,088	30,533,003
40%	24,815,466	30,440,840	32,691,770	35,087,554	35,198,088	32,778,926	27,597,049
50%	13,460,109	28,651,642	30,408,820	32,837,442	32,691,770	30,671,706	27,098,994
60%	10,224,170	19,214,760	30,408,820	32,401,804	30,267,693	28,651,642	16,549,156
70%	10,224,170	19,214,760	30,408,820	28,651,642	28,651,642	20,368,760	12,334,457
80%	10,224,170	19,214,760	29,386,480	21,227,294	28,651,642	10,224,170	10,224,170
90%	10,224,170	19,214,760	28,651,642	14,734,634	10,224,170	10,224,170	10,224,170
Long Term							
Full Simulation Period[b]	19,547,683	26,775,449	31,310,168	29,317,610	28,943,166	26,104,257	22,938,320
Water Year Types[c]							
Wet (32%)	11,076,085	26,159,579	30,814,718	29,324,948	21,828,184	15,211,109	11,941,464
Above Normal (16%)	10,224,170	28,750,622	32,185,751	27,296,663	30,976,207	27,656,337	18,474,607
Below Normal (13%)	23,225,254	24,198,277	31,762,781	29,607,819	34,493,209	34,365,349	31,955,180
Dry (24%)	27,221,390	25,486,065	31,223,266	29,970,496	32,732,891	32,309,793	31,857,927
Critical (15%)	31,842,668	30,481,444	31,165,034	30,136,903	30,752,748	30,109,432	28,469,065

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Probability of Exceedance[a]							
10%	158,513	259,769	0	0	0	0	0
20%	-1,058,275	1,350,562	0	0	0	0	0
30%	-598,459	1,984,376	-1,258,177	0	0	326,395	328,713
40%	-5,388,824	1,789,198	-1,739,471	-108,962	0	87,156	498,055
50%	-14,586,492	6,271,896	-2,282,950	-10,197	0	2,020,064	0
60%	-10,017,188	-131,081	-38,633	2,403,960	1,086,907	811,247	2,649,382
70%	-6,738,814	0	0	0	0	8,378,299	2,110,287
80%	-4,461,359	0	-1,022,340	-1,289,754	2,964,864	0	0
90%	-3,519,807	0	0	-487,270	0	0	0
Long Term							
Full Simulation Period[b]	-4,844,449	1,255,037	-721,388	-15,249	351,551	1,476,520	799,309
Water Year Types[c]							
Wet (32%)	-12,034,138	693,863	-991,563	2,441,569	943,610	690,153	367,671
Above Normal (16%)	-7,674,021	1,654,129	-572,015	-195,587	593,172	4,407,364	4,197,552
Below Normal (13%)	-451,881	1,617,999	-698,984	-4,025,483	118,099	4,402,013	490,026
Dry (24%)	539,461	-353,720	-576,967	-719,310	0	-43,692	-279,116
Critical (15%)	798,875	4,387,107	-559,068	-293,506	-393,082	-142,782	133,976

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.25. American River below Nimbus Fall-run Spawning WUA

Table C-25-1. American River Below Nimbus Fall-Run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	878,663	880,132	881,528
20%	868,978	874,597	881,528
30%	862,503	872,517	881,528
40%	862,503	855,799	876,343
50%	862,503	833,195	859,903
60%	859,526	767,728	791,242
70%	821,118	740,252	609,089
80%	749,898	609,089	467,889
90%	609,089	446,307	282,031
Long Term			
Full Simulation Period[b]	793,199	745,474	709,367
Water Year Types[c]			
Wet (32%)	836,993	709,662	566,617
Above Normal (16%)	734,467	710,743	695,308
Below Normal (13%)	801,950	771,543	795,846
Dry (24%)	782,142	780,077	816,670
Critical (15%)	772,342	779,125	775,777

Alternative 1

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	872,929	880,132	881,528
20%	862,503	879,325	881,528
30%	862,503	874,395	876,990
40%	862,503	868,521	870,868
50%	862,503	841,739	823,381
60%	862,503	762,862	743,750
70%	837,871	689,086	609,089
80%	674,314	609,089	466,520
90%	600,397	403,562	250,680
Long Term			
Full Simulation Period[b]	786,647	741,731	688,437
Water Year Types[c]			
Wet (32%)	825,953	720,015	533,793
Above Normal (16%)	731,801	693,422	667,877
Below Normal (13%)	795,680	772,032	777,325
Dry (24%)	771,424	766,495	799,125
Critical (15%)	777,991	772,070	779,815

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	-5,734	0	0
20%	-6,475	4,727	0
30%	0	1,878	-4,538
40%	0	12,721	-5,475
50%	0	8,544	-36,522
60%	2,978	-4,866	-47,493
70%	16,752	-51,166	0
80%	-75,584	0	-1,369
90%	-8,692	-42,745	-31,351
Long Term			
Full Simulation Period[b]	-6,552	-3,743	-20,929
Water Year Types[c]			
Wet (32%)	-11,041	10,353	-32,824
Above Normal (16%)	-2,666	-17,320	-27,431
Below Normal (13%)	-6,270	489	-18,521
Dry (24%)	-10,718	-13,582	-17,545
Critical (15%)	5,649	-7,055	4,038

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-25-2. American River Below Nimbus Fall-Run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	878,663	880,132	881,528
20%	868,978	874,597	881,528
30%	862,503	872,517	881,528
40%	862,503	855,799	876,343
50%	862,503	833,195	859,903
60%	859,526	767,728	791,242
70%	821,118	740,252	609,089
80%	749,898	609,089	467,889
90%	609,089	446,307	282,031
Long Term			
Full Simulation Period[b]	793,199	745,474	709,367
Water Year Types[c]			
Wet (32%)	836,993	709,662	566,617
Above Normal (16%)	734,467	710,743	695,308
Below Normal (13%)	801,950	771,543	795,846
Dry (24%)	782,142	780,077	816,670
Critical (15%)	772,342	779,125	775,777

Alternative 3

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	879,083	880,132	881,528
20%	866,138	880,132	881,528
30%	862,503	874,395	876,343
40%	862,503	869,546	862,177
50%	862,503	846,219	815,683
60%	862,503	796,665	743,774
70%	845,529	730,285	609,089
80%	774,565	619,125	466,542
90%	609,089	488,788	247,453
Long Term			
Full Simulation Period[b]	798,897	753,761	693,122
Water Year Types[c]			
Wet (32%)	829,926	727,108	535,360
Above Normal (16%)	751,660	711,941	683,812
Below Normal (13%)	801,041	790,161	772,859
Dry (24%)	789,040	774,015	809,347
Critical (15%)	797,304	789,694	778,226

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	419	0	0
20%	-2,841	5,535	0
30%	0	1,878	-5,186
40%	0	13,746	-14,166
50%	0	13,024	-44,220
60%	2,978	28,937	-47,468
70%	24,411	-9,967	0
80%	24,667	10,037	-1,347
90%	0	42,481	-34,578
Long Term			
Full Simulation Period[b]	5,698	8,287	-16,245
Water Year Types[c]			
Wet (32%)	-7,068	17,446	-31,258
Above Normal (16%)	17,194	1,198	-11,496
Below Normal (13%)	-909	18,618	-22,986
Dry (24%)	6,898	-6,062	-7,323
Critical (15%)	24,962	10,569	2,449

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-25-3. American River Below Nimbus Fall-Run Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	878,663	880,132	881,528
20%	868,978	874,597	881,528
30%	862,503	872,517	881,528
40%	862,503	855,799	876,343
50%	862,503	833,195	859,903
60%	859,526	767,728	791,242
70%	821,118	740,252	609,089
80%	749,898	609,089	467,889
90%	609,089	446,307	282,031
Long Term			
Full Simulation Period[b]	793,199	745,474	709,367
Water Year Types[c]			
Wet (32%)	836,993	709,662	566,617
Above Normal (16%)	734,467	710,743	695,308
Below Normal (13%)	801,950	771,543	795,846
Dry (24%)	782,142	780,077	816,670
Critical (15%)	772,342	779,125	775,777

Alternative 5

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	875,329	880,132	881,528
20%	863,849	875,412	881,528
30%	862,503	872,536	878,964
40%	862,503	854,056	875,153
50%	862,503	824,470	854,006
60%	853,955	767,862	795,540
70%	822,159	734,101	609,089
80%	750,763	609,089	468,296
90%	609,089	455,653	281,677
Long Term			
Full Simulation Period[b]	790,823	745,710	707,446
Water Year Types[c]			
Wet (32%)	834,432	706,010	567,264
Above Normal (16%)	747,545	709,433	692,541
Below Normal (13%)	799,217	769,383	781,534
Dry (24%)	783,195	782,444	817,858
Critical (15%)	748,238	788,103	775,390

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	-3,335	0	0
20%	-5,129	815	0
30%	0	20	-2,564
40%	0	-1,743	-1,190
50%	0	-8,726	-5,897
60%	-5,570	134	4,297
70%	1,041	-6,150	0
80%	865	0	407
90%	0	9,346	-354
Long Term			
Full Simulation Period[b]	-2,376	236	-1,920
Water Year Types[c]			
Wet (32%)	-2,561	-3,652	647
Above Normal (16%)	13,078	-1,309	-2,767
Below Normal (13%)	-2,733	-2,160	-14,312
Dry (24%)	1,053	2,366	1,188
Critical (15%)	-24,104	8,978	-387

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-25-4. American River Below Nimbus Fall-Run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	872,929	880,132	881,528
20%	862,503	879,325	881,528
30%	862,503	874,395	876,990
40%	862,503	868,521	870,868
50%	862,503	841,739	823,381
60%	862,503	762,862	743,750
70%	837,871	689,086	609,089
80%	674,314	609,089	466,520
90%	600,397	403,562	250,680
Long Term			
Full Simulation Period[b]	786,647	741,731	688,437
Water Year Types[c]			
Wet (32%)	825,953	720,015	533,793
Above Normal (16%)	731,801	693,422	667,877
Below Normal (13%)	795,680	772,032	777,325
Dry (24%)	771,424	766,495	799,125
Critical (15%)	777,991	772,070	779,815

No Action Alternative

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	878,663	880,132	881,528
20%	868,978	874,597	881,528
30%	862,503	872,517	881,528
40%	862,503	855,799	876,343
50%	862,503	833,195	859,903
60%	859,526	767,728	791,242
70%	821,118	740,252	609,089
80%	749,898	609,089	467,889
90%	609,089	446,307	282,031
Long Term			
Full Simulation Period[b]	793,199	745,474	709,367
Water Year Types[c]			
Wet (32%)	836,993	709,662	566,617
Above Normal (16%)	734,467	710,743	695,308
Below Normal (13%)	801,950	771,543	795,846
Dry (24%)	782,142	780,077	816,670
Critical (15%)	772,342	779,125	775,777

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Oct	Nov	Dec
Probability of Exceedance[a]			
10%	5,734	0	0
20%	6,475	-4,727	0
30%	0	-1,878	4,538
40%	0	-12,721	5,475
50%	0	-8,544	36,522
60%	-2,978	4,866	47,493
70%	-16,752	51,166	0
80%	75,584	0	1,369
90%	8,692	42,745	31,351
Long Term			
Full Simulation Period[b]	6,552	3,743	20,929
Water Year Types[c]			
Wet (32%)	11,041	-10,353	32,824
Above Normal (16%)	2,666	17,320	27,431
Below Normal (13%)	6,270	-489	18,521
Dry (24%)	10,718	13,582	17,545
Critical (15%)	-5,649	7,055	-4,038

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-25-5. American River Below Nimbus Fall-Run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	872,929	880,132	881,528
20%	862,503	879,325	881,528
30%	862,503	874,395	876,990
40%	862,503	868,521	870,868
50%	862,503	841,739	823,381
60%	862,503	762,862	743,750
70%	837,871	689,086	609,089
80%	674,314	609,089	466,520
90%	600,397	403,562	250,680
Long Term			
Full Simulation Period[b]	786,647	741,731	688,437
Water Year Types[c]			
Wet (32%)	825,953	720,015	533,793
Above Normal (16%)	731,801	693,422	667,877
Below Normal (13%)	795,680	772,032	777,325
Dry (24%)	771,424	766,495	799,125
Critical (15%)	777,991	772,070	779,815

Alternative 3

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	879,083	880,132	881,528
20%	866,138	880,132	881,528
30%	862,503	874,395	876,343
40%	862,503	869,546	862,177
50%	862,503	846,219	815,683
60%	862,503	796,665	743,774
70%	845,529	730,285	609,089
80%	774,565	619,125	466,542
90%	609,089	488,788	247,453
Long Term			
Full Simulation Period[b]	798,897	753,761	693,122
Water Year Types[c]			
Wet (32%)	829,926	727,108	535,360
Above Normal (16%)	751,660	711,941	683,812
Below Normal (13%)	801,041	790,161	772,859
Dry (24%)	789,040	774,015	809,347
Critical (15%)	797,304	789,694	778,226

Alternative 3 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	6,153	0	0
20%	3,634	807	0
30%	0	0	-647
40%	0	1,025	-8,691
50%	0	4,480	-7,698
60%	0	33,803	24
70%	7,659	41,199	0
80%	100,251	10,037	22
90%	8,692	85,226	-3,228
Long Term			
Full Simulation Period[b]	12,250	12,030	4,685
Water Year Types[c]			
Wet (32%)	3,973	7,093	1,566
Above Normal (16%)	19,860	18,518	15,935
Below Normal (13%)	5,361	18,129	-4,465
Dry (24%)	17,616	7,520	10,222
Critical (15%)	19,313	17,624	-1,589

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-25-6. American River Below Nimbus Fall-Run Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	872,929	880,132	881,528
20%	862,503	879,325	881,528
30%	862,503	874,395	876,990
40%	862,503	868,521	870,868
50%	862,503	841,739	823,381
60%	862,503	762,862	743,750
70%	837,871	689,086	609,089
80%	674,314	609,089	466,520
90%	600,397	403,562	250,680
Long Term			
Full Simulation Period[b]	786,647	741,731	688,437
Water Year Types[c]			
Wet (32%)	825,953	720,015	533,793
Above Normal (16%)	731,801	693,422	667,877
Below Normal (13%)	795,680	772,032	777,325
Dry (24%)	771,424	766,495	799,125
Critical (15%)	777,991	772,070	779,815

Alternative 5

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	875,329	880,132	881,528
20%	863,849	875,412	881,528
30%	862,503	872,536	878,964
40%	862,503	854,056	875,153
50%	862,503	824,470	854,006
60%	853,955	767,862	795,540
70%	822,159	734,101	609,089
80%	750,763	609,089	468,296
90%	609,089	455,653	281,677
Long Term			
Full Simulation Period[b]	790,823	745,710	707,446
Water Year Types[c]			
Wet (32%)	834,432	706,010	567,264
Above Normal (16%)	747,545	709,433	692,541
Below Normal (13%)	799,217	769,383	781,534
Dry (24%)	783,195	782,444	817,858
Critical (15%)	748,238	788,103	775,390

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)		
	Oct	Nov	Dec
Probability of Exceedance[a]			
10%	2,399	0	0
20%	1,346	**-3,912**	0
30%	0	**-1,858**	1,974
40%	0	**-14,464**	4,285
50%	0	**-17,270**	30,625
60%	**-8,548**	5,000	51,790
70%	**-15,711**	45,016	0
80%	76,449	0	1,777
90%	8,692	52,091	30,997
Long Term			
Full Simulation Period[b]	4,176	3,979	19,009
Water Year Types[c]			
Wet (32%)	8,480	**-14,005**	33,471
Above Normal (16%)	15,745	16,011	24,664
Below Normal (13%)	3,537	**-2,649**	4,209
Dry (24%)	11,771	15,948	18,733
Critical (15%)	**-29,753**	16,033	**-4,424**

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

C.26. American River below Nimbus Steelhead Spawning WUA

Table C-26-1. American River Below Nimbus Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	277,336	280,548	280,548
20%	285,223	279,028	271,755	264,437	276,864
30%	285,223	273,342	263,024	251,454	269,281
40%	280,548	262,440	241,823	205,382	238,344
50%	274,021	231,899	195,347	195,347	206,383
60%	252,244	194,219	137,490	195,347	195,347
70%	195,347	142,694	105,666	167,825	186,789
80%	164,818	98,910	71,518	111,692	154,244
90%	93,384	70,711	70,711	81,209	107,736
Long Term					
Full Simulation Period[b]	229,569	199,778	179,729	193,238	210,109
Water Year Types[c]					
Wet (32%)	186,565	128,944	115,025	157,936	183,565
Above Normal (16%)	224,484	198,784	161,582	169,629	230,626
Below Normal (13%)	256,911	243,922	217,841	242,027	227,164
Dry (24%)	262,329	254,455	240,539	222,522	228,484
Critical (15%)	248,593	222,736	203,294	201,770	199,135

Alternative 1

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	272,186	280,548	281,607
20%	285,223	279,028	263,555	268,472	278,599
30%	282,337	273,690	253,891	249,447	274,209
40%	277,607	264,248	226,168	205,760	252,416
50%	263,613	222,420	195,347	195,347	235,044
60%	240,908	195,347	128,662	195,347	195,347
70%	195,347	145,999	103,353	166,005	187,494
80%	155,541	99,151	72,131	106,868	154,447
90%	81,014	70,711	70,711	80,740	107,736
Long Term					
Full Simulation Period[b]	223,019	199,831	175,836	192,340	213,917
Water Year Types[c]					
Wet (32%)	176,198	128,443	111,109	157,999	183,660
Above Normal (16%)	215,958	193,304	156,690	166,724	230,884
Below Normal (13%)	251,048	248,135	207,597	242,179	235,743
Dry (24%)	256,972	250,904	235,574	223,024	232,560
Critical (15%)	249,833	232,173	208,143	197,667	210,012

Alternative 1 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	-5,150	0	1,058
20%	0	0	-8,200	4,035	1,735
30%	-2,886	349	-9,133	-2,007	4,928
40%	-2,941	1,808	-15,655	378	14,072
50%	-10,408	-9,479	0	0	28,662
60%	-11,335	1,128	-8,829	0	0
70%	0	3,305	-2,314	-1,820	705
80%	-9,277	241	612	-4,824	203
90%	-12,370	0	0	-470	0
Long Term					
Full Simulation Period[b]	-6,550	52	-3,893	-898	3,808
Water Year Types[c]					
Wet (32%)	-10,367	-502	-3,916	62	96
Above Normal (16%)	-8,526	-5,480	-4,893	-2,904	259
Below Normal (13%)	-5,863	4,213	-10,244	152	8,579
Dry (24%)	-5,357	-3,552	-4,964	502	4,076
Critical (15%)	1,239	9,437	4,848	-4,103	10,878

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-26-2. American River Below Nimbus Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	277,336	280,548	280,548
20%	285,223	279,028	271,755	264,437	276,864
30%	285,223	273,342	263,024	251,454	269,281
40%	280,548	262,440	241,823	205,382	238,344
50%	274,021	231,899	195,347	195,347	206,383
60%	252,244	194,219	137,490	195,347	195,347
70%	195,347	142,694	105,666	167,825	186,789
80%	164,818	98,910	71,518	111,692	154,244
90%	93,384	70,711	70,711	81,209	107,736
Long Term					
Full Simulation Period[b]	229,569	199,778	179,729	193,238	210,109
Water Year Types[c]					
Wet (32%)	186,565	128,944	115,025	157,936	183,565
Above Normal (16%)	224,484	198,784	161,582	169,629	230,626
Below Normal (13%)	256,911	243,922	217,841	242,027	227,164
Dry (24%)	262,329	254,455	240,539	222,522	228,484
Critical (15%)	248,593	222,736	203,294	201,770	199,135

Alternative 3

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	280,378	272,186	280,548	280,548
20%	285,223	279,028	263,024	268,472	276,329
30%	280,548	274,553	252,405	249,823	270,028
40%	275,387	264,772	228,189	205,760	244,427
50%	261,755	222,271	195,347	195,347	226,177
60%	240,905	195,347	128,655	195,347	195,347
70%	195,347	143,311	103,353	166,005	187,494
80%	156,211	99,151	72,200	106,868	154,304
90%	81,071	70,711	70,711	80,979	107,736
Long Term					
Full Simulation Period[b]	224,527	200,366	175,739	192,500	211,277
Water Year Types[c]					
Wet (32%)	176,682	128,381	111,139	157,999	183,643
Above Normal (16%)	220,890	197,449	158,358	166,569	230,799
Below Normal (13%)	250,017	246,437	206,868	242,167	229,934
Dry (24%)	260,218	251,966	235,063	222,283	227,573
Critical (15%)	249,279	231,262	207,131	200,181	205,740

Alternative 3 minus No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	1,350	-5,150	0	0
20%	0	0	-8,731	4,035	-536
30%	-4,674	1,212	-10,619	-1,631	748
40%	-5,162	2,332	-13,635	378	6,083
50%	-12,266	-9,628	0	0	19,794
60%	-11,338	1,128	-8,835	0	0
70%	0	617	-2,314	-1,820	705
80%	-8,606	241	682	-4,824	60
90%	-12,313	0	0	-230	0
Long Term					
Full Simulation Period[b]	-5,043	588	-3,990	-738	1,168
Water Year Types[c]					
Wet (32%)	-9,884	-563	-3,887	62	78
Above Normal (16%)	-3,594	-1,335	-3,224	-3,060	174
Below Normal (13%)	-6,894	2,515	-10,973	139	2,769
Dry (24%)	-2,111	-2,489	-5,476	-240	-911
Critical (15%)	686	8,525	3,837	-1,589	6,606

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-26-3. American River Below Nimbus Steelhead Spawning WUA, Monthly WUA

No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	277,336	280,548	280,548
20%	285,223	279,028	271,755	264,437	276,864
30%	285,223	273,342	263,024	251,454	269,281
40%	280,548	262,440	241,823	205,382	238,344
50%	274,021	231,899	195,347	195,347	206,383
60%	252,244	194,219	137,490	195,347	195,347
70%	195,347	142,694	105,666	167,825	186,789
80%	164,818	98,910	71,518	111,692	154,244
90%	93,384	70,711	70,711	81,209	107,736
Long Term					
Full Simulation Period[b]	229,569	199,778	179,729	193,238	210,109
Water Year Types[c]					
Wet (32%)	186,565	128,944	115,025	157,936	183,565
Above Normal (16%)	224,484	198,784	161,582	169,629	230,626
Below Normal (13%)	256,911	243,922	217,841	242,027	227,164
Dry (24%)	262,329	254,455	240,539	222,522	228,484
Critical (15%)	248,593	222,736	203,294	201,770	199,135

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	277,336	280,548	280,548
20%	285,223	279,028	271,741	264,360	276,329
30%	284,188	273,228	259,731	251,261	266,932
40%	280,520	262,675	234,998	205,307	238,344
50%	272,556	232,665	195,347	195,347	200,225
60%	253,403	189,969	136,905	195,347	195,347
70%	195,347	140,468	105,656	165,839	186,539
80%	166,533	98,405	71,525	111,692	154,260
90%	93,239	70,711	70,711	81,131	107,736
Long Term					
Full Simulation Period[b]	228,903	198,721	179,687	193,113	209,482
Water Year Types[c]					
Wet (32%)	186,628	128,857	115,004	157,938	183,569
Above Normal (16%)	223,573	199,284	161,575	169,488	230,609
Below Normal (13%)	252,282	235,698	219,524	241,747	225,309
Dry (24%)	262,804	254,505	239,729	222,559	228,468
Critical (15%)	248,342	222,615	202,869	201,260	196,590

Alternative 5 minus No Action Alternative

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	0	0	0
20%	0	0	-14	-77	-536
30%	-1,035	-113	-3,293	-193	-2,349
40%	-28	235	-6,825	-75	0
50%	-1,465	766	0	0	-6,157
60%	1,159	-4,250	-585	0	0
70%	0	-2,226	-10	-1,986	-250
80%	1,716	-505	7	0	16
90%	-144	0	0	-79	0
Long Term					
Full Simulation Period[b]	-666	-1,057	-42	-125	-627
Water Year Types[c]					
Wet (32%)	63	-87	-21	2	4
Above Normal (16%)	-911	500	-7	-141	-16
Below Normal (13%)	-4,629	-8,224	1,683	-280	-1,855
Dry (24%)	476	50	-809	36	-16
Critical (15%)	-251	-122	-426	-510	-2,545

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-26-4. American River Below Nimbus Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	272,186	280,548	281,607
20%	285,223	279,028	263,555	268,472	278,599
30%	282,337	273,690	253,891	249,447	274,209
40%	277,607	264,248	226,168	205,760	252,416
50%	263,613	222,420	195,347	195,347	235,044
60%	240,908	195,347	128,662	195,347	195,347
70%	195,347	145,999	103,353	166,005	187,494
80%	155,541	99,151	72,131	106,868	154,447
90%	81,014	70,711	70,711	80,740	107,736
Long Term					
Full Simulation Period[b]	223,019	199,831	175,836	192,340	213,917
Water Year Types[c]					
Wet (32%)	176,198	128,443	111,109	157,999	183,660
Above Normal (16%)	215,958	193,304	156,690	166,724	230,884
Below Normal (13%)	251,048	248,135	207,597	242,179	235,743
Dry (24%)	256,972	250,904	235,574	223,024	232,560
Critical (15%)	249,833	232,173	208,143	197,667	210,012

No Action Alternative

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	277,336	280,548	280,548
20%	285,223	279,028	271,755	264,437	276,864
30%	285,223	273,342	263,024	251,454	269,281
40%	280,548	262,440	241,823	205,382	238,344
50%	274,021	231,899	195,347	195,347	206,383
60%	252,244	194,219	137,490	195,347	195,347
70%	195,347	142,694	105,666	167,825	186,789
80%	164,818	98,910	71,518	111,692	154,244
90%	93,384	70,711	70,711	81,209	107,736
Long Term					
Full Simulation Period[b]	229,569	199,778	179,729	193,238	210,109
Water Year Types[c]					
Wet (32%)	186,565	128,944	115,025	157,936	183,565
Above Normal (16%)	224,484	198,784	161,582	169,629	230,626
Below Normal (13%)	256,911	243,922	217,841	242,027	227,164
Dry (24%)	262,329	254,455	240,539	222,522	228,484
Critical (15%)	248,593	222,736	203,294	201,770	199,135

No Action Alternative minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2) Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	5,150	0	-1,058
20%	0	0	8,200	-4,035	-1,735
30%	2,886	-349	9,133	2,007	-4,928
40%	2,941	-1,808	15,655	-378	-14,072
50%	10,408	9,479	0	0	-28,662
60%	11,335	-1,128	8,829	0	0
70%	0	-3,305	2,314	1,820	-705
80%	9,277	-241	-612	4,824	-203
90%	12,370	0	0	470	0
Long Term					
Full Simulation Period[b]	6,550	-52	3,893	898	-3,808
Water Year Types[c]					
Wet (32%)	10,367	502	3,916	-62	-96
Above Normal (16%)	8,526	5,480	4,893	2,904	-259
Below Normal (13%)	5,863	-4,213	10,244	-152	-8,579
Dry (24%)	5,357	3,552	4,964	-502	-4,076
Critical (15%)	-1,239	-9,437	-4,848	4,103	-10,878

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-26-5. American River Below Nimbus Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	272,186	280,548	281,607
20%	285,223	279,028	263,555	268,472	278,599
30%	282,337	273,690	253,891	249,447	274,209
40%	277,607	264,248	226,168	205,760	252,416
50%	263,613	222,420	195,347	195,347	235,044
60%	240,908	195,347	128,662	195,347	195,347
70%	195,347	145,999	103,353	166,005	187,494
80%	155,541	99,151	72,131	106,868	154,447
90%	81,014	70,711	70,711	80,740	107,736
Long Term					
Full Simulation Period[b]	223,019	199,831	175,836	192,340	213,917
Water Year Types[c]					
Wet (32%)	176,198	128,443	111,109	157,999	183,660
Above Normal (16%)	215,958	193,304	156,690	166,724	230,884
Below Normal (13%)	251,048	248,135	207,597	242,179	235,743
Dry (24%)	256,972	250,904	235,574	223,024	232,560
Critical (15%)	249,833	232,173	208,143	197,667	210,012

Alternative 3

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	280,378	272,186	280,548	280,548
20%	285,223	279,028	263,024	268,472	276,329
30%	280,548	274,553	252,405	249,823	270,028
40%	275,387	264,772	228,189	205,760	244,427
50%	261,755	222,271	195,347	195,347	226,177
60%	240,905	195,347	128,655	195,347	195,347
70%	195,347	143,311	103,353	166,005	187,494
80%	156,211	99,151	72,200	106,868	154,304
90%	81,071	70,711	70,711	80,979	107,736
Long Term					
Full Simulation Period[b]	224,527	200,366	175,739	192,500	211,277
Water Year Types[c]					
Wet (32%)	176,682	128,381	111,139	157,999	183,643
Above Normal (16%)	220,890	197,449	158,358	166,569	230,799
Below Normal (13%)	250,017	246,437	206,868	242,167	229,934
Dry (24%)	260,218	251,966	235,063	222,283	227,573
Critical (15%)	249,279	231,262	207,131	200,181	205,740

Alternative 3 minus Second Basis of Comparison

	Monthly WUA (Feet2)				
Statistic	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	1,350	0	0	-1,058
20%	0	0	-531	0	-2,271
30%	-1,788	863	-1,485	376	-4,181
40%	-2,220	524	2,020	0	-7,988
50%	-1,858	-148	0	0	-8,867
60%	-3	0	-6	0	0
70%	0	-2,688	0	-1	0
80%	671	0	70	0	-143
90%	57	0	0	240	0
Long Term					
Full Simulation Period[b]	1,507	536	-97	161	-2,640
Water Year Types[c]					
Wet (32%)	483	-62	29	0	-18
Above Normal (16%)	4,932	4,145	1,668	-156	-85
Below Normal (13%)	-1,031	-1,698	-729	-13	-5,810
Dry (24%)	3,246	1,063	-511	-742	-4,987
Critical (15%)	-553	-912	-1,011	2,514	-4,272

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table C-26-6. American River Below Nimbus Steelhead Spawning WUA, Monthly WUA

Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	272,186	280,548	281,607
20%	285,223	279,028	263,555	268,472	278,599
30%	282,337	273,690	253,891	249,447	274,209
40%	277,607	264,248	226,168	205,760	252,416
50%	263,613	222,420	195,347	195,347	235,044
60%	240,908	195,347	128,662	195,347	195,347
70%	195,347	145,999	103,353	166,005	187,494
80%	155,541	99,151	72,131	106,868	154,447
90%	81,014	70,711	70,711	80,740	107,736
Long Term					
Full Simulation Period[b]	223,019	199,831	175,836	192,340	213,917
Water Year Types[c]					
Wet (32%)	176,198	128,443	111,109	157,999	183,660
Above Normal (16%)	215,958	193,304	156,690	166,724	230,884
Below Normal (13%)	251,048	248,135	207,597	242,179	235,743
Dry (24%)	256,972	250,904	235,574	223,024	232,560
Critical (15%)	249,833	232,173	208,143	197,667	210,012

Alternative 5

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	285,223	279,028	277,336	280,548	280,548
20%	285,223	279,028	271,741	264,360	276,329
30%	284,188	273,228	259,731	251,261	266,932
40%	280,520	262,675	234,998	205,307	238,344
50%	272,556	232,665	195,347	195,347	200,225
60%	253,403	189,969	136,905	195,347	195,347
70%	195,347	140,468	105,656	165,839	186,539
80%	166,533	98,405	71,525	111,692	154,260
90%	93,239	70,711	70,711	81,131	107,736
Long Term					
Full Simulation Period[b]	228,903	198,721	179,687	193,113	209,482
Water Year Types[c]					
Wet (32%)	186,628	128,857	115,004	157,938	183,569
Above Normal (16%)	223,573	199,284	161,575	169,488	230,609
Below Normal (13%)	252,282	235,698	219,524	241,747	225,309
Dry (24%)	262,804	254,505	239,729	222,559	228,468
Critical (15%)	248,342	222,615	202,869	201,260	196,590

Alternative 5 minus Second Basis of Comparison

Statistic	Monthly WUA (Feet2)				
	Dec	Jan	Feb	Mar	Apr
Probability of Exceedance[a]					
10%	0	0	5,150	0	**-1,058**
20%	0	0	8,186	**-4,112**	**-2,271**
30%	1,851	**-462**	5,840	1,814	**-7,278**
40%	2,913	**-1,573**	8,830	**-452**	**-14,072**
50%	8,943	10,245	0	0	**-34,819**
60%	12,495	**-5,378**	8,243	0	0
70%	0	**-5,531**	2,304	**-166**	**-955**
80%	10,993	**-746**	**-606**	4,824	**-188**
90%	12,225	0	0	391	0
Long Term					
Full Simulation Period[b]	5,884	**-1,110**	3,851	773	**-4,435**
Water Year Types[c]					
Wet (32%)	10,430	414	3,895	**-61**	**-92**
Above Normal (16%)	7,615	5,980	4,885	2,763	**-275**
Below Normal (13%)	1,234	**-12,438**	11,927	**-432**	**-10,434**
Dry (24%)	5,832	3,601	4,155	**-466**	**-4,092**
Critical (15%)	**-1,490**	**-9,559**	**-5,274**	3,594	**-13,423**

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

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Appendix 9F

Reservoir Fish Analysis Documentation

This appendix provides information about the methods and assumptions used for the Coordinated Long Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis of reservoir fish. It is organized in two main sections:

- Section 9F.1: Reservoir Fish Analysis Methodology and Assumptions
  - The reservoir fish impacts analysis uses modeled monthly reservoir elevations to develop rates of water level change to evaluate the effects on reservoir fish that spawn in the nearshore areas. The species analyzed were Largemouth Bass, Smallmouth Bass, and Spotted Bass. This section describes the overall analytical approach and assumptions.
- Section 9F.2: Reservoir Fish Analysis Results
  - This section presents the survival estimates for each reservoir and fish species evaluated during the spawning period. Statistics are presented in exceedance plots and in tabular format.

9F.1 Reservoir Fish Analysis Methodology and Assumptions

9F.1.1 Reservoir Fish Analysis Methodology

Reservoir storage and surface water elevations in the reservoirs from the CalSim II model were used to analyze the potential effects on reservoir fishes. Although aquatic habitat within the CVP and SWP water supply reservoirs may not be limiting, storage volume is used as an indicator of how much habitat is available to fish species inhabiting these reservoirs. Warm water fish species that inhabit the upper layer of these reservoirs may be affected by fluctuations in storage through changes in reservoir water surface elevations.

The evaluation method used to assess the influence of fluctuating water levels in the reservoirs was developed using the relationship presented in Lee (1999) and by examining literature on nest success levels found in self-sustaining populations of black bass (*Micropterus* spp.). Available literature suggests that nest failure is highly variable among water bodies and between years, but it is not uncommon to have up to 40 percent of nests fail (60 percent survival) (Scott and Crossman 1973). Many self-sustaining black bass populations in North America experience nest success (that is, the nest produces swim-up fry) rates of 21 to 96 percent, with many reported survival rates in the 40 to 60 percent range (Forbes 1981; Hunt and Annett 2002; Steinhart 2004) suggesting that much less than 100 percent survival is required to support a self-sustaining population. Based on the literature review, nest survival probability in excess of 40 percent is assumed to be sufficient to provide for a self-sustaining bass fishery.

The conceptual approach used to evaluate the effects of water surface elevation fluctuations on bass nests was based on a relationship between black bass nest success and water surface elevation reductions developed by Lee (1999) from research conducted on five California reservoirs. Lee (1999) examined the relationship between water surface elevation fluctuation rates and nesting success for Black Bass, and developed nest survival curves for Largemouth, Smallmouth, and Spotted bass. The equations corresponding to the relationship curves are the following:

- *Largemouth Bass Y = -56.378*ln(X)-102.59*
- *Smallmouth Bass Y = -46.466*ln(X)-83.34*
- *Spotted Bass Y = -79.095*ln(X)-94.162*
  - where: X is the fluctuation rate (meter/day) and Y is the percentage of successful nests

Based on the work by Lee (1999), the maximum receding water level rate providing 100 percent successful nesting varied among species, with receding water level rates of less than 0.02, less than 0.01, and less than 0.065 meters per day (m/day) providing successful nesting of 100 percent of the Largemouth Bass, Smallmouth Bass, and Spotted Bass, nests, respectively. Recession rates of 0.07, 0.06, and 0.17 m/day would allow for successful nesting of 50 percent of the Largemouth Bass, Smallmouth Bass, and Spotted Bass, nests, respectively.

For this analysis, water surface elevations at the end of each month from the CalSim II model output were used to calculate the monthly, and subsequently, daily fluctuation rates used to compute the percentage of successful nests using the equations from Lee (1999). CalSim II reports end-of-month (EOM) water surface elevations; therefore, water surface elevations from February through June were used in this analysis (that is, the March fluctuation rate is equal to the March EOM elevation minus the February EOM elevation). The average daily fluctuation rate used as “X” in the equations presented previously to compute the percentage of successful nests during that month was approximated by use of the monthly change in elevation divided by the number of days in that month. The percentage of successful nests was computed based on the equations from Lee (1999) for each month of the potential spawning season for these species.

This assessment is not intended to predict the absolute rate of survival in Black Bass nests, but rather to provide the basis for evaluating the relative differences among alternatives. These results should be viewed as indicators of the relative performance of the alternatives evaluated.

9F.1.2 Reservoir Fish Analysis Scenario Assumptions

This section describes the assumptions for the Reservoir Fish Analysis for the No Action Alternative, Second Basis of Comparison, and other alternatives.

The following CalSim II model simulations were performed as the basis for evaluating the impacts of the Alternatives 1 through 5 as compared to the No

Action Alternative, and the No Action Alternative and Alternatives 1 through 5 as compared to the Second Basis of Comparison:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 5

Assumptions for each of these alternatives were developed with the surface water modeling tools and are described in Appendix 5A, Section B.

Alternative 1 modeling assumptions are the same as those for the Second Basis of Comparison and Alternative 2 modeling assumptions are the same as those for the No Action Alternative; therefore, the assumptions for those alternatives are not discussed separately in this document.

Assumptions for each of these alternatives are reflected to monthly CalSim II reservoir storage elevations that are used in the Reservoir Fish analysis described in this section.

9F.2 Reservoir Fish Results

Results are provided for each of the following runs separately:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1
- Alternative 3
- Alternative 5

In addition, the same statistics are provided for the following comparisons to establish changes of the alternative with respect to one of the bases of comparison:

- Alternative 1 compared to No Action Alternative
- Alternative 3 compared to No Action Alternative
- Alternative 5 compared to No Action Alternative

- No Action Alternative compared to Second Basis of Comparison
- Alternative 1 compared to Second Basis of Comparison
- Alternative 3 compared to Second Basis of Comparison
- Alternative 5 compared to Second Basis of Comparison

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

The first set of results is provided as probability exceedance curves of nest survival percentage for each reservoir and species of bass. For this analysis, exceedance plots for the percentage of nest survival were generated based on the 82-year CalSim II time period for each of the alternatives and bases of comparison. Differences among alternatives were evaluated using the exceedance probability corresponding to varying levels of survival.

The second set of results is provided as tables summarizing the monthly nest survival percentage for each reservoir and species of bass (as described previously) with monthly exceedance probabilities and long-term averages over the entire CalSim II simulation period. Averages are also provided by water year type.

Exceedance plots and tables, numbered to correspond to the following model results, are presented at the end of this appendix:

- B.1. Trinity Largemouth Bass Survival Percentage
- B.2. Trinity Smallmouth Bass Survival Percentage
- B.3. Trinity Spotted Bass Survival Percentage
- B.4. Shasta Largemouth Bass Survival Percentage
- B.5. Shasta Smallmouth Bass Survival Percentage
- B.6. Shasta Spotted Bass Survival Percentage
- B.7. Oroville Largemouth Bass Survival Percentage
- B.8. Oroville Smallmouth Bass Survival Percentage
- B.9. Oroville Spotted Bass Survival Percentage
- B.10. Folsom Largemouth Bass Survival Percentage
- B.11. Folsom Smallmouth Bass Survival Percentage
- B.12. Folsom Spotted Bass Survival Percentage
- B.13. New Melones Largemouth Bass Survival Percentage
- B.14. New Melones Smallmouth Bass Survival Percentage
- B.15. New Melones Spotted Bass Survival Percentage

9F.3 References

Forbes, A. 1981. *Review of Smallmouth Bass (Micropterus dolomieui) Spawning Requirements and First Year Survival in Lakes*. Wisconsin Department of Natural Resources Research Report 111.

Hunt, J. and C.A. Annett. 2002. *Effects of habitat manipulation on reproductive success of individual largemouth bass in an Ozark Reservoir*. North American Journal of Fisheries Management 22:1201-1208.

Lee, D.P. 1999. *Water Level Fluctuation Criteria for Black Bass in California Reservoirs*. California Department of Fish and Game. Reservoir Research and Management Project–Informational Leaflet No. 12. 12 pp.

Scott, W.B. and E.J. Crossman, 1973. *Freshwater fishes of Canada*. Bull. Fish. Res. Board Can. 184:1-966.

Steinhart, G.B. 2004. *Exploring factors affecting smallmouth bass nest success and reproductive behavior*. Ph. D. Dissertation. Department of Evolution, Ecology, and Organismal Biology. The Ohio State University.

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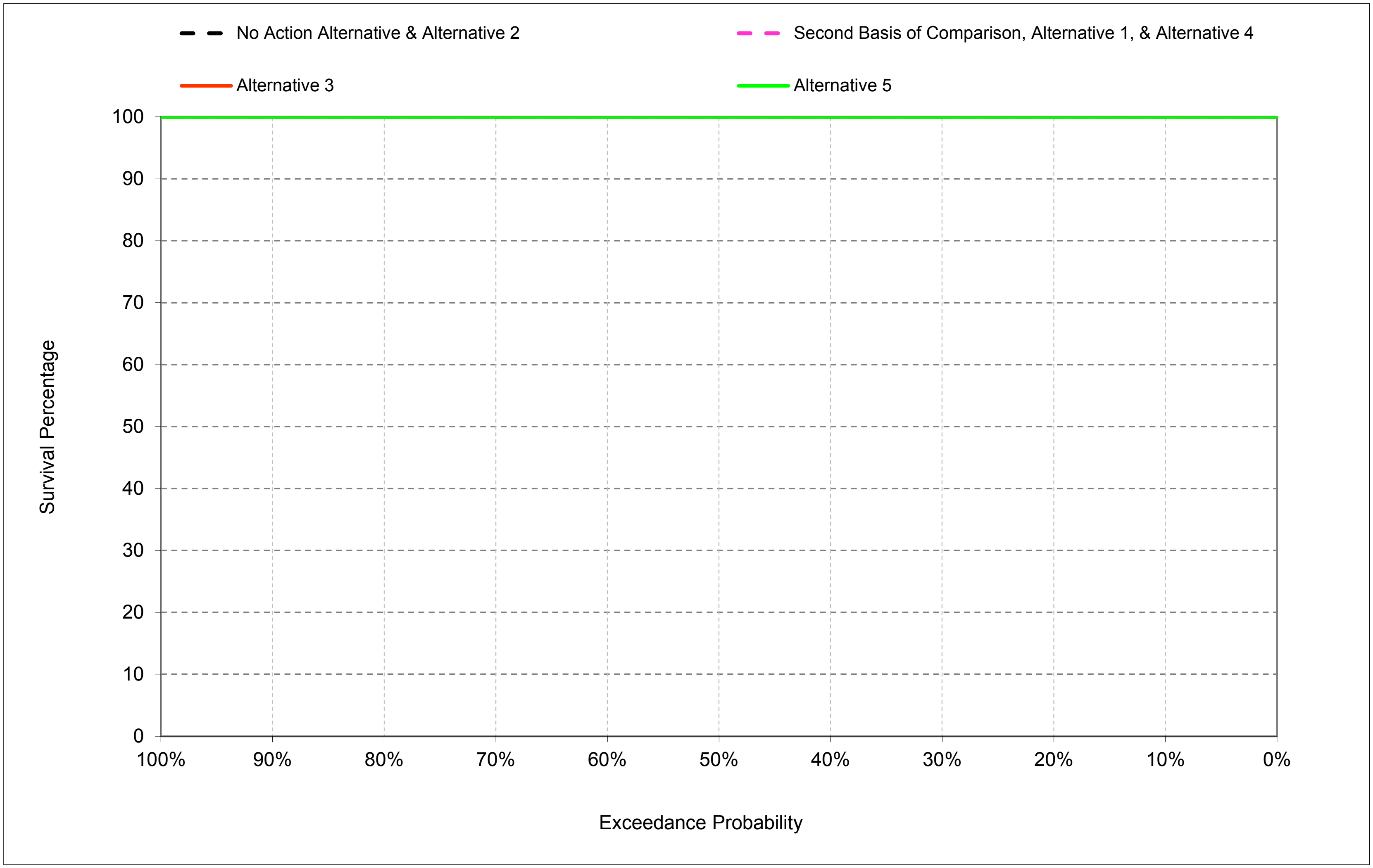
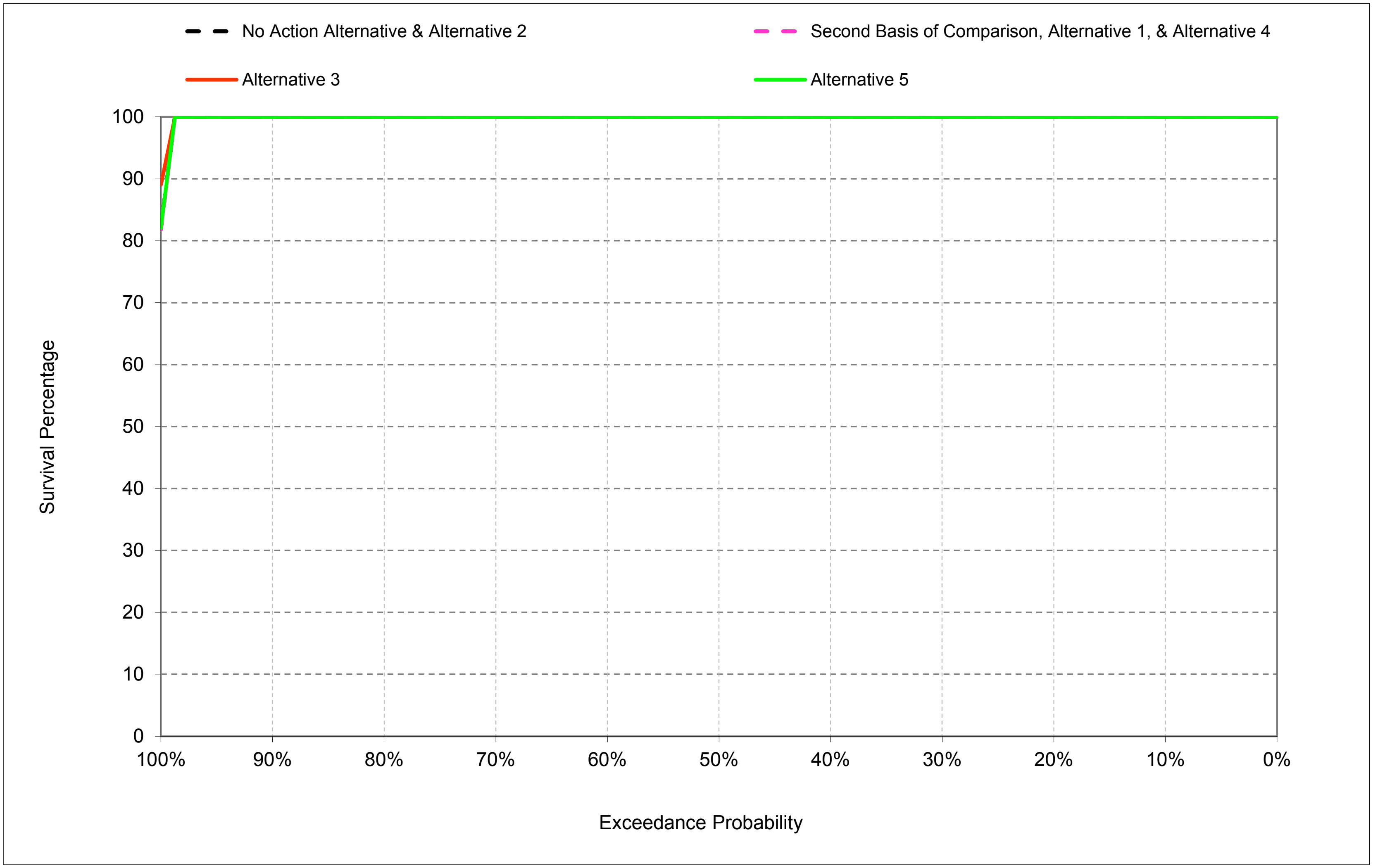
B.1. Trinity Large Mouth Bass Survival Percentage

Figure B-1-1. Trinity Large Mouth Bass Nest Survival Percentage, March



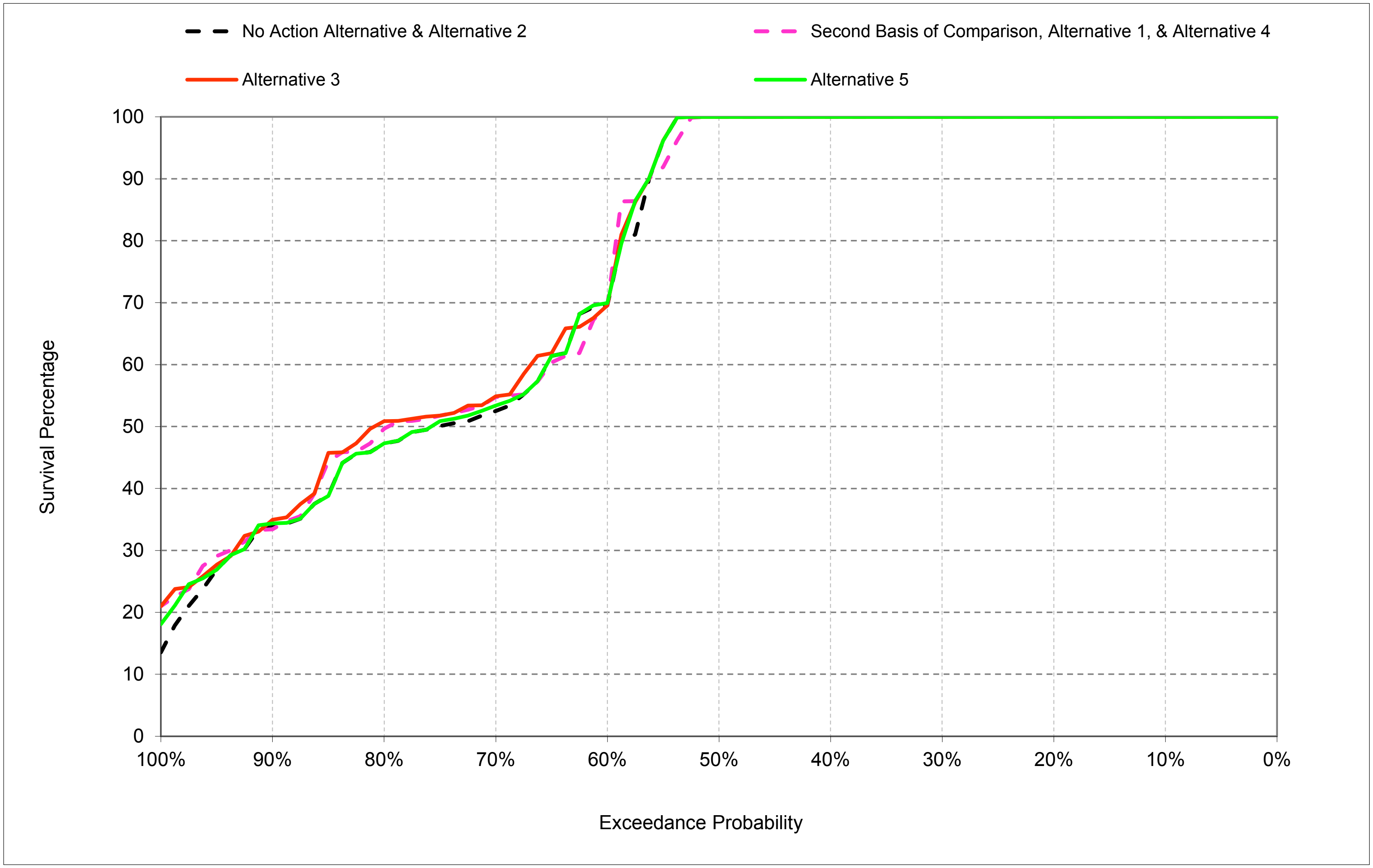
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-2. Trinity Large Mouth Bass Nest Survival Percentage, April



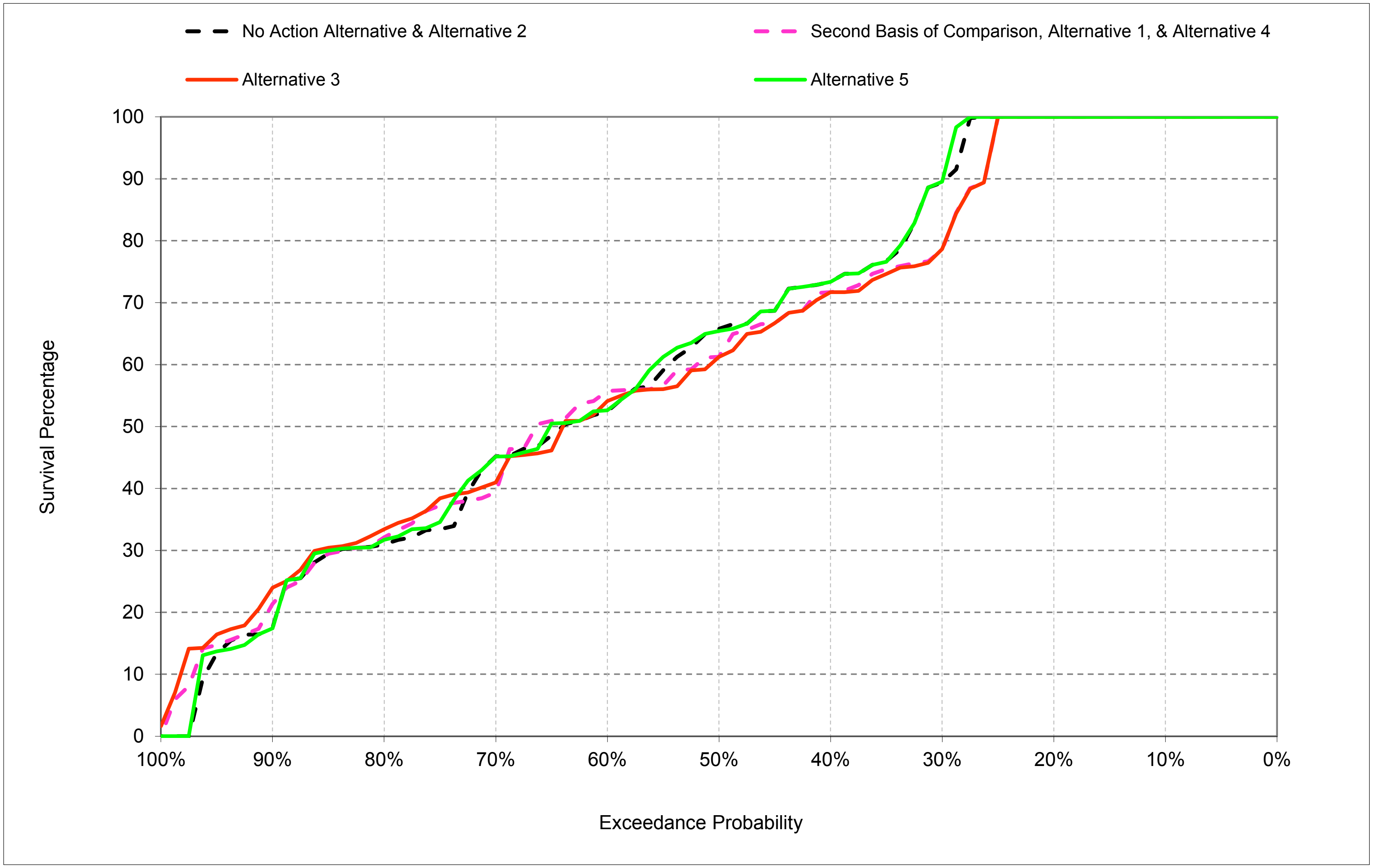
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-3. Trinity Large Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-1-4. Trinity Large Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-1. Trinity Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	89
40%	100	100	100	73
50%	100	100	100	65
60%	100	100	69	52
70%	100	100	52	44
80%	100	100	46	31
90%	100	100	33	17
Long Term				
Full Simulation Period[b]	100	100	76	62
Water Year Types[c]				
Wet (32%)	99	100	87	72
Above Normal (16%)	100	100	84	52
Below Normal (13%)	100	100	64	42
Dry (24%)	100	100	67	58
Critical (15%)	100	97	67	75

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	78
40%	100	100	100	72
50%	100	100	100	61
60%	100	100	68	55
70%	100	100	54	39
80%	100	100	48	31
90%	100	100	33	18
Long Term				
Full Simulation Period[b]	100	99	76	61
Water Year Types[c]				
Wet (32%)	99	100	87	71
Above Normal (16%)	100	100	85	51
Below Normal (13%)	100	100	66	46
Dry (24%)	100	100	68	59
Critical (15%)	100	95	69	69

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-11
40%	0	0	0	-2
50%	0	0	0	-4
60%	0	0	-1	3
70%	0	0	2	-5
80%	0	0	2	0
90%	0	0	0	1
Long Term				
Full Simulation Period[b]	0	0	1	-1
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	1	-1
Below Normal (13%)	0	0	1	4
Dry (24%)	0	0	0	0
Critical (15%)	0	-2	1	-6

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-2. Trinity Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	89
40%	100	100	100	73
50%	100	100	100	65
60%	100	100	69	52
70%	100	100	52	44
80%	100	100	46	31
90%	100	100	33	17
Long Term				
Full Simulation Period[b]	100	100	76	62
Water Year Types[c]				
Wet (32%)	99	100	87	72
Above Normal (16%)	100	100	84	52
Below Normal (13%)	100	100	64	42
Dry (24%)	100	100	67	58
Critical (15%)	100	97	67	75

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	78
40%	100	100	100	71
50%	100	100	100	60
60%	100	100	68	53
70%	100	100	54	40
80%	100	100	50	32
90%	100	100	33	21
Long Term				
Full Simulation Period[b]	100	100	77	61
Water Year Types[c]				
Wet (32%)	99	100	87	71
Above Normal (16%)	100	100	86	52
Below Normal (13%)	100	100	65	42
Dry (24%)	100	100	68	60
Critical (15%)	100	98	70	70

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-11
40%	0	0	0	-2
50%	0	0	0	-5
60%	0	0	-1	1
70%	0	0	2	-3
80%	0	0	4	2
90%	0	0	0	4
Long Term				
Full Simulation Period[b]	0	0	1	-1
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	2	0
Below Normal (13%)	0	0	1	0
Dry (24%)	0	0	1	2
Critical (15%)	0	1	2	-5

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-3. Trinity Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	89
40%	100	100	100	73
50%	100	100	100	65
60%	100	100	69	52
70%	100	100	52	44
80%	100	100	46	31
90%	100	100	33	17
Long Term				
Full Simulation Period[b]	100	100	76	62
Water Year Types[c]				
Wet (32%)	99	100	87	72
Above Normal (16%)	100	100	84	52
Below Normal (13%)	100	100	64	42
Dry (24%)	100	100	67	58
Critical (15%)	100	97	67	75

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	89
40%	100	100	100	73
50%	100	100	100	65
60%	100	100	70	53
70%	100	100	53	44
80%	100	100	46	31
90%	100	100	34	17
Long Term				
Full Simulation Period[b]	100	100	76	62
Water Year Types[c]				
Wet (32%)	99	100	87	72
Above Normal (16%)	100	100	84	53
Below Normal (13%)	100	100	65	42
Dry (24%)	100	100	68	58
Critical (15%)	100	97	67	78

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	1	0
80%	0	0	0	0
90%	0	0	1	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	1	0
Dry (24%)	0	0	0	-1
Critical (15%)	0	0	0	3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-4. Trinity Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	78
40%	100	100	100	72
50%	100	100	100	61
60%	100	100	68	55
70%	100	100	54	39
80%	100	100	48	31
90%	100	100	33	18
Long Term				
Full Simulation Period[b]	100	99	76	61
Water Year Types[c]				
Wet (32%)	99	100	87	71
Above Normal (16%)	100	100	85	51
Below Normal (13%)	100	100	66	46
Dry (24%)	100	100	68	59
Critical (15%)	100	95	69	69

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	89
40%	100	100	100	73
50%	100	100	100	65
60%	100	100	69	52
70%	100	100	52	44
80%	100	100	46	31
90%	100	100	33	17
Long Term				
Full Simulation Period[b]	100	100	76	62
Water Year Types[c]				
Wet (32%)	99	100	87	72
Above Normal (16%)	100	100	84	52
Below Normal (13%)	100	100	64	42
Dry (24%)	100	100	67	58
Critical (15%)	100	97	67	75

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	11
40%	0	0	0	2
50%	0	0	0	4
60%	0	0	1	-3
70%	0	0	-2	5
80%	0	0	-2	0
90%	0	0	0	-1
Long Term				
Full Simulation Period[b]	0	0	-1	1
Water Year Types[c]				
Wet (32%)	0	0	0	1
Above Normal (16%)	0	0	-1	1
Below Normal (13%)	0	0	-1	-4
Dry (24%)	0	0	0	0
Critical (15%)	0	2	-1	6

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-5. Trinity Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	78
40%	100	100	100	72
50%	100	100	100	61
60%	100	100	68	55
70%	100	100	54	39
80%	100	100	48	31
90%	100	100	33	18
Long Term				
Full Simulation Period[b]	100	99	76	61
Water Year Types[c]				
Wet (32%)	99	100	87	71
Above Normal (16%)	100	100	85	51
Below Normal (13%)	100	100	66	46
Dry (24%)	100	100	68	59
Critical (15%)	100	95	69	69

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	78
40%	100	100	100	71
50%	100	100	100	60
60%	100	100	68	53
70%	100	100	54	40
80%	100	100	50	32
90%	100	100	33	21
Long Term				
Full Simulation Period[b]	100	100	77	61
Water Year Types[c]				
Wet (32%)	99	100	87	71
Above Normal (16%)	100	100	86	52
Below Normal (13%)	100	100	65	42
Dry (24%)	100	100	68	60
Critical (15%)	100	98	70	70

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	-1
60%	0	0	0	-2
70%	0	0	0	2
80%	0	0	2	2
90%	0	0	0	3
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	1	1
Below Normal (13%)	0	0	0	-4
Dry (24%)	0	0	0	1
Critical (15%)	0	3	1	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-1-6. Trinity Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	78
40%	100	100	100	72
50%	100	100	100	61
60%	100	100	68	55
70%	100	100	54	39
80%	100	100	48	31
90%	100	100	33	18
Long Term				
Full Simulation Period[b]	100	99	76	61
Water Year Types[c]				
Wet (32%)	99	100	87	71
Above Normal (16%)	100	100	85	51
Below Normal (13%)	100	100	66	46
Dry (24%)	100	100	68	59
Critical (15%)	100	95	69	69

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	89
40%	100	100	100	73
50%	100	100	100	65
60%	100	100	70	53
70%	100	100	53	44
80%	100	100	46	31
90%	100	100	34	17
Long Term				
Full Simulation Period[b]	100	100	76	62
Water Year Types[c]				
Wet (32%)	99	100	87	72
Above Normal (16%)	100	100	84	53
Below Normal (13%)	100	100	65	42
Dry (24%)	100	100	68	58
Critical (15%)	100	97	67	78

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	11
40%	0	0	0	2
50%	0	0	0	4
60%	0	0	2	-2
70%	0	0	-1	5
80%	0	0	-2	0
90%	0	0	1	-1
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	1
Above Normal (16%)	0	0	0	2
Below Normal (13%)	0	0	0	-4
Dry (24%)	0	0	0	-1
Critical (15%)	0	2	-1	9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

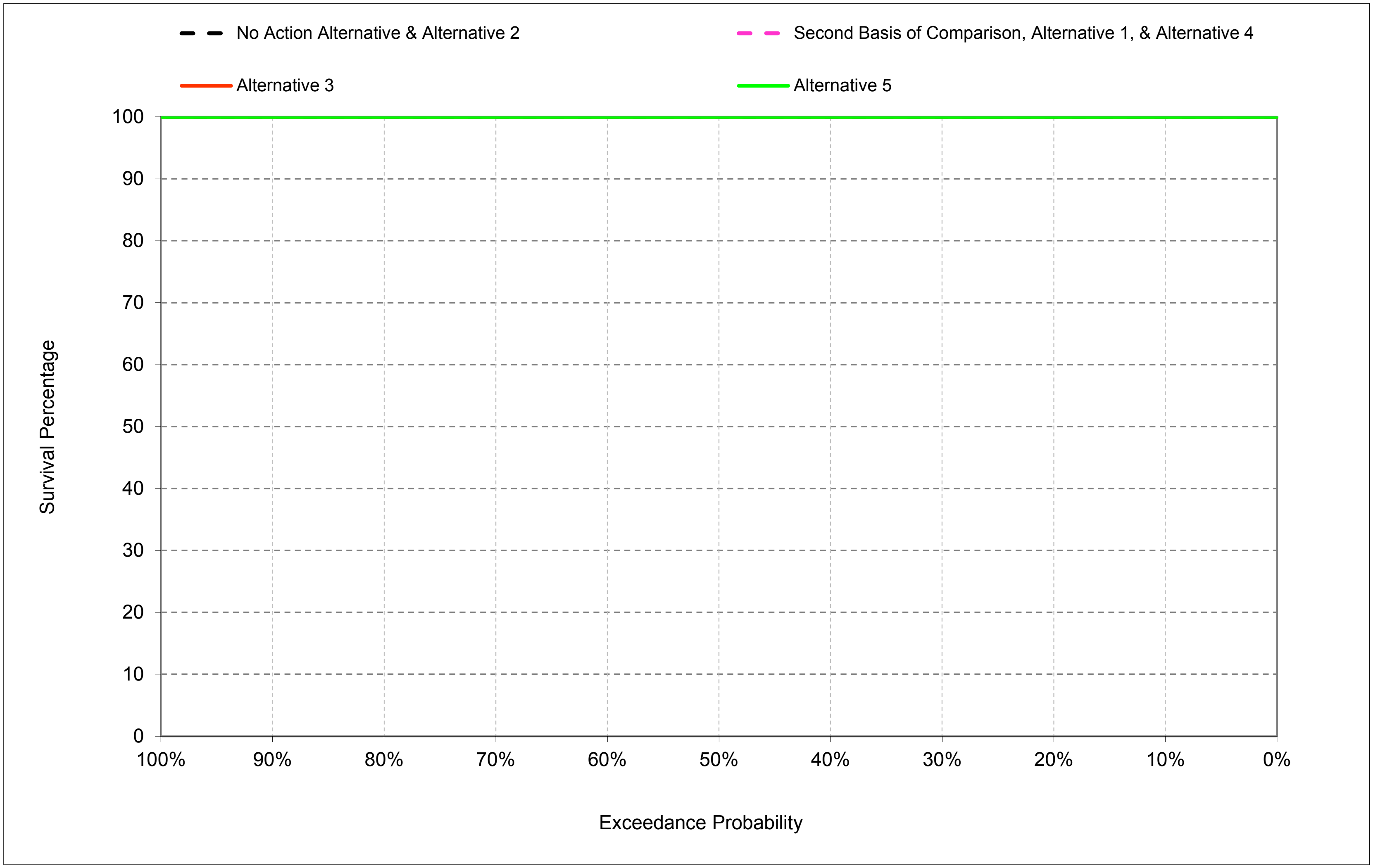
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

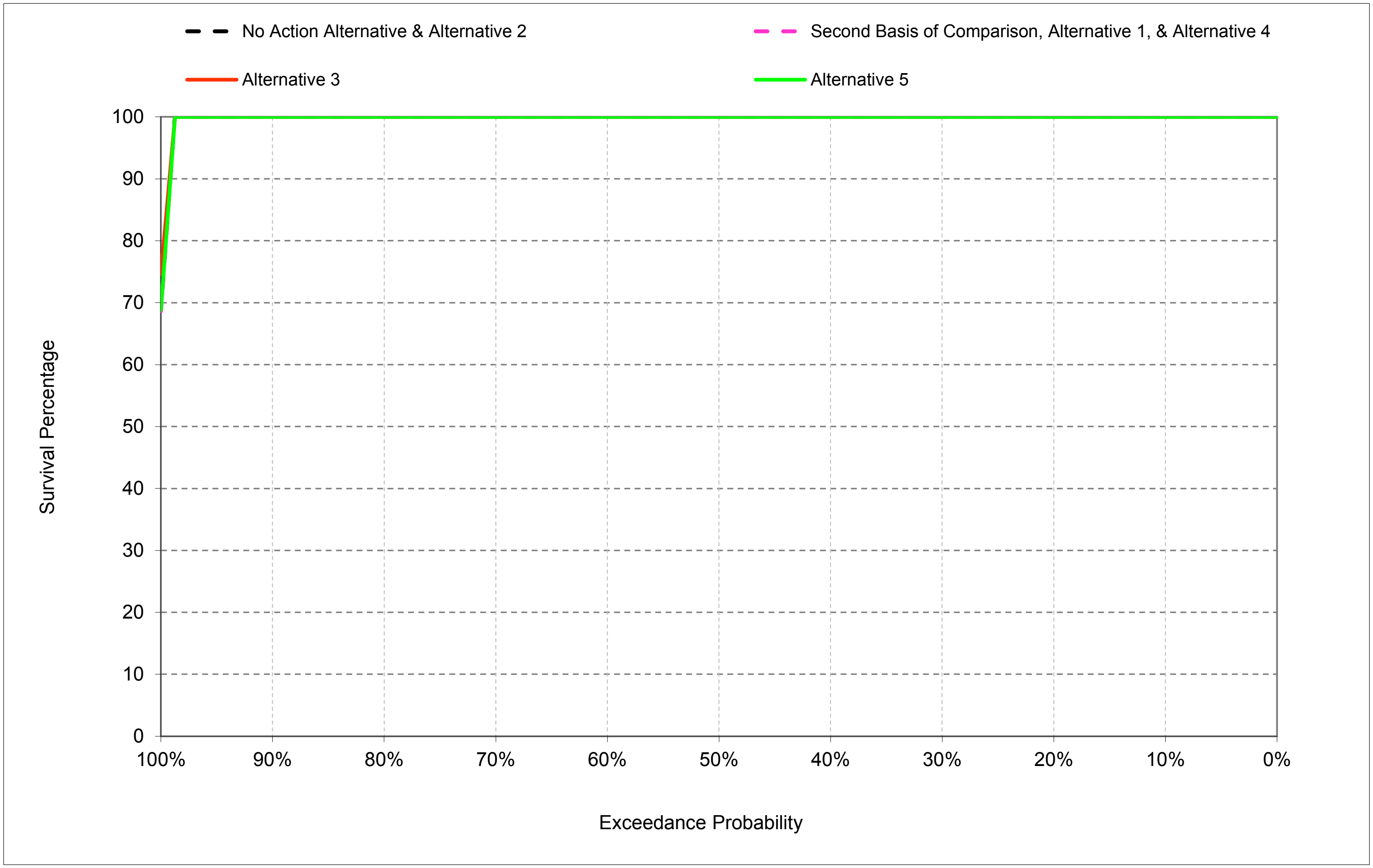
B.2. Trinity Small Mouth Bass Survival Percentage

Figure B-2-1. Trinity Small Mouth Bass Nest Survival Percentage, March



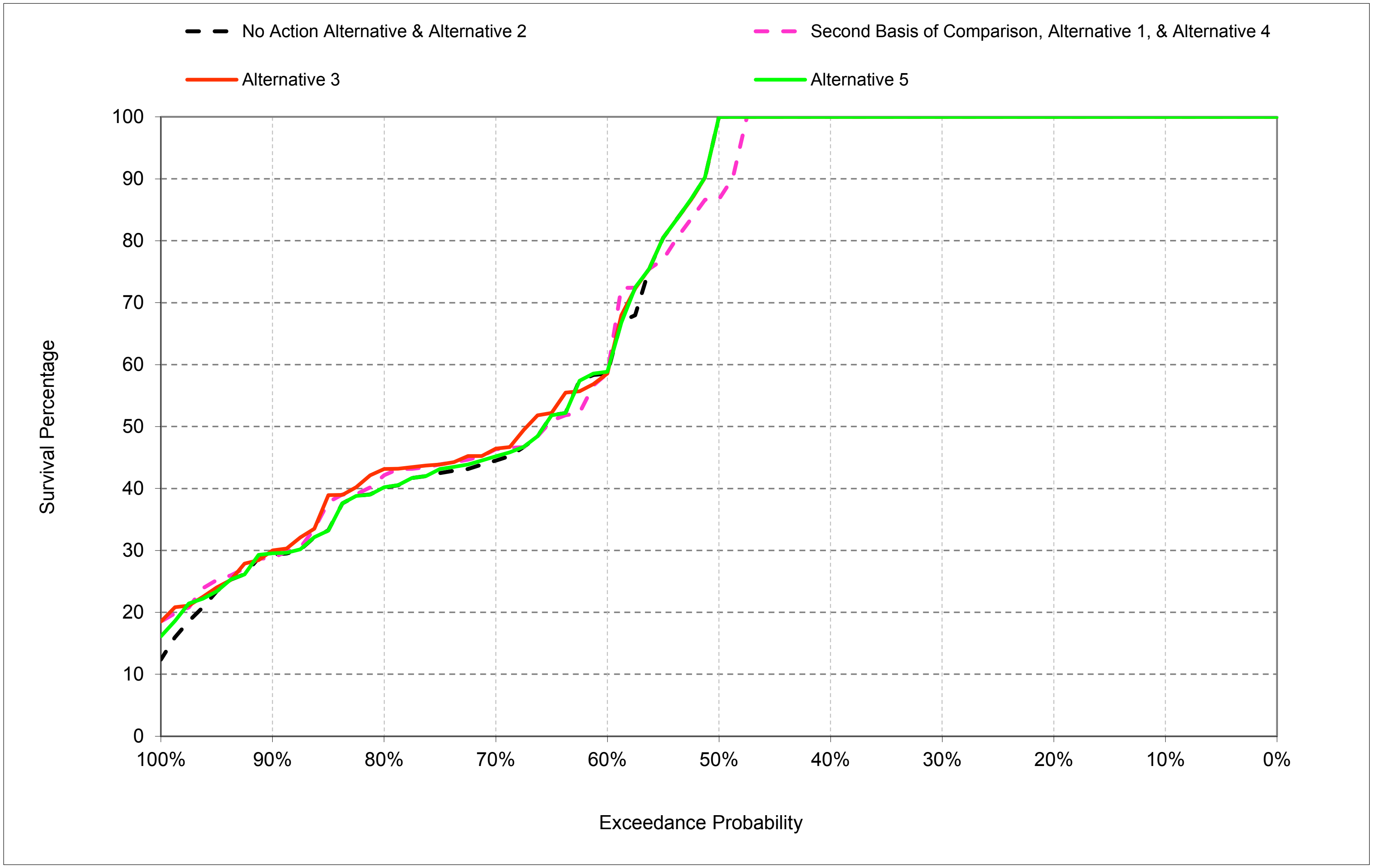
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-2. Trinity Small Mouth Bass Nest Survival Percentage, April



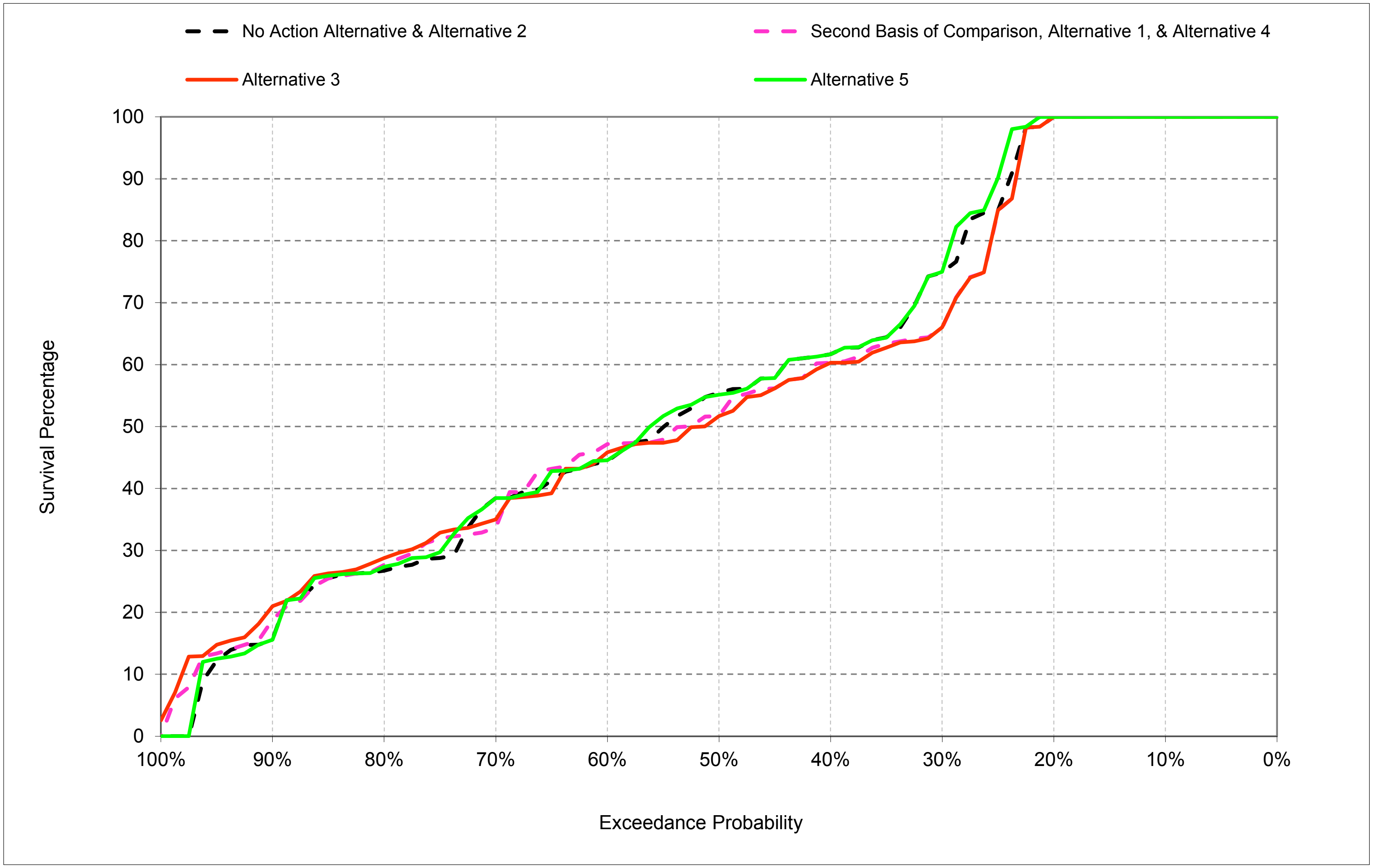
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-3. Trinity Small Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-2-4. Trinity Small Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-1. Trinity Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	75
40%	100	100	100	62
50%	100	100	95	55
60%	100	100	58	44
70%	100	100	44	37
80%	100	100	39	26
90%	100	100	29	15
Long Term				
Full Simulation Period[b]	100	99	72	56
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	80	47
Below Normal (13%)	100	100	59	37
Dry (24%)	100	100	63	51
Critical (15%)	100	95	62	70

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	65
40%	100	100	100	60
50%	100	100	87	52
60%	100	100	57	46
70%	100	100	46	33
80%	100	100	41	27
90%	100	100	29	16
Long Term				
Full Simulation Period[b]	100	99	72	55
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	81	46
Below Normal (13%)	100	100	60	41
Dry (24%)	100	100	63	52
Critical (15%)	100	93	62	63

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-9
40%	0	0	0	-1
50%	0	0	-8	-3
60%	0	0	-1	2
70%	0	0	1	-4
80%	0	0	1	0
90%	0	0	0	1
Long Term				
Full Simulation Period[b]	0	0	0	-1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	1	-1
Below Normal (13%)	0	0	1	3
Dry (24%)	0	0	0	1
Critical (15%)	0	-2	0	-6

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-2. Trinity Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	75
40%	100	100	100	62
50%	100	100	95	55
60%	100	100	58	44
70%	100	100	44	37
80%	100	100	39	26
90%	100	100	29	15
Long Term				
Full Simulation Period[b]	100	99	72	56
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	80	47
Below Normal (13%)	100	100	59	37
Dry (24%)	100	100	63	51
Critical (15%)	100	95	62	70

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	65
40%	100	100	100	60
50%	100	100	95	51
60%	100	100	58	45
70%	100	100	46	35
80%	100	100	42	28
90%	100	100	29	18
Long Term				
Full Simulation Period[b]	100	99	73	56
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	82	47
Below Normal (13%)	100	100	60	37
Dry (24%)	100	100	64	53
Critical (15%)	100	95	64	64

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-9
40%	0	0	0	-2
50%	0	0	0	-4
60%	0	0	-1	1
70%	0	0	2	-3
80%	0	0	3	2
90%	0	0	0	4
Long Term				
Full Simulation Period[b]	0	0	1	-1
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	1	0
Below Normal (13%)	0	0	1	0
Dry (24%)	0	0	1	2
Critical (15%)	0	0	2	-5

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-3. Trinity Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	75
40%	100	100	100	62
50%	100	100	95	55
60%	100	100	58	44
70%	100	100	44	37
80%	100	100	39	26
90%	100	100	29	15
Long Term				
Full Simulation Period[b]	100	99	72	56
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	80	47
Below Normal (13%)	100	100	59	37
Dry (24%)	100	100	63	51
Critical (15%)	100	95	62	70

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	75
40%	100	100	100	62
50%	100	100	95	55
60%	100	100	59	44
70%	100	100	45	37
80%	100	100	39	27
90%	100	100	29	15
Long Term				
Full Simulation Period[b]	100	99	72	57
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	81	47
Below Normal (13%)	100	100	60	38
Dry (24%)	100	100	64	51
Critical (15%)	100	95	62	72

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	1	0
80%	0	0	0	0
90%	0	0	1	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	1	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-4. Trinity Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	65
40%	100	100	100	60
50%	100	100	87	52
60%	100	100	57	46
70%	100	100	46	33
80%	100	100	41	27
90%	100	100	29	16
Long Term				
Full Simulation Period[b]	100	99	72	55
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	81	46
Below Normal (13%)	100	100	60	41
Dry (24%)	100	100	63	52
Critical (15%)	100	93	62	63

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	75
40%	100	100	100	62
50%	100	100	95	55
60%	100	100	58	44
70%	100	100	44	37
80%	100	100	39	26
90%	100	100	29	15
Long Term				
Full Simulation Period[b]	100	99	72	56
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	80	47
Below Normal (13%)	100	100	59	37
Dry (24%)	100	100	63	51
Critical (15%)	100	95	62	70

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	9
40%	0	0	0	1
50%	0	0	8	3
60%	0	0	1	-2
70%	0	0	-1	4
80%	0	0	-1	0
90%	0	0	0	-1
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	-1	1
Below Normal (13%)	0	0	-1	-3
Dry (24%)	0	0	0	-1
Critical (15%)	0	2	0	6

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-5. Trinity Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	65
40%	100	100	100	60
50%	100	100	87	52
60%	100	100	57	46
70%	100	100	46	33
80%	100	100	41	27
90%	100	100	29	16
Long Term				
Full Simulation Period[b]	100	99	72	55
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	81	46
Below Normal (13%)	100	100	60	41
Dry (24%)	100	100	63	52
Critical (15%)	100	93	62	63

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	65
40%	100	100	100	60
50%	100	100	95	51
60%	100	100	58	45
70%	100	100	46	35
80%	100	100	42	28
90%	100	100	29	18
Long Term				
Full Simulation Period[b]	100	99	73	56
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	82	47
Below Normal (13%)	100	100	60	37
Dry (24%)	100	100	64	53
Critical (15%)	100	95	64	64

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	8	-1
60%	0	0	0	-2
70%	0	0	0	1
80%	0	0	2	1
90%	0	0	0	3
Long Term				
Full Simulation Period[b]	0	0	1	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	1	1
Below Normal (13%)	0	0	0	-3
Dry (24%)	0	0	1	1
Critical (15%)	0	2	2	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.
b Based on the 82-year simulation period.
c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-2-6. Trinity Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	65
40%	100	100	100	60
50%	100	100	87	52
60%	100	100	57	46
70%	100	100	46	33
80%	100	100	41	27
90%	100	100	29	16
Long Term				
Full Simulation Period[b]	100	99	72	55
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	81	46
Below Normal (13%)	100	100	60	41
Dry (24%)	100	100	63	52
Critical (15%)	100	93	62	63

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	75
40%	100	100	100	62
50%	100	100	95	55
60%	100	100	59	44
70%	100	100	45	37
80%	100	100	39	27
90%	100	100	29	15
Long Term				
Full Simulation Period[b]	100	99	72	57
Water Year Types[c]				
Wet (32%)	99	100	84	66
Above Normal (16%)	100	100	81	47
Below Normal (13%)	100	100	60	38
Dry (24%)	100	100	64	51
Critical (15%)	100	95	62	72

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	9
40%	0	0	0	1
50%	0	0	8	3
60%	0	0	1	-2
70%	0	0	-1	4
80%	0	0	-1	0
90%	0	0	1	-1
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	1
Below Normal (13%)	0	0	0	-3
Dry (24%)	0	0	1	-1
Critical (15%)	0	2	0	9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

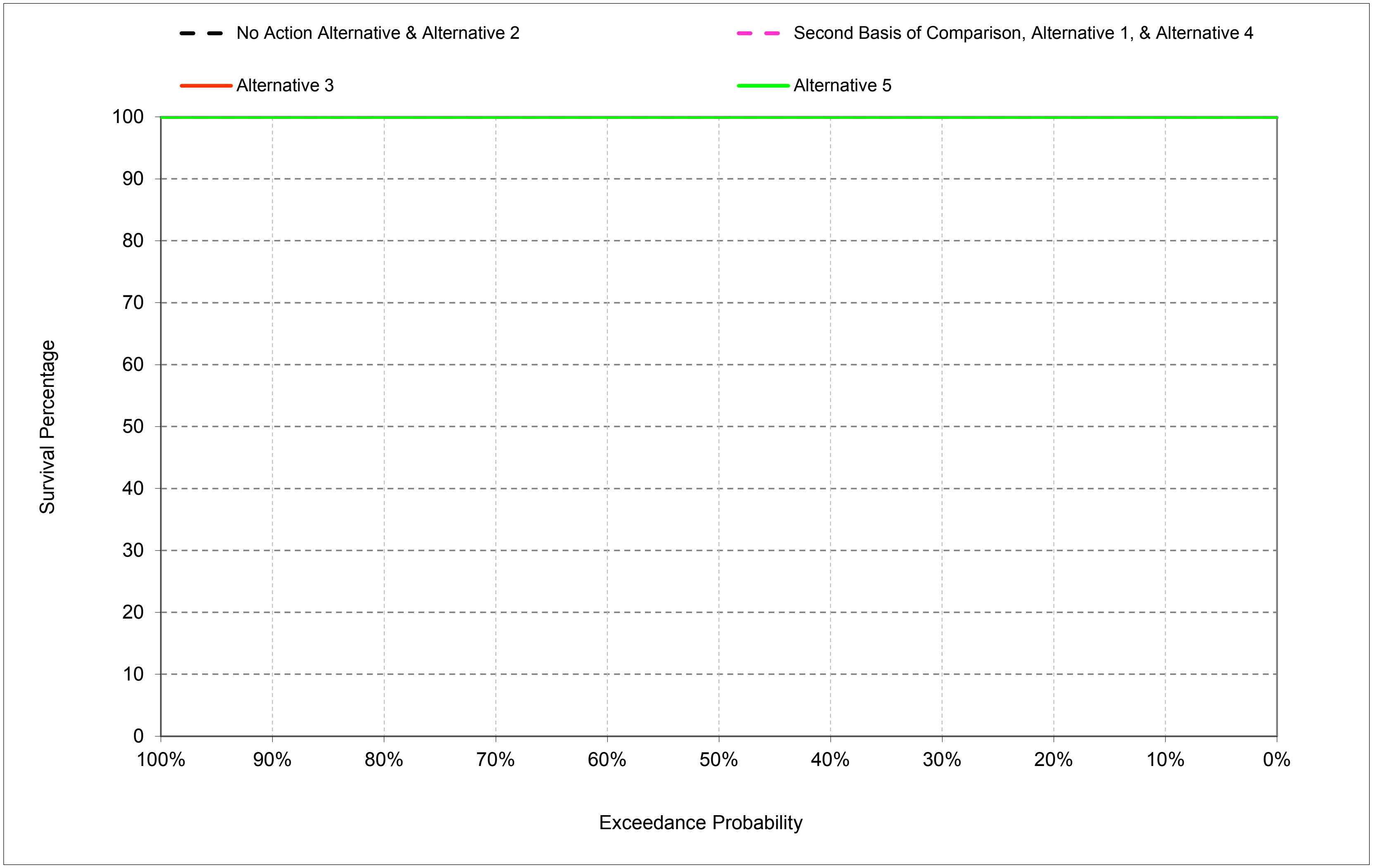
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

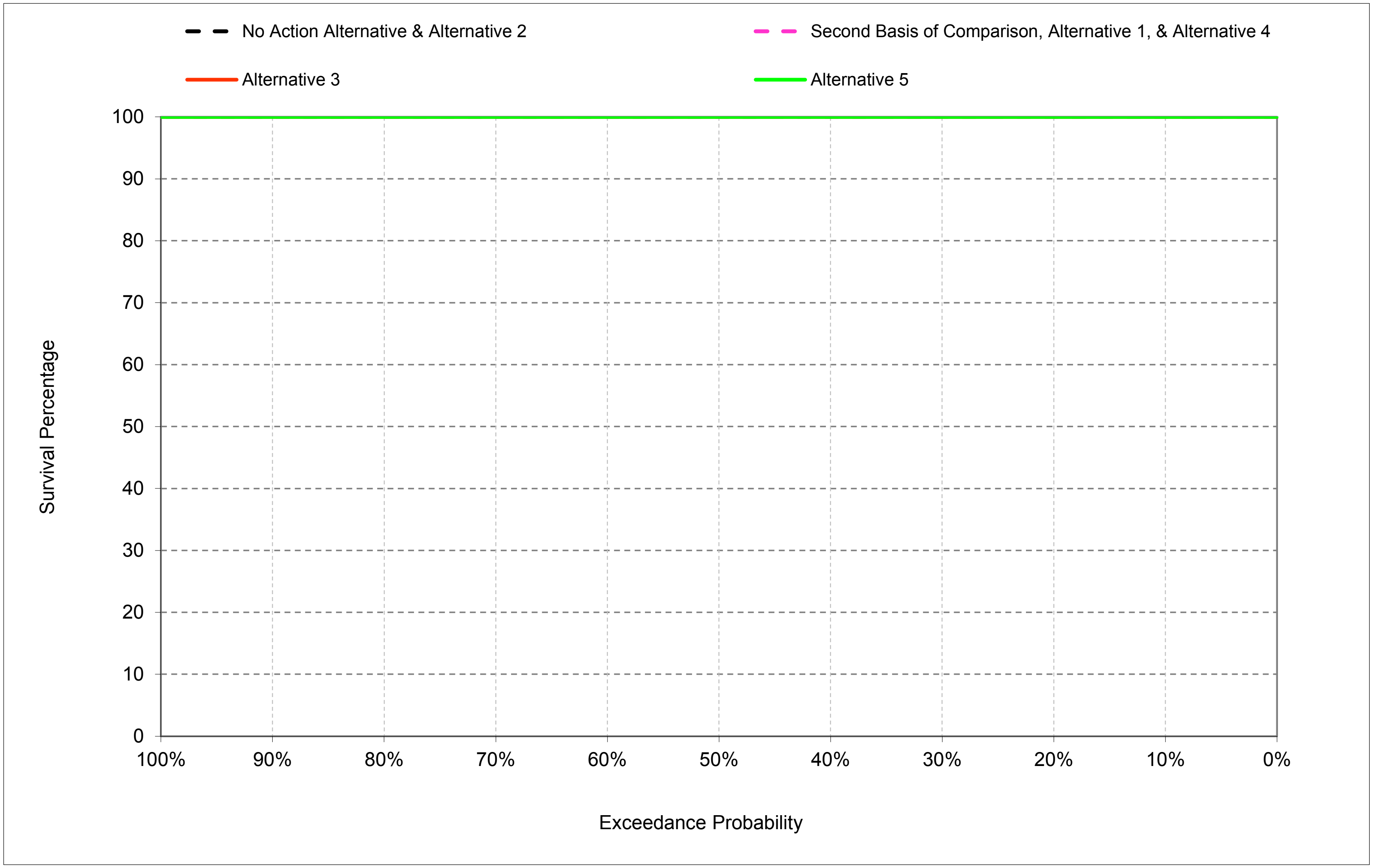
B.3. Trinity Spotted Bass Survival Percentage

Figure B-3-1. Trinity Spotted Bass Nest Survival Percentage, March



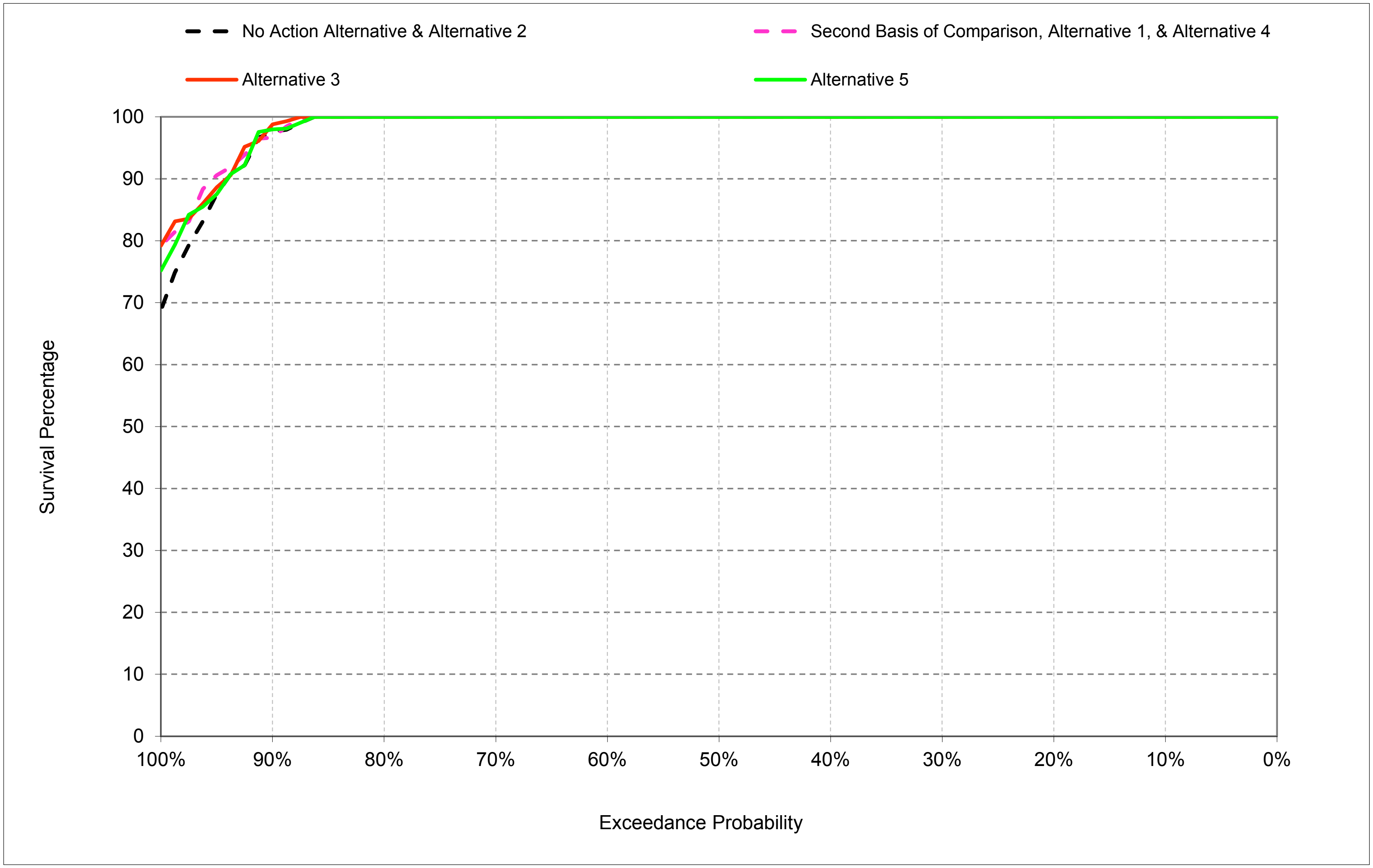
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-2. Trinity Spotted Bass Nest Survival Percentage, April



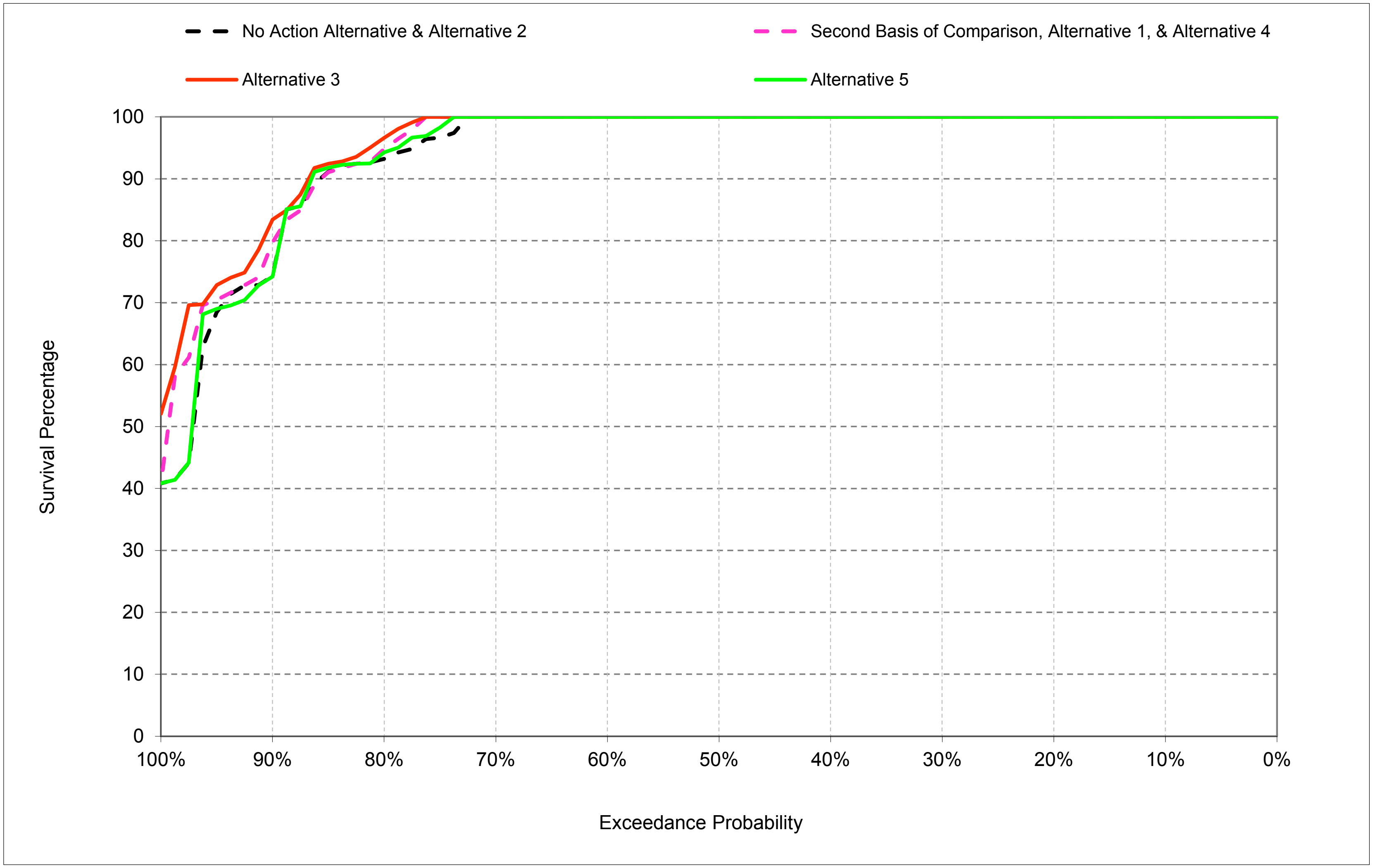
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-3. Trinity Spotted Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-3-4. Trinity Spotted Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-1. Trinity Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	73
Long Term				
Full Simulation Period[b]	100	100	98	94
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	93
Below Normal (13%)	100	100	96	89
Dry (24%)	100	100	96	90
Critical (15%)	100	100	99	99

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	75
Long Term				
Full Simulation Period[b]	100	100	98	95
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	91
Below Normal (13%)	100	100	98	89
Dry (24%)	100	100	97	96
Critical (15%)	100	100	99	99

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	**0**	2
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	**0**	**0**
Above Normal (16%)	0	0	0	**-2**
Below Normal (13%)	0	0	2	**-1**
Dry (24%)	0	0	1	5
Critical (15%)	0	0	**0**	**0**

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-2. Trinity Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	73
Long Term				
Full Simulation Period[b]	100	100	98	94
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	93
Below Normal (13%)	100	100	96	89
Dry (24%)	100	100	96	90
Critical (15%)	100	100	99	99

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	95
90%	100	100	96	79
Long Term				
Full Simulation Period[b]	100	100	98	95
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	93
Below Normal (13%)	100	100	97	90
Dry (24%)	100	100	97	96
Critical (15%)	100	100	100	100

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	3
90%	0	0	0	6
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	2	1
Dry (24%)	0	0	1	6
Critical (15%)	0	0	0	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-3. Trinity Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	73
Long Term				
Full Simulation Period[b]	100	100	98	94
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	93
Below Normal (13%)	100	100	96	89
Dry (24%)	100	100	96	90
Critical (15%)	100	100	99	99

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	98	73
Long Term				
Full Simulation Period[b]	100	100	98	94
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	97	89
Dry (24%)	100	100	96	90
Critical (15%)	100	100	99	99

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	1	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	2	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-4. Trinity Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	75
Long Term				
Full Simulation Period[b]	100	100	98	95
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	91
Below Normal (13%)	100	100	98	89
Dry (24%)	100	100	97	96
Critical (15%)	100	100	99	99

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	73
Long Term				
Full Simulation Period[b]	100	100	98	94
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	93
Below Normal (13%)	100	100	96	89
Dry (24%)	100	100	96	90
Critical (15%)	100	100	99	99

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	0	-2
Long Term				
Full Simulation Period[b]	0	0	0	-1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	2
Below Normal (13%)	0	0	-2	1
Dry (24%)	0	0	-1	-5
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-5. Trinity Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	75
Long Term				
Full Simulation Period[b]	100	100	98	95
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	91
Below Normal (13%)	100	100	98	89
Dry (24%)	100	100	97	96
Critical (15%)	100	100	99	99

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	95
90%	100	100	96	79
Long Term				
Full Simulation Period[b]	100	100	98	95
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	93
Below Normal (13%)	100	100	97	90
Dry (24%)	100	100	97	96
Critical (15%)	100	100	100	100

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	2
90%	0	0	0	4
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	2
Below Normal (13%)	0	0	-1	1
Dry (24%)	0	0	0	0
Critical (15%)	0	0	0	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-3-6. Trinity Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	97	75
Long Term				
Full Simulation Period[b]	100	100	98	95
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	91
Below Normal (13%)	100	100	98	89
Dry (24%)	100	100	97	96
Critical (15%)	100	100	99	99

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	93
90%	100	100	98	73
Long Term				
Full Simulation Period[b]	100	100	98	94
Water Year Types[c]				
Wet (32%)	100	100	98	96
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	97	89
Dry (24%)	100	100	96	90
Critical (15%)	100	100	99	99

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	0
90%	0	0	1	-2
Long Term				
Full Simulation Period[b]	0	0	0	-1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	3
Below Normal (13%)	0	0	-1	1
Dry (24%)	0	0	-1	-5
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

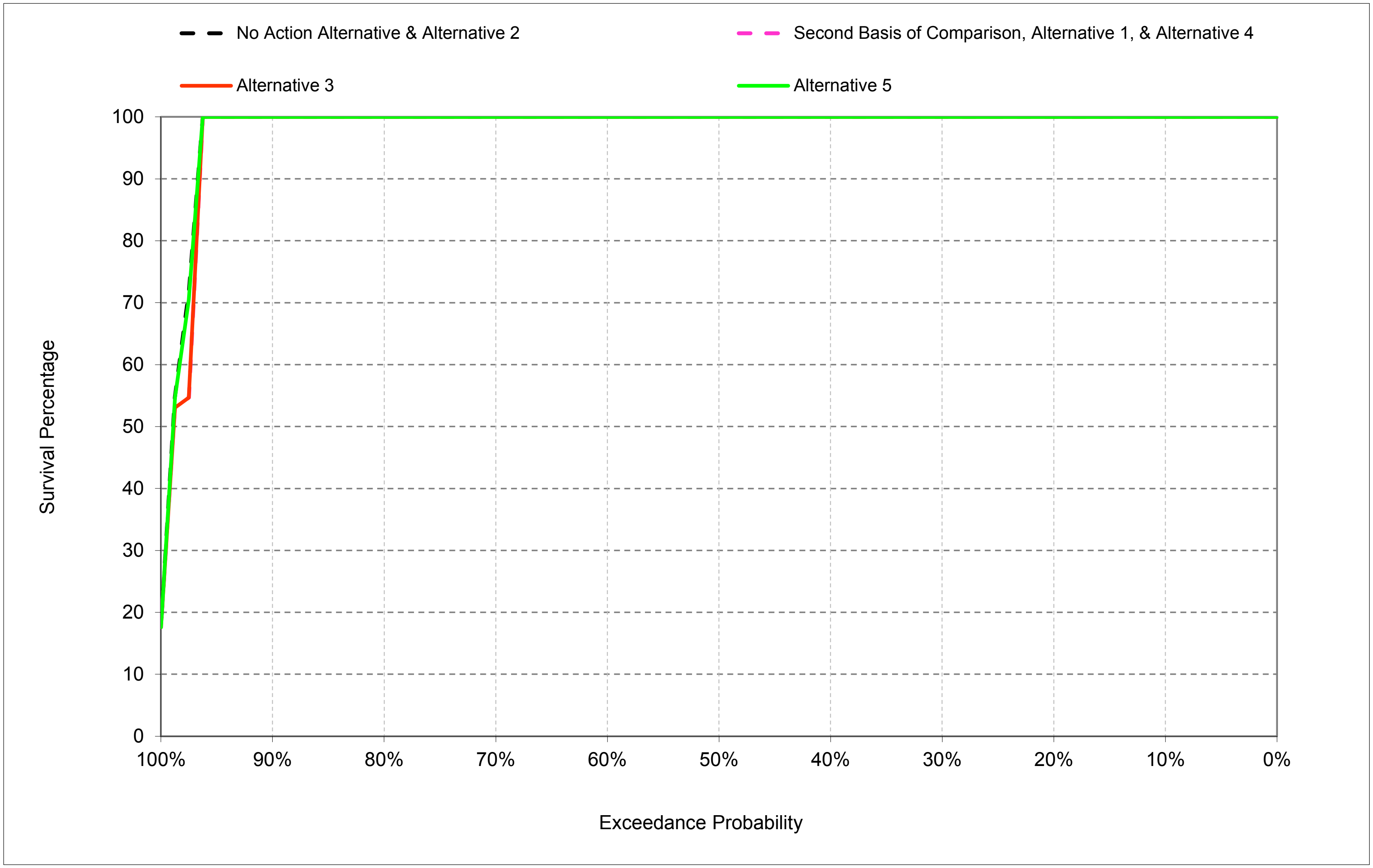
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

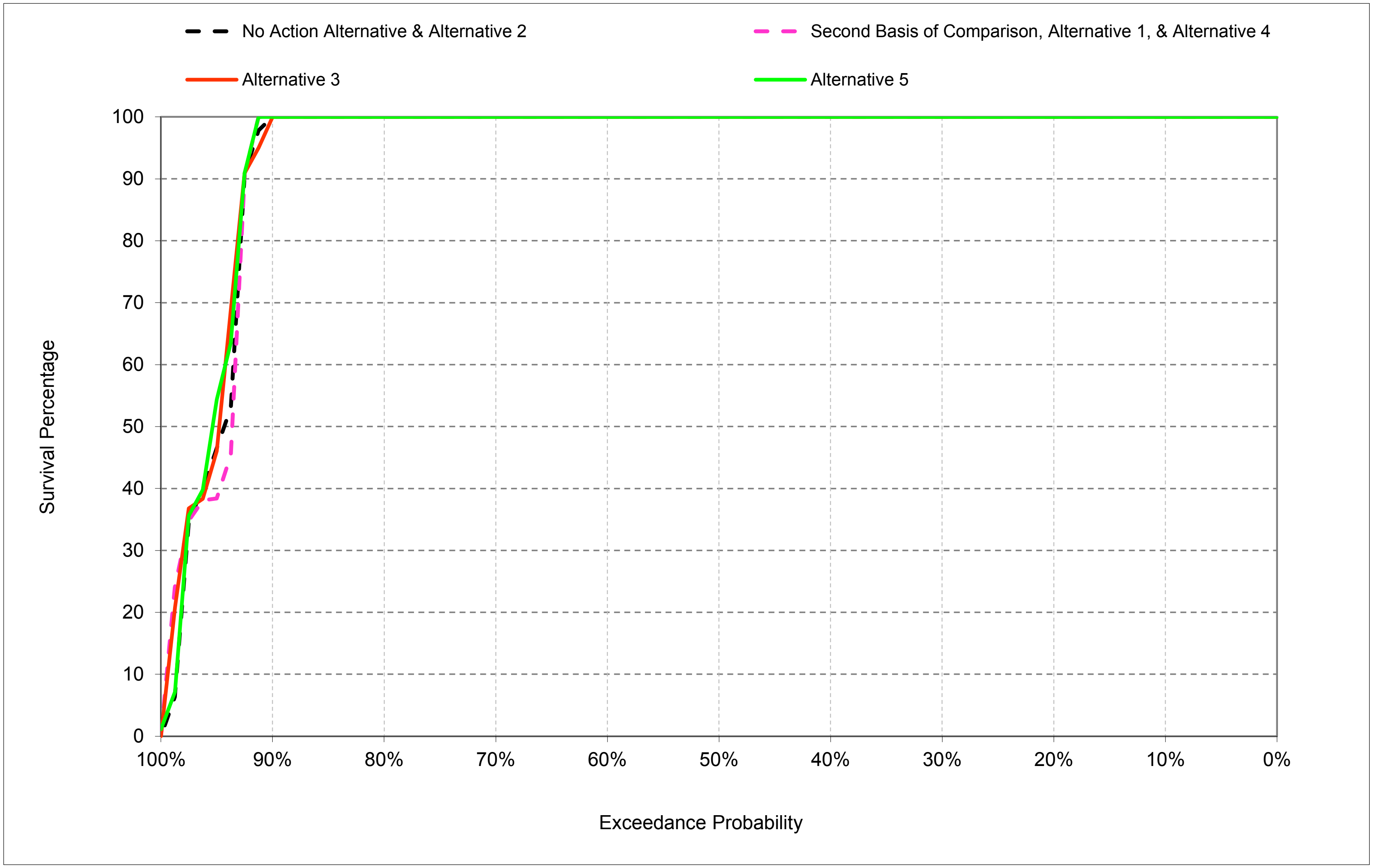
B.4. Shasta Large Mouth Bass Survival Percentage

Figure B-4-1. Shasta Large Mouth Bass Nest Survival Percentage, March



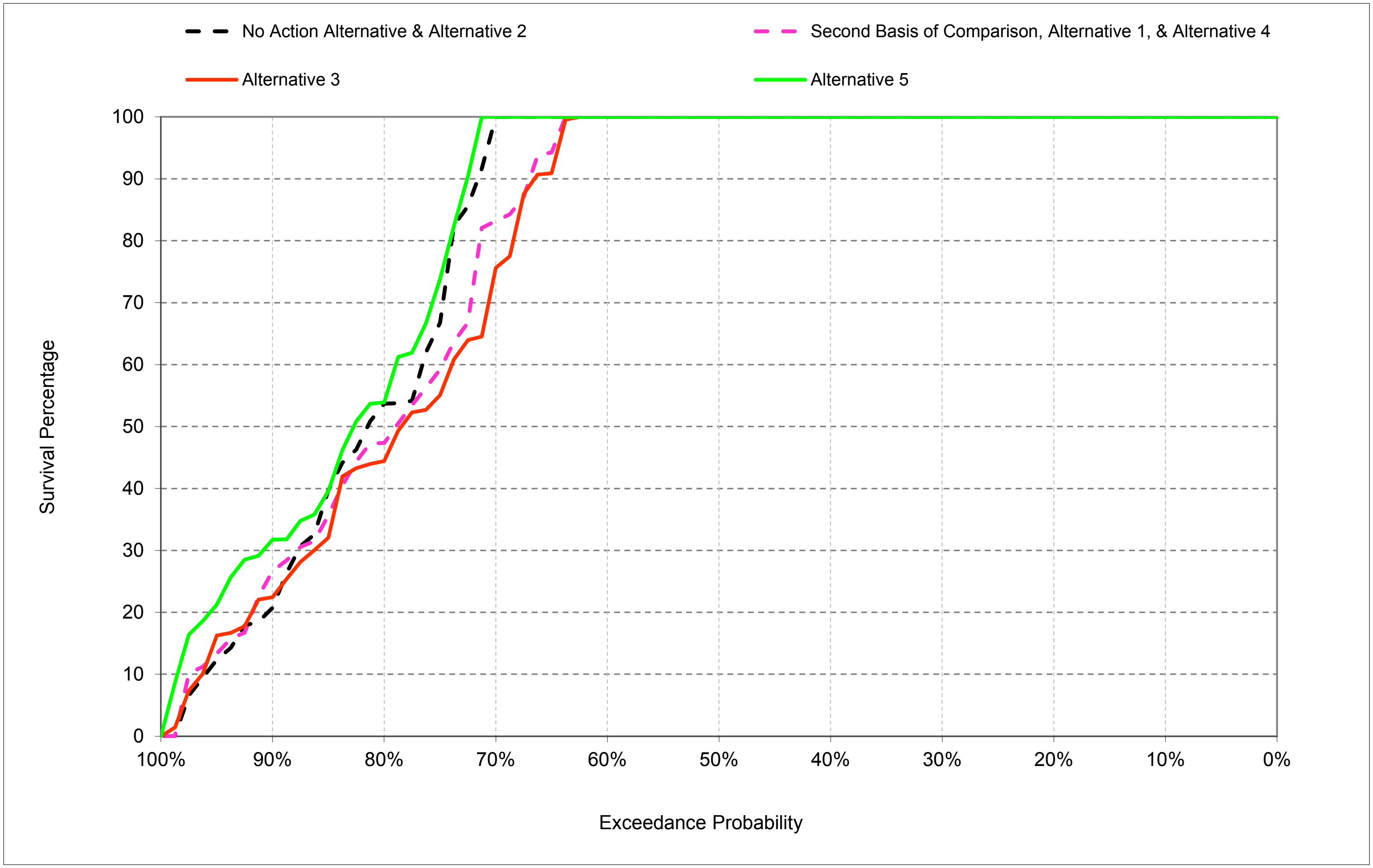
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-2. Shasta Large Mouth Bass Nest Survival Percentage, April



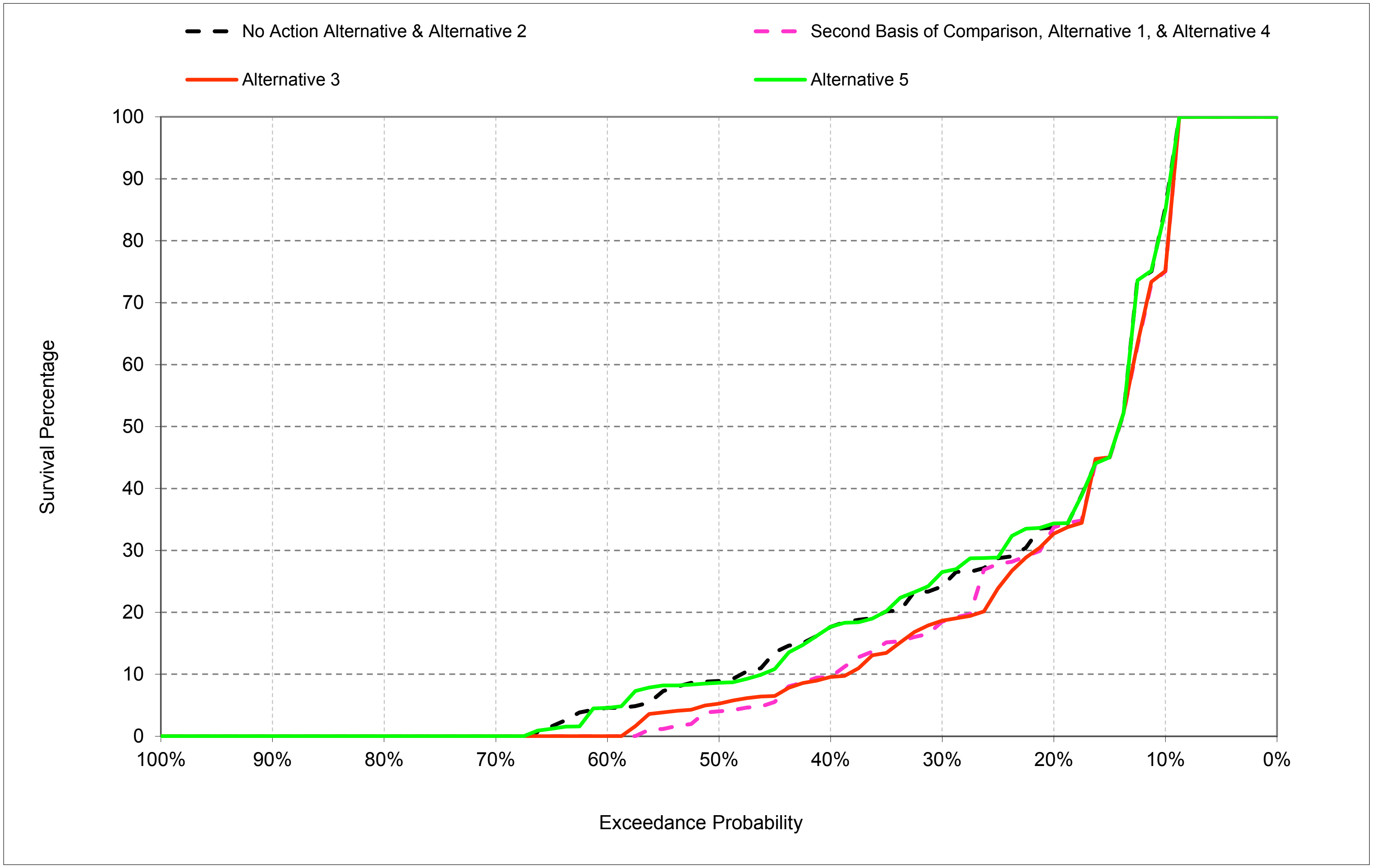
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-3. Shasta Large Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-4-4. Shasta Large Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-1. Shasta Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	84
20%	100	100	100	34
30%	100	100	100	24
40%	100	100	100	17
50%	100	100	100	9
60%	100	100	100	4
70%	100	100	94	0
80%	100	100	51	0
90%	100	98	19	0
Long Term				
Full Simulation Period[b]	97	94	81	22
Water Year Types[c]				
Wet (32%)	91	100	98	48
Above Normal (16%)	100	100	99	14
Below Normal (13%)	100	95	71	17
Dry (24%)	100	98	68	9
Critical (15%)	100	65	55	3

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	75
20%	100	100	100	33
30%	100	100	100	18
40%	100	100	100	10
50%	100	100	100	4
60%	100	100	100	0
70%	100	100	82	0
80%	100	100	47	0
90%	100	100	23	0
Long Term				
Full Simulation Period[b]	97	94	79	20
Water Year Types[c]				
Wet (32%)	90	100	97	46
Above Normal (16%)	100	100	97	11
Below Normal (13%)	100	94	64	13
Dry (24%)	100	97	68	5
Critical (15%)	100	66	54	3

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	-9
20%	0	0	0	-1
30%	0	0	0	-6
40%	0	0	0	-8
50%	0	0	0	-5
60%	0	0	0	-4
70%	0	0	-12	0
80%	0	0	-4	0
90%	0	2	4	0
Long Term				
Full Simulation Period[b]	0	0	-2	-3
Water Year Types[c]				
Wet (32%)	-1	0	-1	-2
Above Normal (16%)	0	0	-2	-3
Below Normal (13%)	0	-1	-7	-3
Dry (24%)	0	0	1	-4
Critical (15%)	0	1	-1	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-2. Shasta Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	84
20%	100	100	100	34
30%	100	100	100	24
40%	100	100	100	17
50%	100	100	100	9
60%	100	100	100	4
70%	100	100	94	0
80%	100	100	51	0
90%	100	98	19	0
Long Term				
Full Simulation Period[b]	97	94	81	22
Water Year Types[c]				
Wet (32%)	91	100	98	48
Above Normal (16%)	100	100	99	14
Below Normal (13%)	100	95	71	17
Dry (24%)	100	98	68	9
Critical (15%)	100	65	55	3

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	75
20%	100	100	100	32
30%	100	100	100	18
40%	100	100	100	9
50%	100	100	100	5
60%	100	100	100	0
70%	100	100	68	0
80%	100	100	44	0
90%	100	95	22	0
Long Term				
Full Simulation Period[b]	97	94	78	20
Water Year Types[c]				
Wet (32%)	90	100	96	45
Above Normal (16%)	100	100	94	12
Below Normal (13%)	100	97	64	14
Dry (24%)	100	97	68	5
Critical (15%)	100	66	54	3

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	-9
20%	0	0	0	-1
30%	0	0	0	-5
40%	0	0	0	-8
50%	0	0	0	-4
60%	0	0	0	-4
70%	0	0	-26	0
80%	0	0	-7	0
90%	0	-3	3	0
Long Term				
Full Simulation Period[b]	0	0	-2	-3
Water Year Types[c]				
Wet (32%)	-1	0	-1	-3
Above Normal (16%)	0	0	-5	-3
Below Normal (13%)	0	2	-8	-3
Dry (24%)	0	0	0	-3
Critical (15%)	0	1	-1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-3. Shasta Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	84
20%	100	100	100	34
30%	100	100	100	24
40%	100	100	100	17
50%	100	100	100	9
60%	100	100	100	4
70%	100	100	94	0
80%	100	100	51	0
90%	100	98	19	0
Long Term				
Full Simulation Period[b]	97	94	81	22
Water Year Types[c]				
Wet (32%)	91	100	98	48
Above Normal (16%)	100	100	99	14
Below Normal (13%)	100	95	71	17
Dry (24%)	100	98	68	9
Critical (15%)	100	65	55	3

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	84
20%	100	100	100	34
30%	100	100	100	26
40%	100	100	100	17
50%	100	100	100	9
60%	100	100	100	4
70%	100	100	100	0
80%	100	100	54	0
90%	100	100	29	0
Long Term				
Full Simulation Period[b]	97	94	82	22
Water Year Types[c]				
Wet (32%)	90	100	98	48
Above Normal (16%)	100	100	100	14
Below Normal (13%)	100	97	71	16
Dry (24%)	100	98	72	10
Critical (15%)	100	65	58	3

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	1
30%	0	0	0	2
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	6	0
80%	0	0	2	0
90%	0	2	11	0
Long Term				
Full Simulation Period[b]	0	0	2	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	1	0
Below Normal (13%)	0	2	0	-1
Dry (24%)	0	0	4	1
Critical (15%)	0	0	4	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-4. Shasta Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	75
20%	100	100	100	33
30%	100	100	100	18
40%	100	100	100	10
50%	100	100	100	4
60%	100	100	100	0
70%	100	100	82	0
80%	100	100	47	0
90%	100	100	23	0
Long Term				
Full Simulation Period[b]	97	94	79	20
Water Year Types[c]				
Wet (32%)	90	100	97	46
Above Normal (16%)	100	100	97	11
Below Normal (13%)	100	94	64	13
Dry (24%)	100	97	68	5
Critical (15%)	100	66	54	3

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	84
20%	100	100	100	34
30%	100	100	100	24
40%	100	100	100	17
50%	100	100	100	9
60%	100	100	100	4
70%	100	100	94	0
80%	100	100	51	0
90%	100	98	19	0
Long Term				
Full Simulation Period[b]	97	94	81	22
Water Year Types[c]				
Wet (32%)	91	100	98	48
Above Normal (16%)	100	100	99	14
Below Normal (13%)	100	95	71	17
Dry (24%)	100	98	68	9
Critical (15%)	100	65	55	3

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	9
20%	0	0	0	1
30%	0	0	0	6
40%	0	0	0	8
50%	0	0	0	5
60%	0	0	0	4
70%	0	0	12	0
80%	0	0	4	0
90%	0	-2	-4	0
Long Term				
Full Simulation Period[b]	0	0	2	3
Water Year Types[c]				
Wet (32%)	1	0	1	2
Above Normal (16%)	0	0	2	3
Below Normal (13%)	0	1	7	3
Dry (24%)	0	0	-1	4
Critical (15%)	0	-1	1	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-5. Shasta Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	75
20%	100	100	100	33
30%	100	100	100	18
40%	100	100	100	10
50%	100	100	100	4
60%	100	100	100	0
70%	100	100	82	0
80%	100	100	47	0
90%	100	100	23	0
Long Term				
Full Simulation Period[b]	97	94	79	20
Water Year Types[c]				
Wet (32%)	90	100	97	46
Above Normal (16%)	100	100	97	11
Below Normal (13%)	100	94	64	13
Dry (24%)	100	97	68	5
Critical (15%)	100	66	54	3

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	75
20%	100	100	100	32
30%	100	100	100	18
40%	100	100	100	9
50%	100	100	100	5
60%	100	100	100	0
70%	100	100	68	0
80%	100	100	44	0
90%	100	95	22	0
Long Term				
Full Simulation Period[b]	97	94	78	20
Water Year Types[c]				
Wet (32%)	90	100	96	45
Above Normal (16%)	100	100	94	12
Below Normal (13%)	100	97	64	14
Dry (24%)	100	97	68	5
Critical (15%)	100	66	54	3

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	-1
30%	0	0	0	1
40%	0	0	0	0
50%	0	0	0	1
60%	0	0	0	0
70%	0	0	-15	0
80%	0	0	-3	0
90%	0	-5	-1	0
Long Term				
Full Simulation Period[b]	0	0	-1	0
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	-3	1
Below Normal (13%)	0	3	-1	0
Dry (24%)	0	0	-1	1
Critical (15%)	0	0	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-4-6. Shasta Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	75
20%	100	100	100	33
30%	100	100	100	18
40%	100	100	100	10
50%	100	100	100	4
60%	100	100	100	0
70%	100	100	82	0
80%	100	100	47	0
90%	100	100	23	0
Long Term				
Full Simulation Period[b]	97	94	79	20
Water Year Types[c]				
Wet (32%)	90	100	97	46
Above Normal (16%)	100	100	97	11
Below Normal (13%)	100	94	64	13
Dry (24%)	100	97	68	5
Critical (15%)	100	66	54	3

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	84
20%	100	100	100	34
30%	100	100	100	26
40%	100	100	100	17
50%	100	100	100	9
60%	100	100	100	4
70%	100	100	100	0
80%	100	100	54	0
90%	100	100	29	0
Long Term				
Full Simulation Period[b]	97	94	82	22
Water Year Types[c]				
Wet (32%)	90	100	98	48
Above Normal (16%)	100	100	100	14
Below Normal (13%)	100	97	71	16
Dry (24%)	100	98	72	10
Critical (15%)	100	65	58	3

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	9
20%	0	0	0	1
30%	0	0	0	8
40%	0	0	0	8
50%	0	0	0	5
60%	0	0	0	4
70%	0	0	18	0
80%	0	0	6	0
90%	0	0	6	0
Long Term				
Full Simulation Period[b]	0	0	3	3
Water Year Types[c]				
Wet (32%)	1	0	1	2
Above Normal (16%)	0	0	3	3
Below Normal (13%)	0	2	7	3
Dry (24%)	0	0	4	5
Critical (15%)	0	-1	5	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

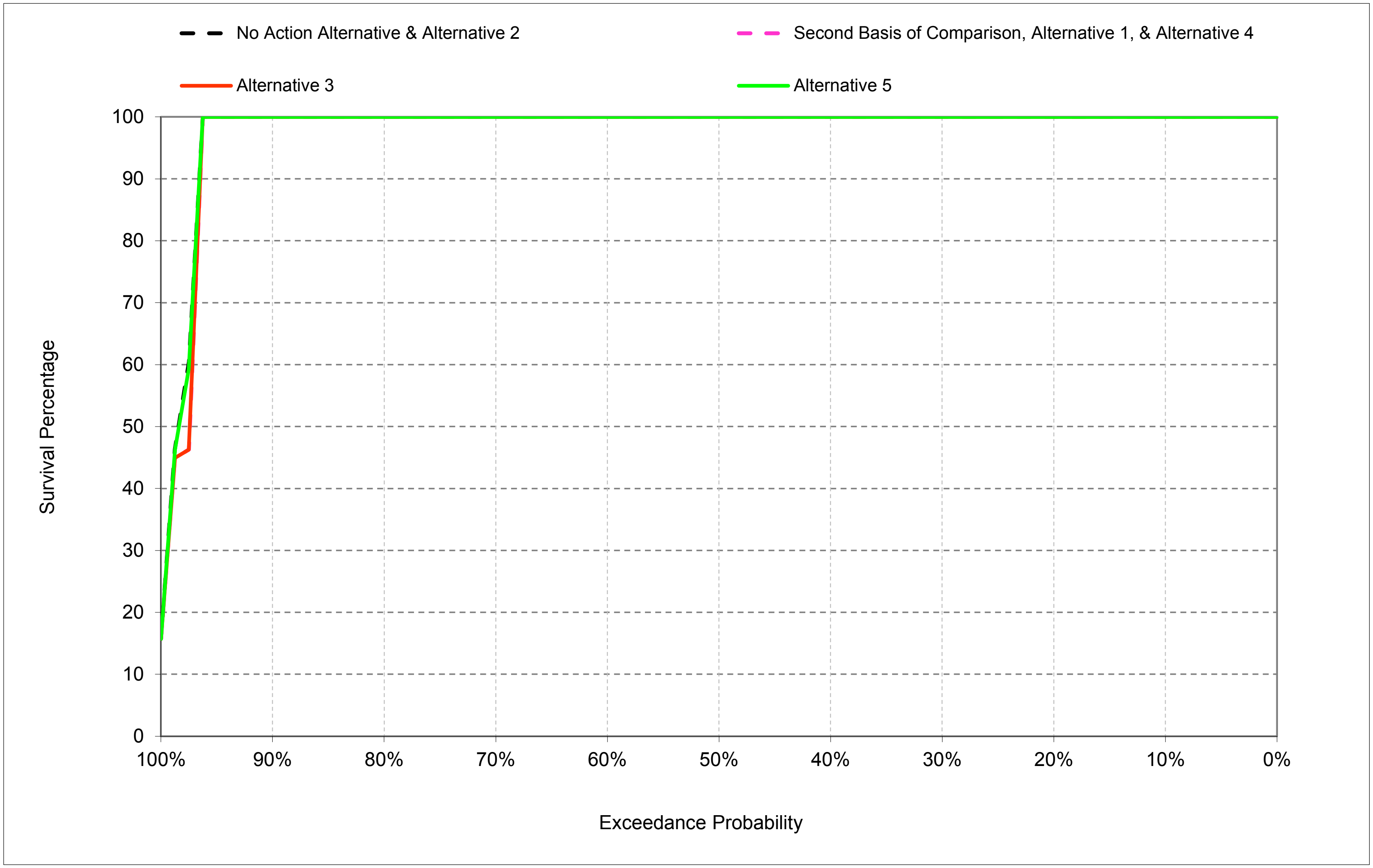
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

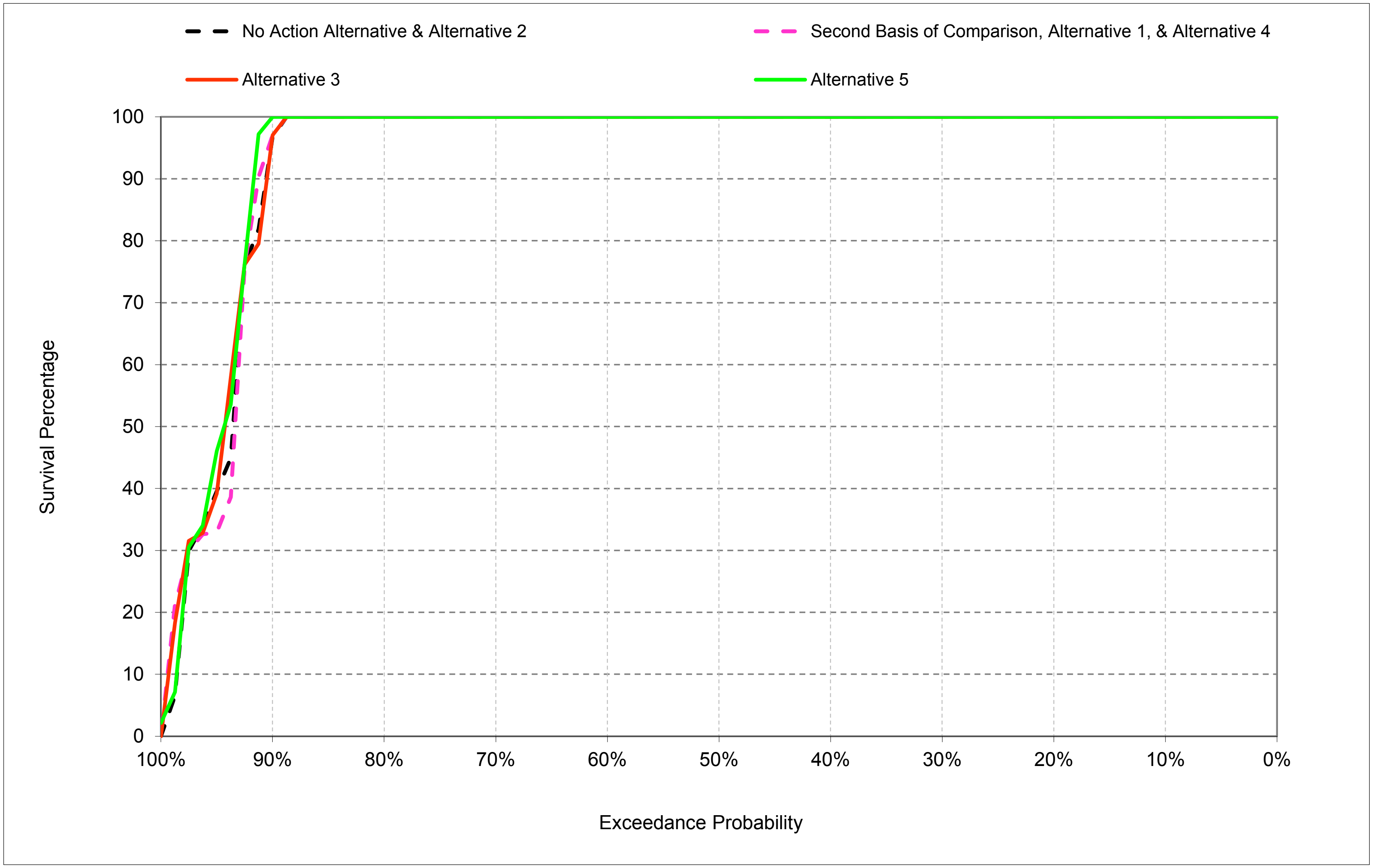
B.5. Shasta Small Mouth Bass Survival Percentage

Figure B-5-1. Shasta Small Mouth Bass Nest Survival Percentage, March



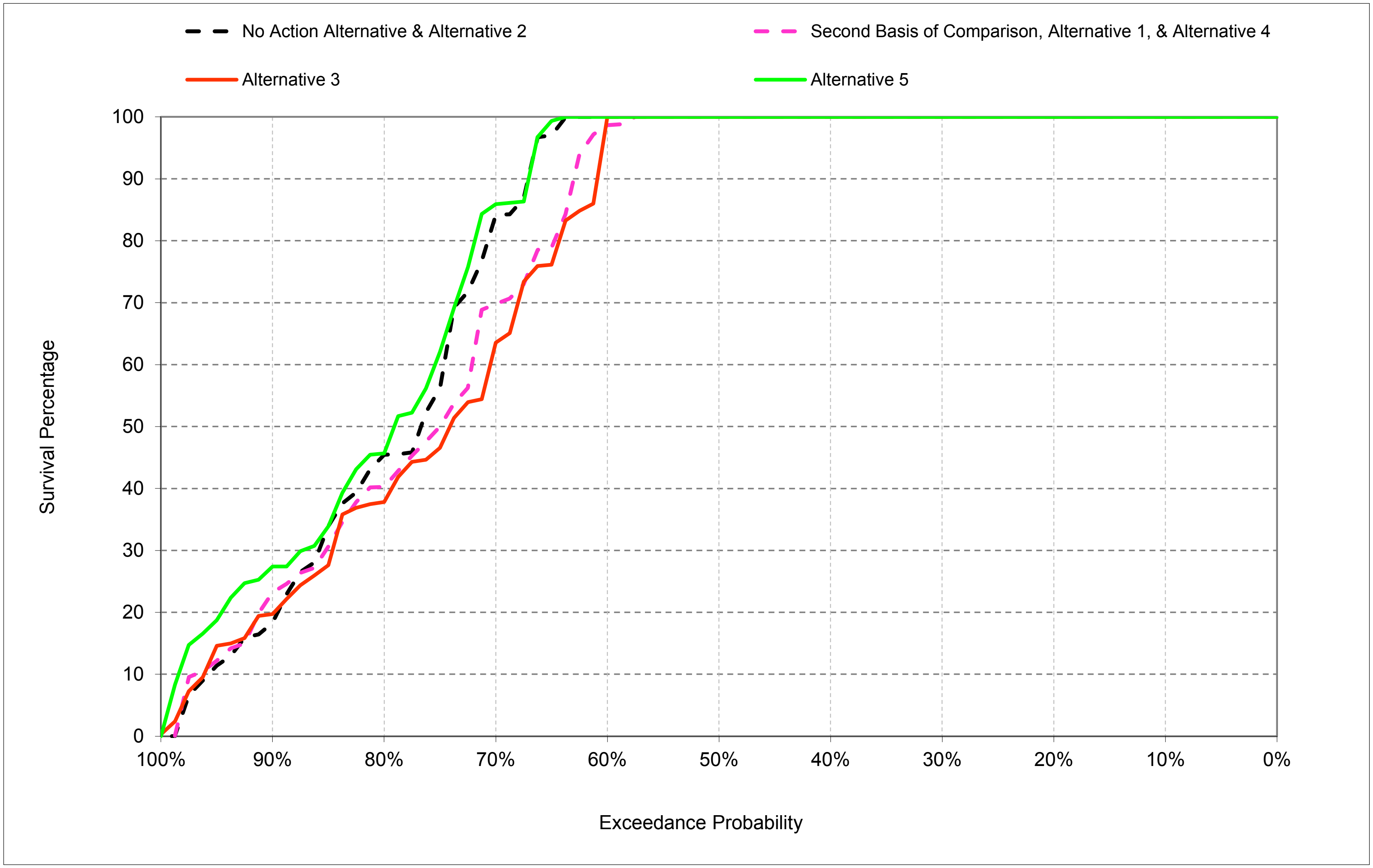
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-5-2. Shasta Small Mouth Bass Nest Survival Percentage, April



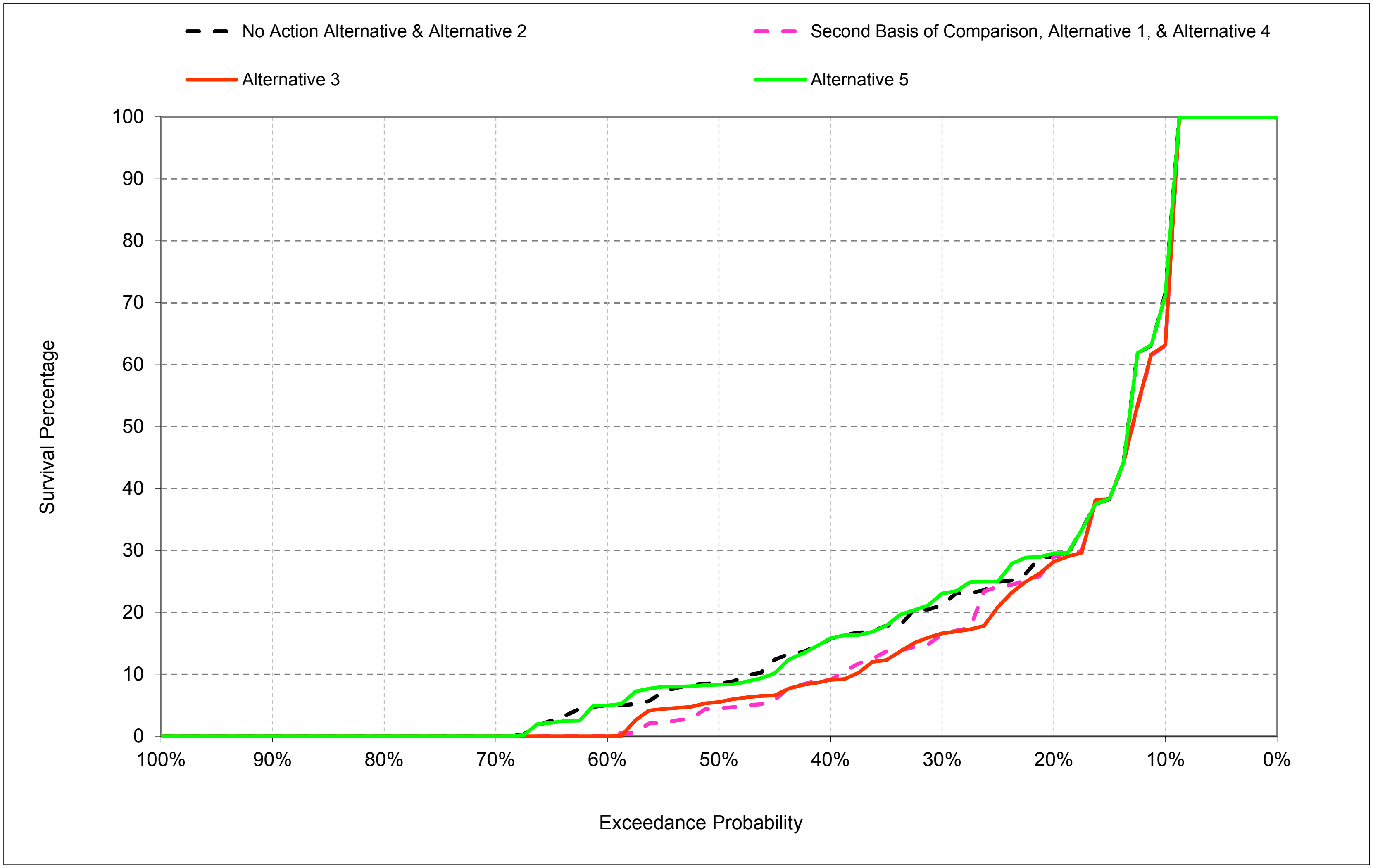
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-5-3. Shasta Small Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-5-4. Shasta Small Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-1. Shasta Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	71
20%	100	100	100	29
30%	100	100	100	21
40%	100	100	100	15
50%	100	100	100	9
60%	100	100	100	5
70%	100	100	79	0
80%	100	100	44	0
90%	100	83	17	0
Long Term				
Full Simulation Period[b]	97	93	78	21
Water Year Types[c]				
Wet (32%)	90	99	97	44
Above Normal (16%)	100	100	97	14
Below Normal (13%)	100	95	66	16
Dry (24%)	100	96	66	8
Critical (15%)	100	64	50	3

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	63
20%	100	100	100	28
30%	100	100	100	16
40%	100	100	100	9
50%	100	100	100	4
60%	100	100	98	0
70%	100	100	69	0
80%	100	100	40	0
90%	100	91	20	0
Long Term				
Full Simulation Period[b]	97	93	77	19
Water Year Types[c]				
Wet (32%)	89	99	96	43
Above Normal (16%)	100	100	95	11
Below Normal (13%)	100	94	57	13
Dry (24%)	100	97	66	5
Critical (15%)	100	64	49	2

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	-8
20%	0	0	0	-1
30%	0	0	0	-5
40%	0	0	0	-6
50%	0	0	0	-4
60%	0	0	-2	-5
70%	0	0	-10	0
80%	0	0	-3	0
90%	0	8	4	0
Long Term				
Full Simulation Period[b]	0	0	-2	-2
Water Year Types[c]				
Wet (32%)	-1	0	-1	-2
Above Normal (16%)	0	0	-2	-3
Below Normal (13%)	0	-1	-8	-3
Dry (24%)	0	1	0	-3
Critical (15%)	0	0	-1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-2. Shasta Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	71
20%	100	100	100	29
30%	100	100	100	21
40%	100	100	100	15
50%	100	100	100	9
60%	100	100	100	5
70%	100	100	79	0
80%	100	100	44	0
90%	100	83	17	0
Long Term				
Full Simulation Period[b]	97	93	78	21
Water Year Types[c]				
Wet (32%)	90	99	97	44
Above Normal (16%)	100	100	97	14
Below Normal (13%)	100	95	66	16
Dry (24%)	100	96	66	8
Critical (15%)	100	64	50	3

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	63
20%	100	100	100	28
30%	100	100	100	16
40%	100	100	100	9
50%	100	100	100	5
60%	100	100	92	0
70%	100	100	57	0
80%	100	100	38	0
90%	100	81	19	0
Long Term				
Full Simulation Period[b]	97	93	76	19
Water Year Types[c]				
Wet (32%)	89	99	96	42
Above Normal (16%)	100	100	91	12
Below Normal (13%)	100	96	57	13
Dry (24%)	100	96	65	5
Critical (15%)	100	65	50	3

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	-8
20%	0	0	0	-1
30%	0	0	0	-5
40%	0	0	0	-6
50%	0	0	0	-3
60%	0	0	-8	-5
70%	0	0	-22	0
80%	0	0	-6	0
90%	0	-2	3	0
Long Term				
Full Simulation Period[b]	0	0	-3	-2
Water Year Types[c]				
Wet (32%)	-1	0	-2	-2
Above Normal (16%)	0	0	-6	-2
Below Normal (13%)	0	2	-9	-2
Dry (24%)	0	0	-1	-3
Critical (15%)	0	1	-1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-3. Shasta Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	71
20%	100	100	100	29
30%	100	100	100	21
40%	100	100	100	15
50%	100	100	100	9
60%	100	100	100	5
70%	100	100	79	0
80%	100	100	44	0
90%	100	83	17	0
Long Term				
Full Simulation Period[b]	97	93	78	21
Water Year Types[c]				
Wet (32%)	90	99	97	44
Above Normal (16%)	100	100	97	14
Below Normal (13%)	100	95	66	16
Dry (24%)	100	96	66	8
Critical (15%)	100	64	50	3

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	70
20%	100	100	100	29
30%	100	100	100	22
40%	100	100	100	15
50%	100	100	100	8
60%	100	100	100	5
70%	100	100	85	0
80%	100	100	45	0
90%	100	97	25	0
Long Term				
Full Simulation Period[b]	97	93	80	21
Water Year Types[c]				
Wet (32%)	90	99	97	45
Above Normal (16%)	100	100	98	14
Below Normal (13%)	100	96	65	15
Dry (24%)	100	97	70	9
Critical (15%)	100	64	55	3

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	2
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	6	0
80%	0	0	2	0
90%	0	14	9	0
Long Term				
Full Simulation Period[b]	0	0	2	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	1	0
Below Normal (13%)	0	1	-1	0
Dry (24%)	0	1	3	1
Critical (15%)	0	0	5	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-4. Shasta Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	63
20%	100	100	100	28
30%	100	100	100	16
40%	100	100	100	9
50%	100	100	100	4
60%	100	100	98	0
70%	100	100	69	0
80%	100	100	40	0
90%	100	91	20	0
Long Term				
Full Simulation Period[b]	97	93	77	19
Water Year Types[c]				
Wet (32%)	89	99	96	43
Above Normal (16%)	100	100	95	11
Below Normal (13%)	100	94	57	13
Dry (24%)	100	97	66	5
Critical (15%)	100	64	49	2

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	71
20%	100	100	100	29
30%	100	100	100	21
40%	100	100	100	15
50%	100	100	100	9
60%	100	100	100	5
70%	100	100	79	0
80%	100	100	44	0
90%	100	83	17	0
Long Term				
Full Simulation Period[b]	97	93	78	21
Water Year Types[c]				
Wet (32%)	90	99	97	44
Above Normal (16%)	100	100	97	14
Below Normal (13%)	100	95	66	16
Dry (24%)	100	96	66	8
Critical (15%)	100	64	50	3

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	8
20%	0	0	0	1
30%	0	0	0	5
40%	0	0	0	6
50%	0	0	0	4
60%	0	0	2	5
70%	0	0	10	0
80%	0	0	3	0
90%	0	-8	-4	0
Long Term				
Full Simulation Period[b]	0	0	2	2
Water Year Types[c]				
Wet (32%)	1	0	1	2
Above Normal (16%)	0	0	2	3
Below Normal (13%)	0	1	8	3
Dry (24%)	0	-1	0	3
Critical (15%)	0	0	1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-5. Shasta Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	63
20%	100	100	100	28
30%	100	100	100	16
40%	100	100	100	9
50%	100	100	100	4
60%	100	100	98	0
70%	100	100	69	0
80%	100	100	40	0
90%	100	91	20	0
Long Term				
Full Simulation Period[b]	97	93	77	19
Water Year Types[c]				
Wet (32%)	89	99	96	43
Above Normal (16%)	100	100	95	11
Below Normal (13%)	100	94	57	13
Dry (24%)	100	97	66	5
Critical (15%)	100	64	49	2

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	63
20%	100	100	100	28
30%	100	100	100	16
40%	100	100	100	9
50%	100	100	100	5
60%	100	100	92	0
70%	100	100	57	0
80%	100	100	38	0
90%	100	81	19	0
Long Term				
Full Simulation Period[b]	97	93	76	19
Water Year Types[c]				
Wet (32%)	89	99	96	42
Above Normal (16%)	100	100	91	12
Below Normal (13%)	100	96	57	13
Dry (24%)	100	96	65	5
Critical (15%)	100	65	50	3

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	-1
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	1
60%	0	0	-6	0
70%	0	0	-12	0
80%	0	0	-3	0
90%	0	-10	-1	0
Long Term				
Full Simulation Period[b]	0	0	-1	0
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	-4	1
Below Normal (13%)	0	2	0	0
Dry (24%)	0	-1	-1	0
Critical (15%)	0	1	0	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-5-6. Shasta Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	63
20%	100	100	100	28
30%	100	100	100	16
40%	100	100	100	9
50%	100	100	100	4
60%	100	100	98	0
70%	100	100	69	0
80%	100	100	40	0
90%	100	91	20	0
Long Term				
Full Simulation Period[b]	97	93	77	19
Water Year Types[c]				
Wet (32%)	89	99	96	43
Above Normal (16%)	100	100	95	11
Below Normal (13%)	100	94	57	13
Dry (24%)	100	97	66	5
Critical (15%)	100	64	49	2

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	70
20%	100	100	100	29
30%	100	100	100	22
40%	100	100	100	15
50%	100	100	100	8
60%	100	100	100	5
70%	100	100	85	0
80%	100	100	45	0
90%	100	97	25	0
Long Term				
Full Simulation Period[b]	97	93	80	21
Water Year Types[c]				
Wet (32%)	90	99	97	45
Above Normal (16%)	100	100	98	14
Below Normal (13%)	100	96	65	15
Dry (24%)	100	97	70	9
Critical (15%)	100	64	55	3

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	7
20%	0	0	0	1
30%	0	0	0	7
40%	0	0	0	6
50%	0	0	0	4
60%	0	0	2	5
70%	0	0	16	0
80%	0	0	5	0
90%	0	7	5	0
Long Term				
Full Simulation Period[b]	0	0	3	2
Water Year Types[c]				
Wet (32%)	1	0	1	2
Above Normal (16%)	0	0	3	3
Below Normal (13%)	0	2	7	2
Dry (24%)	0	0	3	4
Critical (15%)	0	0	5	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

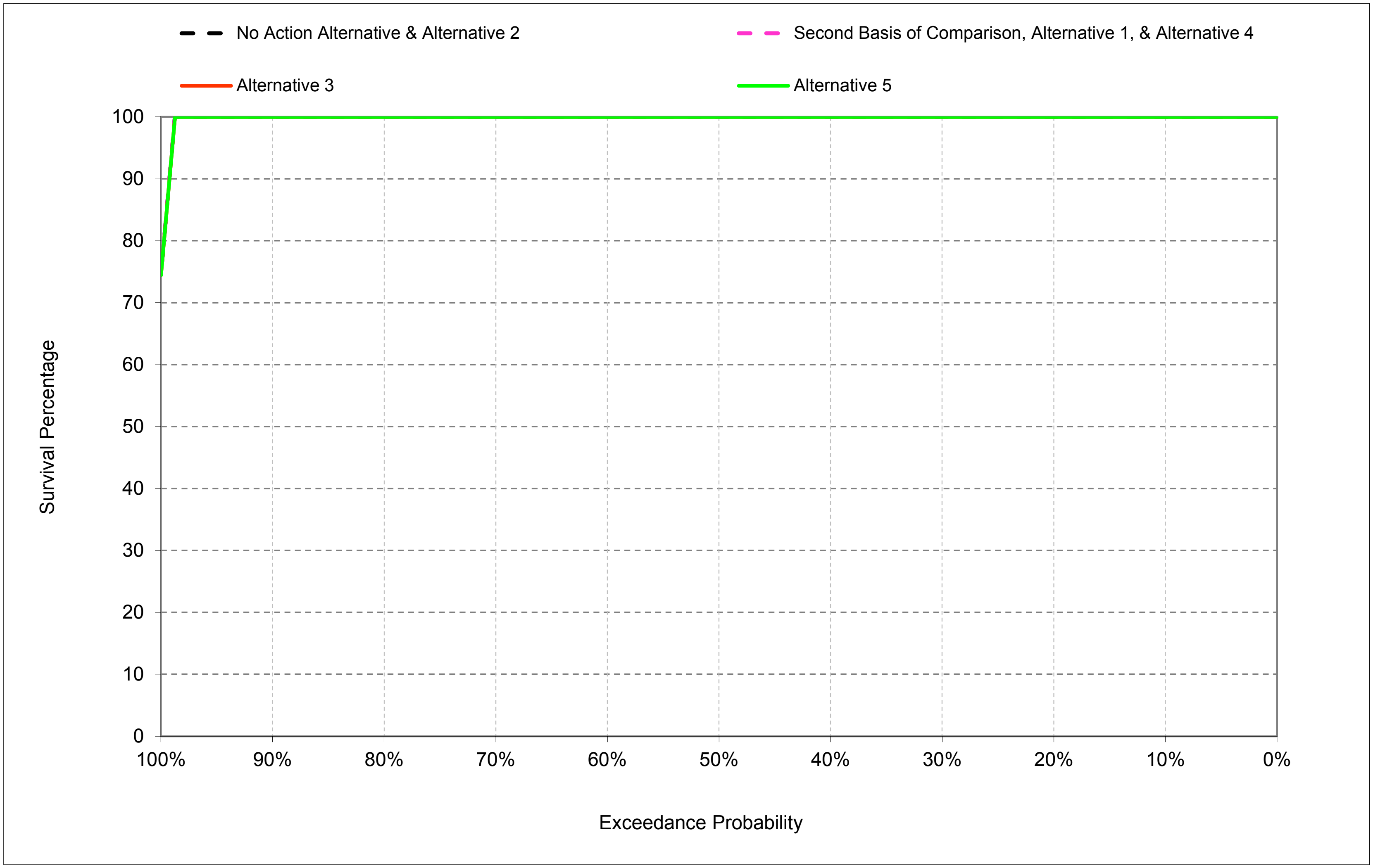
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

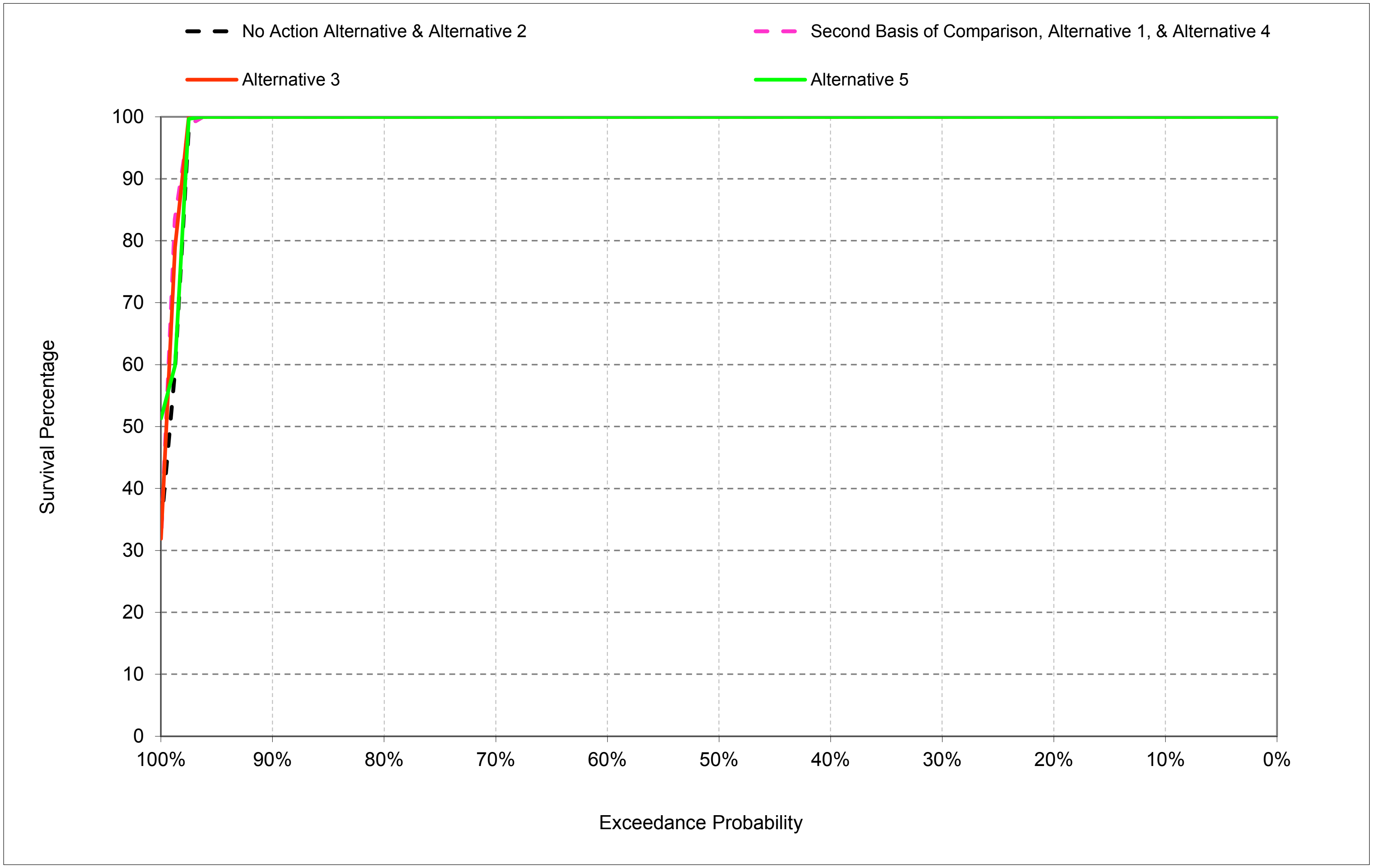
B.6. Shasta Spotted Bass Survival Percentage

Figure B-6-1. Shasta Spotted Bass Nest Survival Percentage, March



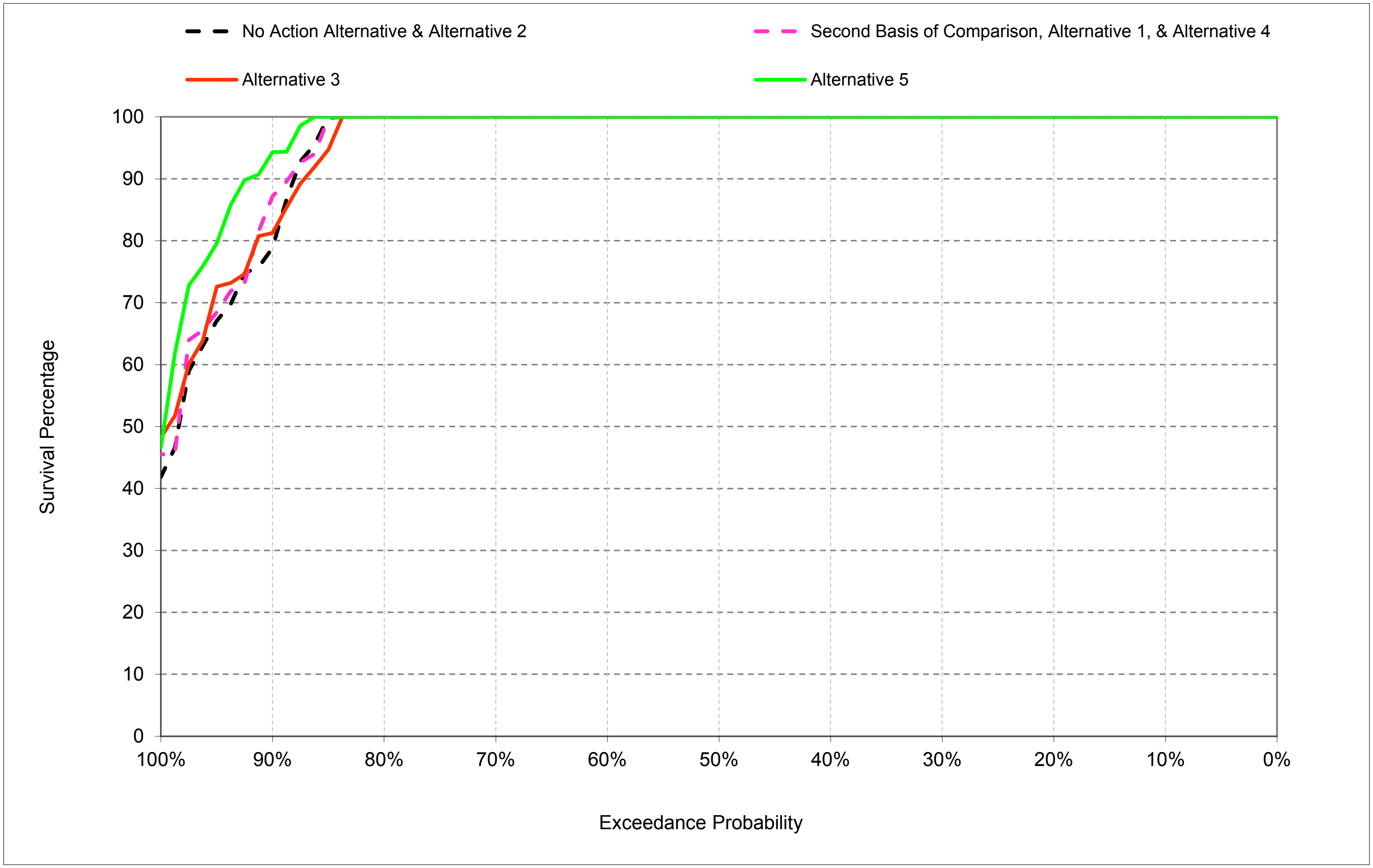
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-6-2. Shasta Spotted Bass Nest Survival Percentage, April



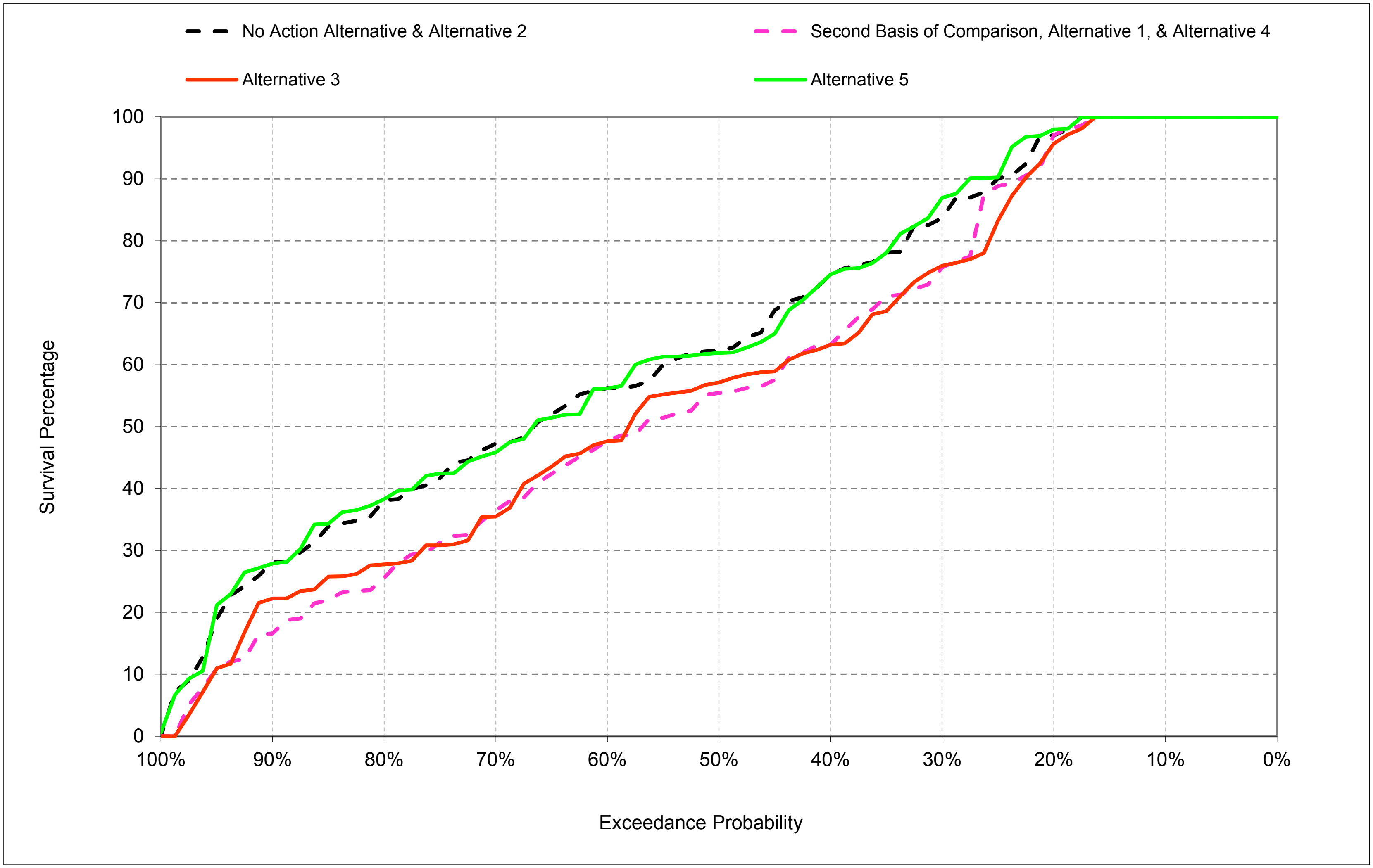
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-6-3. Shasta Spotted Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-6-4. Shasta Spotted Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-1. Shasta Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	97
30%	100	100	100	83
40%	100	100	100	74
50%	100	100	100	62
60%	100	100	100	56
70%	100	100	100	46
80%	100	100	100	36
90%	100	100	76	26
Long Term				
Full Simulation Period[b]	99	98	95	63
Water Year Types[c]				
Wet (32%)	98	100	100	87
Above Normal (16%)	100	100	100	60
Below Normal (13%)	100	100	96	58
Dry (24%)	100	100	91	55
Critical (15%)	100	84	84	31

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	96
30%	100	100	100	75
40%	100	100	100	63
50%	100	100	100	55
60%	100	100	100	47
70%	100	100	100	35
80%	100	100	100	24
90%	100	100	82	16
Long Term				
Full Simulation Period[b]	99	98	95	56
Water Year Types[c]				
Wet (32%)	98	100	100	86
Above Normal (16%)	100	100	100	51
Below Normal (13%)	100	100	96	45
Dry (24%)	100	100	93	44
Critical (15%)	100	86	83	27

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	-1
30%	0	0	0	-8
40%	0	0	0	-11
50%	0	0	0	-7
60%	0	0	0	-9
70%	0	0	0	-11
80%	0	0	0	-12
90%	0	0	6	-10
Long Term				
Full Simulation Period[b]	0	0	0	-7
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	0	-9
Below Normal (13%)	0	0	-1	-13
Dry (24%)	0	0	2	-11
Critical (15%)	0	2	0	-4

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-2. Shasta Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	97
30%	100	100	100	83
40%	100	100	100	74
50%	100	100	100	62
60%	100	100	100	56
70%	100	100	100	46
80%	100	100	100	36
90%	100	100	76	26
Long Term				
Full Simulation Period[b]	99	98	95	63
Water Year Types[c]				
Wet (32%)	98	100	100	87
Above Normal (16%)	100	100	100	60
Below Normal (13%)	100	100	96	58
Dry (24%)	100	100	91	55
Critical (15%)	100	84	84	31

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	95
30%	100	100	100	76
40%	100	100	100	63
50%	100	100	100	57
60%	100	100	100	47
70%	100	100	100	35
80%	100	100	100	28
90%	100	100	81	22
Long Term				
Full Simulation Period[b]	99	98	95	57
Water Year Types[c]				
Wet (32%)	98	100	100	84
Above Normal (16%)	100	100	100	53
Below Normal (13%)	100	100	96	48
Dry (24%)	100	100	92	45
Critical (15%)	100	86	84	29

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	-2
30%	0	0	0	-8
40%	0	0	0	-11
50%	0	0	0	-5
60%	0	0	0	-9
70%	0	0	0	-11
80%	0	0	0	-8
90%	0	0	5	-5
Long Term				
Full Simulation Period[b]	0	0	0	-6
Water Year Types[c]				
Wet (32%)	0	0	0	-3
Above Normal (16%)	0	0	0	-7
Below Normal (13%)	0	0	-1	-11
Dry (24%)	0	0	1	-10
Critical (15%)	0	2	1	-2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-3. Shasta Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	97
30%	100	100	100	83
40%	100	100	100	74
50%	100	100	100	62
60%	100	100	100	56
70%	100	100	100	46
80%	100	100	100	36
90%	100	100	76	26
Long Term				
Full Simulation Period[b]	99	98	95	63
Water Year Types[c]				
Wet (32%)	98	100	100	87
Above Normal (16%)	100	100	100	60
Below Normal (13%)	100	100	96	58
Dry (24%)	100	100	91	55
Critical (15%)	100	84	84	31

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	98
30%	100	100	100	86
40%	100	100	100	74
50%	100	100	100	62
60%	100	100	100	56
70%	100	100	100	45
80%	100	100	100	37
90%	100	100	91	27
Long Term				
Full Simulation Period[b]	99	98	97	63
Water Year Types[c]				
Wet (32%)	98	100	100	87
Above Normal (16%)	100	100	100	60
Below Normal (13%)	100	100	97	58
Dry (24%)	100	100	97	56
Critical (15%)	100	87	86	32

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	1
30%	0	0	0	3
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	-1
80%	0	0	0	1
90%	0	0	15	1
Long Term				
Full Simulation Period[b]	0	0	2	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	6	1
Critical (15%)	0	3	2	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-4. Shasta Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	96
30%	100	100	100	75
40%	100	100	100	63
50%	100	100	100	55
60%	100	100	100	47
70%	100	100	100	35
80%	100	100	100	24
90%	100	100	82	16
Long Term				
Full Simulation Period[b]	99	98	95	56
Water Year Types[c]				
Wet (32%)	98	100	100	86
Above Normal (16%)	100	100	100	51
Below Normal (13%)	100	100	96	45
Dry (24%)	100	100	93	44
Critical (15%)	100	86	83	27

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	97
30%	100	100	100	83
40%	100	100	100	74
50%	100	100	100	62
60%	100	100	100	56
70%	100	100	100	46
80%	100	100	100	36
90%	100	100	76	26
Long Term				
Full Simulation Period[b]	99	98	95	63
Water Year Types[c]				
Wet (32%)	98	100	100	87
Above Normal (16%)	100	100	100	60
Below Normal (13%)	100	100	96	58
Dry (24%)	100	100	91	55
Critical (15%)	100	84	84	31

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	1
30%	0	0	0	8
40%	0	0	0	11
50%	0	0	0	7
60%	0	0	0	9
70%	0	0	0	11
80%	0	0	0	12
90%	0	0	-6	10
Long Term				
Full Simulation Period[b]	0	0	0	7
Water Year Types[c]				
Wet (32%)	0	0	0	1
Above Normal (16%)	0	0	0	9
Below Normal (13%)	0	0	1	13
Dry (24%)	0	0	-2	11
Critical (15%)	0	-2	0	4

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-5. Shasta Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	96
30%	100	100	100	75
40%	100	100	100	63
50%	100	100	100	55
60%	100	100	100	47
70%	100	100	100	35
80%	100	100	100	24
90%	100	100	82	16
Long Term				
Full Simulation Period[b]	99	98	95	56
Water Year Types[c]				
Wet (32%)	98	100	100	86
Above Normal (16%)	100	100	100	51
Below Normal (13%)	100	100	96	45
Dry (24%)	100	100	93	44
Critical (15%)	100	86	83	27

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	95
30%	100	100	100	76
40%	100	100	100	63
50%	100	100	100	57
60%	100	100	100	47
70%	100	100	100	35
80%	100	100	100	28
90%	100	100	81	22
Long Term				
Full Simulation Period[b]	99	98	95	57
Water Year Types[c]				
Wet (32%)	98	100	100	84
Above Normal (16%)	100	100	100	53
Below Normal (13%)	100	100	96	48
Dry (24%)	100	100	92	45
Critical (15%)	100	86	84	29

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	-1
30%	0	0	0	1
40%	0	0	0	0
50%	0	0	0	2
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	4
90%	0	0	-1	5
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	-2
Above Normal (16%)	0	0	0	2
Below Normal (13%)	0	0	0	2
Dry (24%)	0	0	-1	1
Critical (15%)	0	0	1	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-6-6. Shasta Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	96
30%	100	100	100	75
40%	100	100	100	63
50%	100	100	100	55
60%	100	100	100	47
70%	100	100	100	35
80%	100	100	100	24
90%	100	100	82	16
Long Term				
Full Simulation Period[b]	99	98	95	56
Water Year Types[c]				
Wet (32%)	98	100	100	86
Above Normal (16%)	100	100	100	51
Below Normal (13%)	100	100	96	45
Dry (24%)	100	100	93	44
Critical (15%)	100	86	83	27

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	98
30%	100	100	100	86
40%	100	100	100	74
50%	100	100	100	62
60%	100	100	100	56
70%	100	100	100	45
80%	100	100	100	37
90%	100	100	91	27
Long Term				
Full Simulation Period[b]	99	98	97	63
Water Year Types[c]				
Wet (32%)	98	100	100	87
Above Normal (16%)	100	100	100	60
Below Normal (13%)	100	100	97	58
Dry (24%)	100	100	97	56
Critical (15%)	100	87	86	32

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	2
30%	0	0	0	11
40%	0	0	0	11
50%	0	0	0	7
60%	0	0	0	9
70%	0	0	0	10
80%	0	0	0	13
90%	0	0	9	11
Long Term				
Full Simulation Period[b]	0	0	1	7
Water Year Types[c]				
Wet (32%)	0	0	0	2
Above Normal (16%)	0	0	0	9
Below Normal (13%)	0	0	1	13
Dry (24%)	0	0	4	12
Critical (15%)	0	1	2	4

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

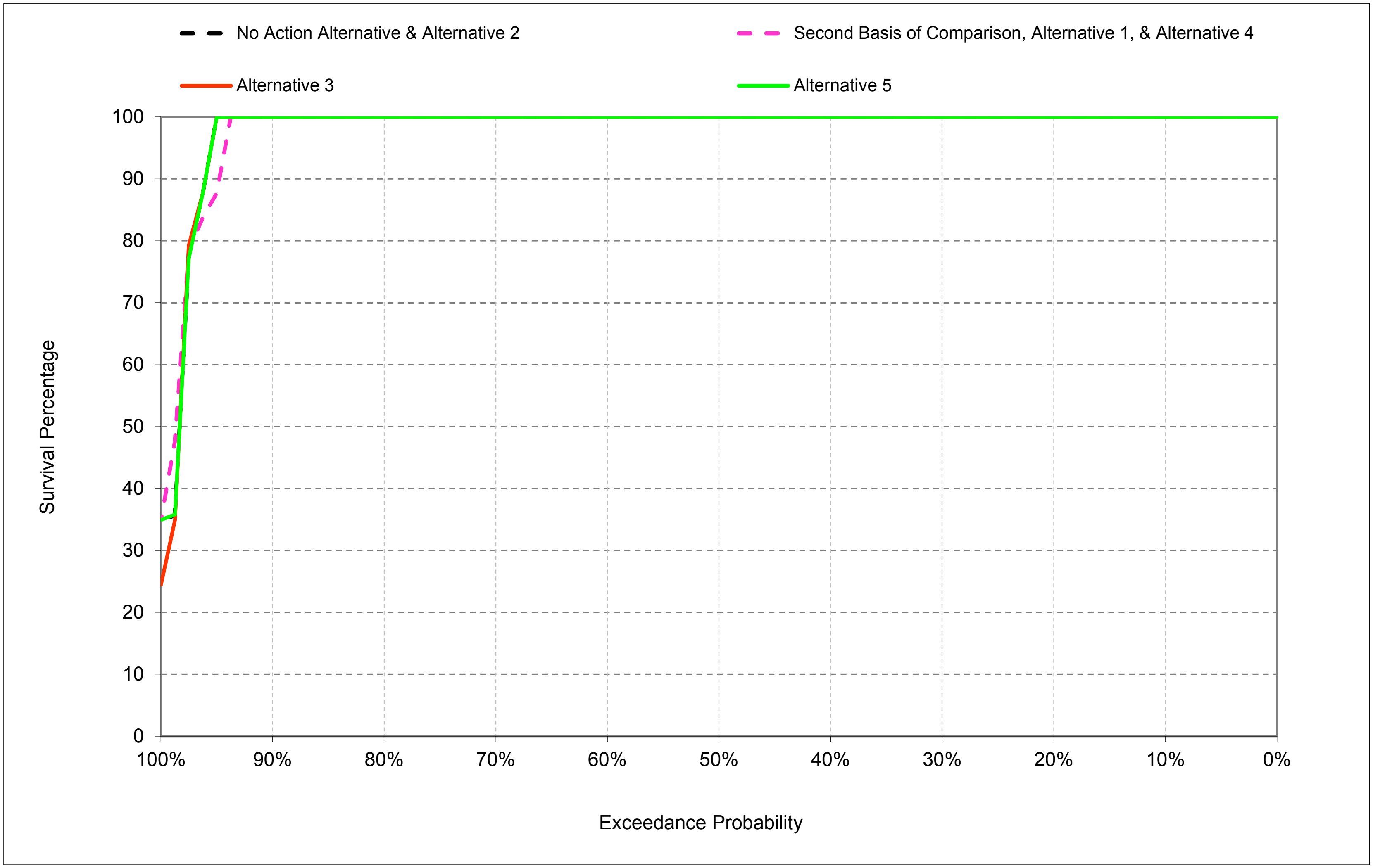
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

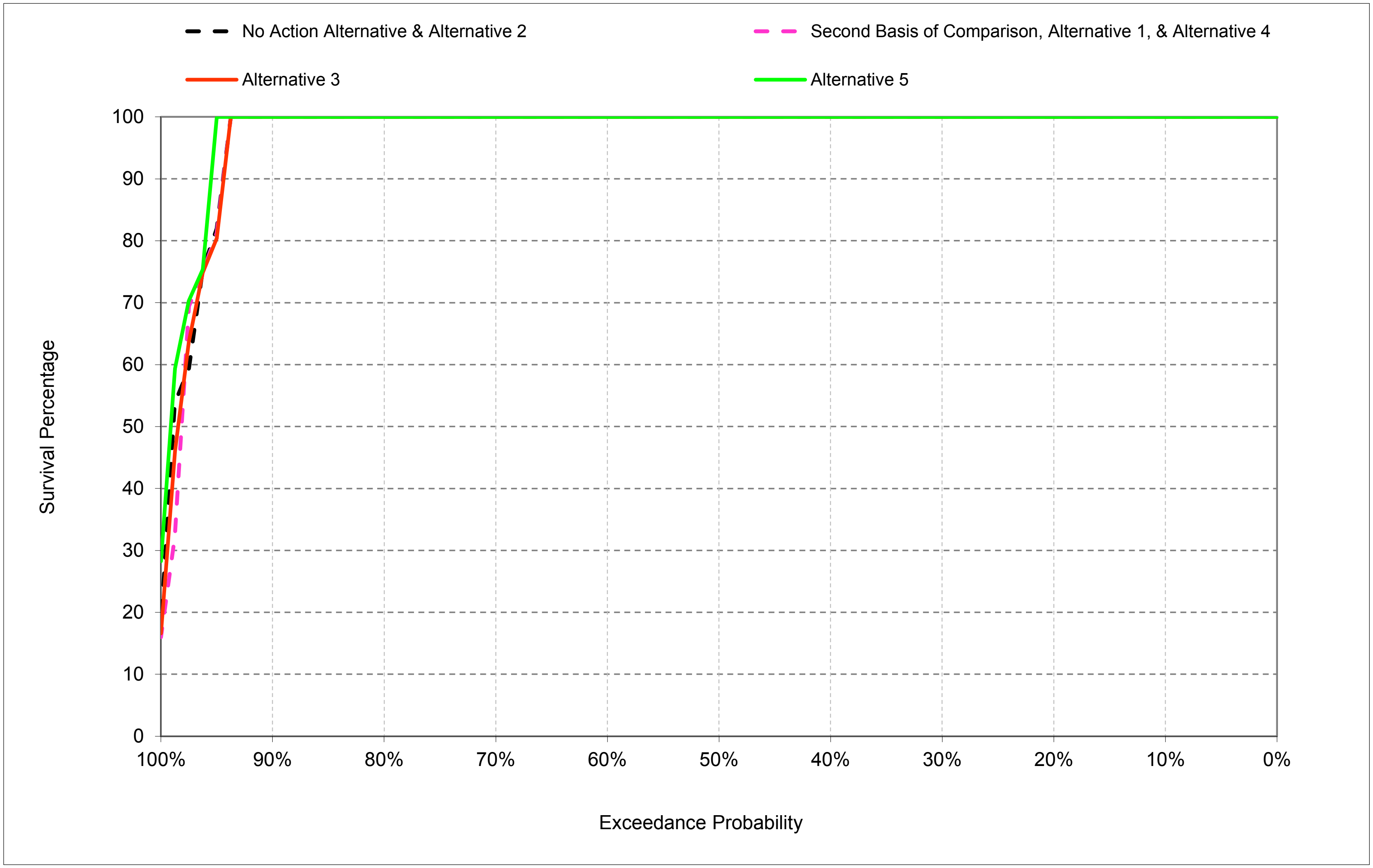
B.7. Oroville Large Mouth Bass Survival Percentage

Figure B-7-1. Oroville Large Mouth Bass Nest Survival Percentage, March



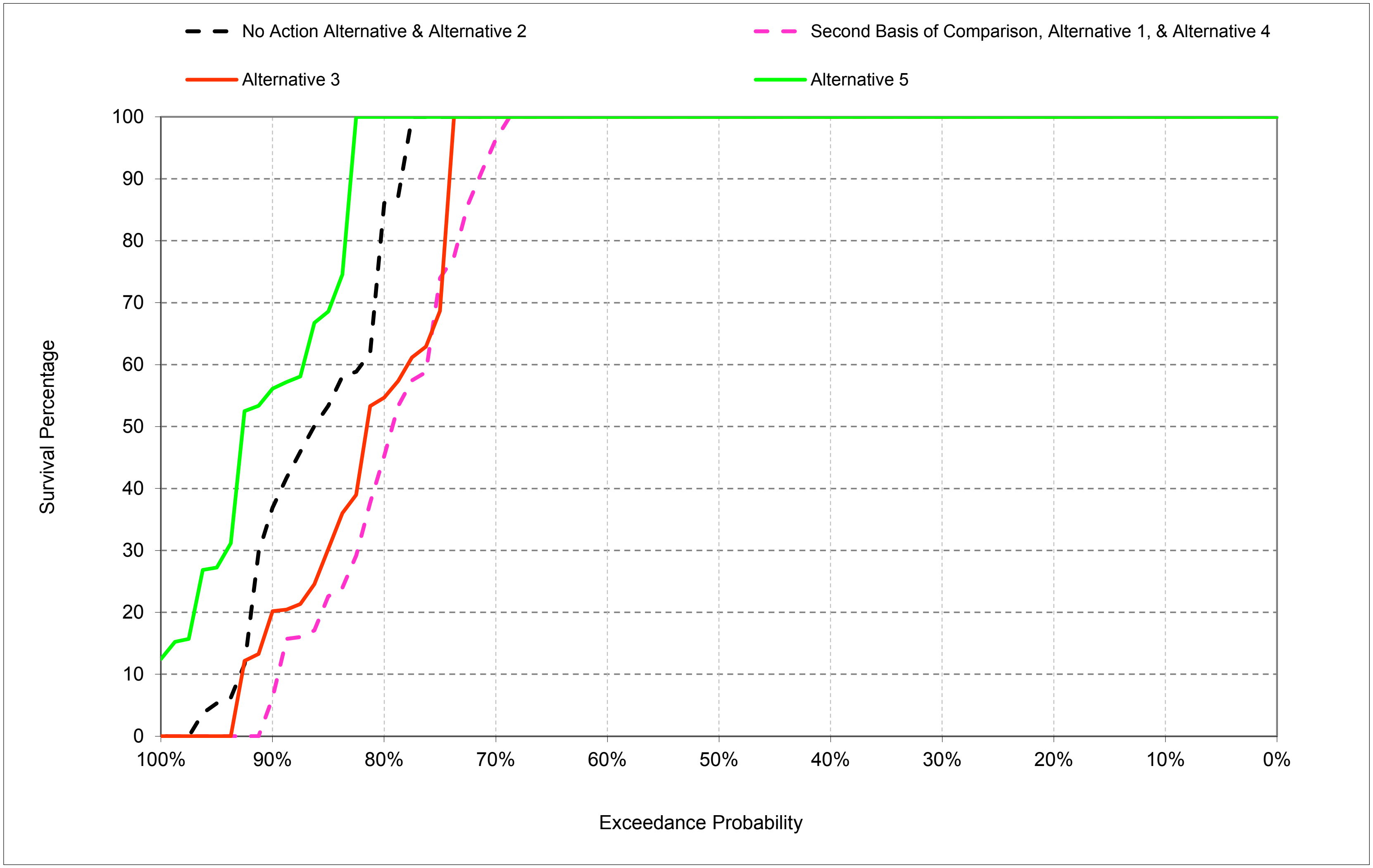
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-7-2. Oroville Large Mouth Bass Nest Survival Percentage, April



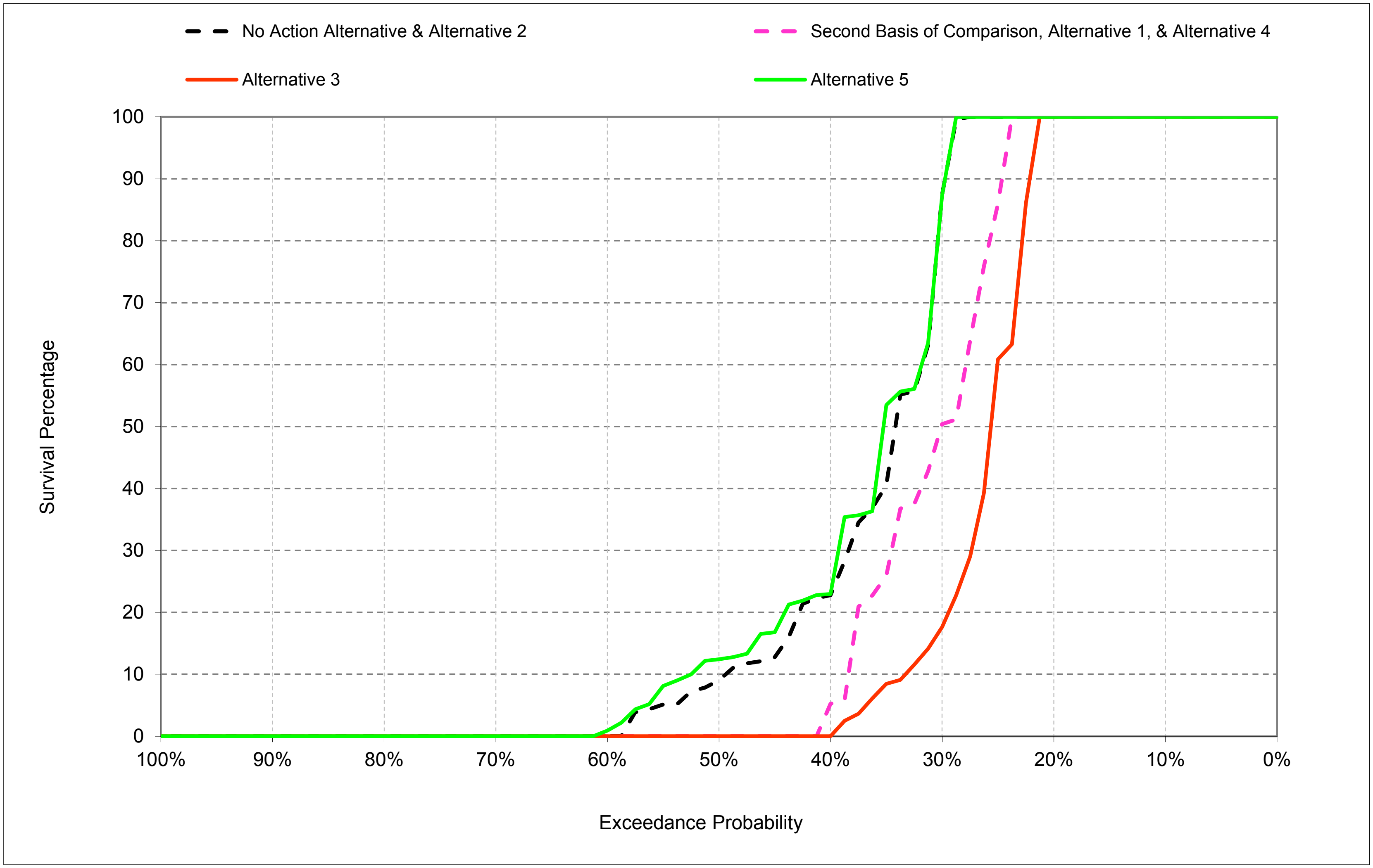
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-7-3. Oroville Large Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-7-4. Oroville Large Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-1. Oroville Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	80
40%	100	100	100	23
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	67	0
90%	100	100	30	0
Long Term				
Full Simulation Period[b]	97	96	85	36
Water Year Types[c]				
Wet (32%)	91	100	100	81
Above Normal (16%)	100	100	100	37
Below Normal (13%)	100	96	82	24
Dry (24%)	100	100	69	2
Critical (15%)	98	78	62	7

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	48
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	93	0
80%	100	100	39	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	97	96	78	31
Water Year Types[c]				
Wet (32%)	91	100	97	73
Above Normal (16%)	100	100	85	31
Below Normal (13%)	100	98	63	12
Dry (24%)	100	100	67	0
Critical (15%)	98	74	63	7

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-32
40%	0	0	0	-19
50%	0	0	0	-8
60%	0	0	0	0
70%	0	0	-7	0
80%	0	0	-27	0
90%	0	0	-30	0
Long Term				
Full Simulation Period[b]	0	0	-6	-5
Water Year Types[c]				
Wet (32%)	0	0	-3	-8
Above Normal (16%)	0	0	-15	-6
Below Normal (13%)	0	2	-20	-12
Dry (24%)	0	0	-3	-2
Critical (15%)	0	-3	1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-2. Oroville Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	80
40%	100	100	100	23
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	67	0
90%	100	100	30	0
Long Term				
Full Simulation Period[b]	97	96	85	36
Water Year Types[c]				
Wet (32%)	91	100	100	81
Above Normal (16%)	100	100	100	37
Below Normal (13%)	100	96	82	24
Dry (24%)	100	100	69	2
Critical (15%)	98	78	62	7

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	17
40%	100	100	100	0
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	54	0
90%	100	100	14	0
Long Term				
Full Simulation Period[b]	97	96	80	27
Water Year Types[c]				
Wet (32%)	90	100	97	63
Above Normal (16%)	100	100	86	26
Below Normal (13%)	100	95	73	10
Dry (24%)	100	100	67	0
Critical (15%)	98	78	65	6

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-64
40%	0	0	0	-23
50%	0	0	0	-8
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	-13	0
90%	0	0	-16	0
Long Term				
Full Simulation Period[b]	0	0	-4	-10
Water Year Types[c]				
Wet (32%)	0	0	-3	-17
Above Normal (16%)	0	0	-14	-11
Below Normal (13%)	0	-1	-9	-13
Dry (24%)	0	0	-2	-2
Critical (15%)	0	0	3	-2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.
b Based on the 82-year simulation period.
c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification
(SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-3. Oroville Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	80
40%	100	100	100	23
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	67	0
90%	100	100	30	0
Long Term				
Full Simulation Period[b]	97	96	85	36
Water Year Types[c]				
Wet (32%)	91	100	100	81
Above Normal (16%)	100	100	100	37
Below Normal (13%)	100	96	82	24
Dry (24%)	100	100	69	2
Critical (15%)	98	78	62	7

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	80
40%	100	100	100	23
50%	100	100	100	12
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	100	0
90%	100	100	54	0
Long Term				
Full Simulation Period[b]	97	97	89	37
Water Year Types[c]				
Wet (32%)	91	100	100	82
Above Normal (16%)	100	100	100	37
Below Normal (13%)	100	96	90	26
Dry (24%)	100	100	81	3
Critical (15%)	98	82	68	8

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	4
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	33	0
90%	0	0	23	0
Long Term				
Full Simulation Period[b]	0	1	5	1
Water Year Types[c]				
Wet (32%)	0	0	0	1
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	8	2
Dry (24%)	0	0	12	1
Critical (15%)	0	4	6	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-4. Oroville Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	48
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	93	0
80%	100	100	39	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	97	96	78	31
Water Year Types[c]				
Wet (32%)	91	100	97	73
Above Normal (16%)	100	100	85	31
Below Normal (13%)	100	98	63	12
Dry (24%)	100	100	67	0
Critical (15%)	98	74	63	7

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	80
40%	100	100	100	23
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	67	0
90%	100	100	30	0
Long Term				
Full Simulation Period[b]	97	96	85	36
Water Year Types[c]				
Wet (32%)	91	100	100	81
Above Normal (16%)	100	100	100	37
Below Normal (13%)	100	96	82	24
Dry (24%)	100	100	69	2
Critical (15%)	98	78	62	7

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	32
40%	0	0	0	19
50%	0	0	0	8
60%	0	0	0	0
70%	0	0	7	0
80%	0	0	27	0
90%	0	0	30	0
Long Term				
Full Simulation Period[b]	0	0	6	5
Water Year Types[c]				
Wet (32%)	0	0	3	8
Above Normal (16%)	0	0	15	6
Below Normal (13%)	0	-2	20	12
Dry (24%)	0	0	3	2
Critical (15%)	0	3	-1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-5. Oroville Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	48
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	93	0
80%	100	100	39	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	97	96	78	31
Water Year Types[c]				
Wet (32%)	91	100	97	73
Above Normal (16%)	100	100	85	31
Below Normal (13%)	100	98	63	12
Dry (24%)	100	100	67	0
Critical (15%)	98	74	63	7

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	17
40%	100	100	100	0
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	54	0
90%	100	100	14	0
Long Term				
Full Simulation Period[b]	97	96	80	27
Water Year Types[c]				
Wet (32%)	90	100	97	63
Above Normal (16%)	100	100	86	26
Below Normal (13%)	100	95	73	10
Dry (24%)	100	100	67	0
Critical (15%)	98	78	65	6

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-32
40%	0	0	0	-3
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	7	0
80%	0	0	14	0
90%	0	0	13	0
Long Term				
Full Simulation Period[b]	0	0	2	-4
Water Year Types[c]				
Wet (32%)	0	0	0	-10
Above Normal (16%)	0	0	0	-5
Below Normal (13%)	0	-3	10	-1
Dry (24%)	0	0	1	0
Critical (15%)	0	4	2	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-7-6. Oroville Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	48
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	93	0
80%	100	100	39	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	97	96	78	31
Water Year Types[c]				
Wet (32%)	91	100	97	73
Above Normal (16%)	100	100	85	31
Below Normal (13%)	100	98	63	12
Dry (24%)	100	100	67	0
Critical (15%)	98	74	63	7

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	80
40%	100	100	100	23
50%	100	100	100	12
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	100	0
90%	100	100	54	0
Long Term				
Full Simulation Period[b]	97	97	89	37
Water Year Types[c]				
Wet (32%)	91	100	100	82
Above Normal (16%)	100	100	100	37
Below Normal (13%)	100	96	90	26
Dry (24%)	100	100	81	3
Critical (15%)	98	82	68	8

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	32
40%	0	0	0	20
50%	0	0	0	12
60%	0	0	0	0
70%	0	0	7	0
80%	0	0	61	0
90%	0	0	53	0
Long Term				
Full Simulation Period[b]	0	1	11	6
Water Year Types[c]				
Wet (32%)	0	0	3	8
Above Normal (16%)	0	0	15	6
Below Normal (13%)	0	-2	28	14
Dry (24%)	0	0	14	2
Critical (15%)	0	7	5	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

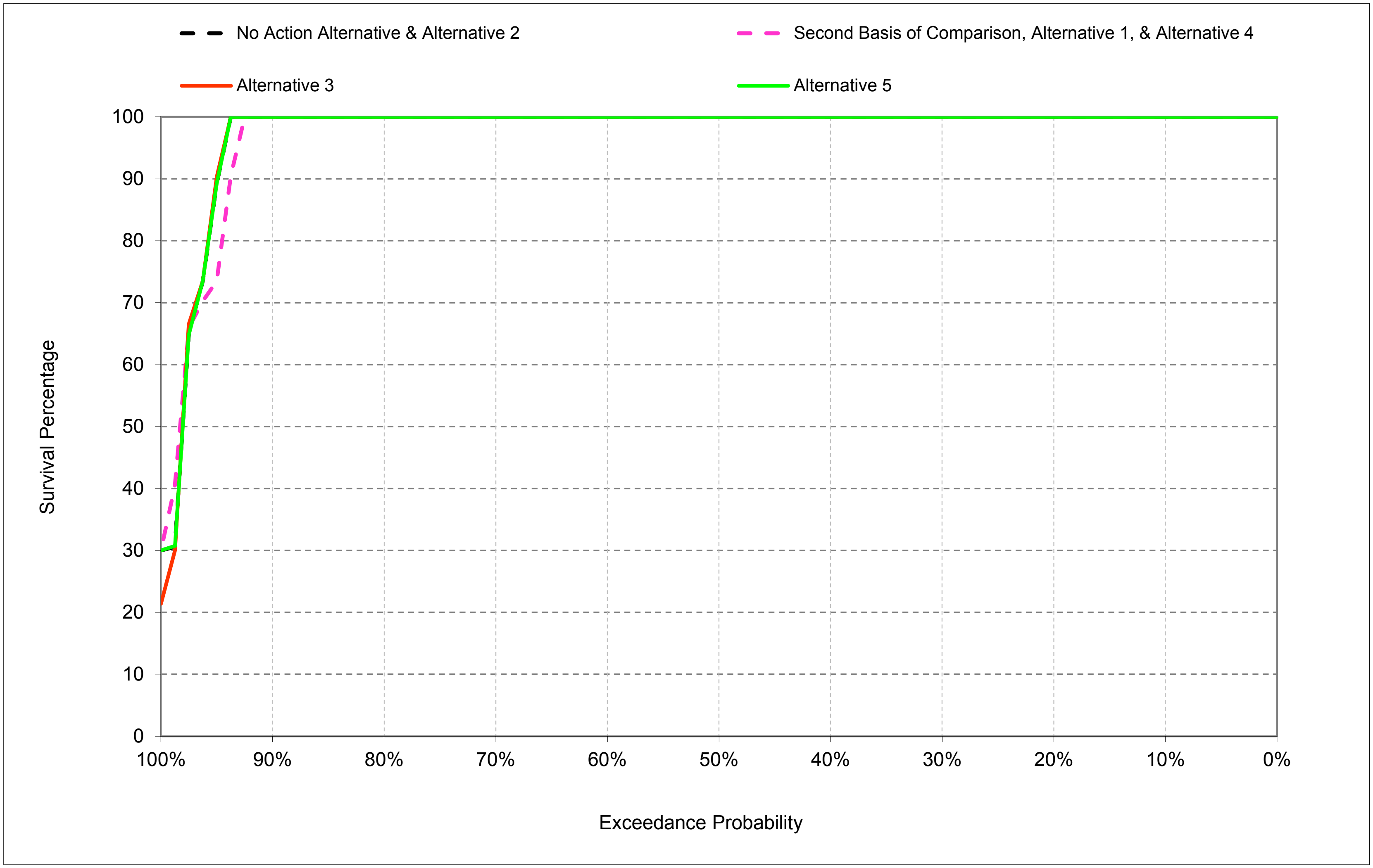
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

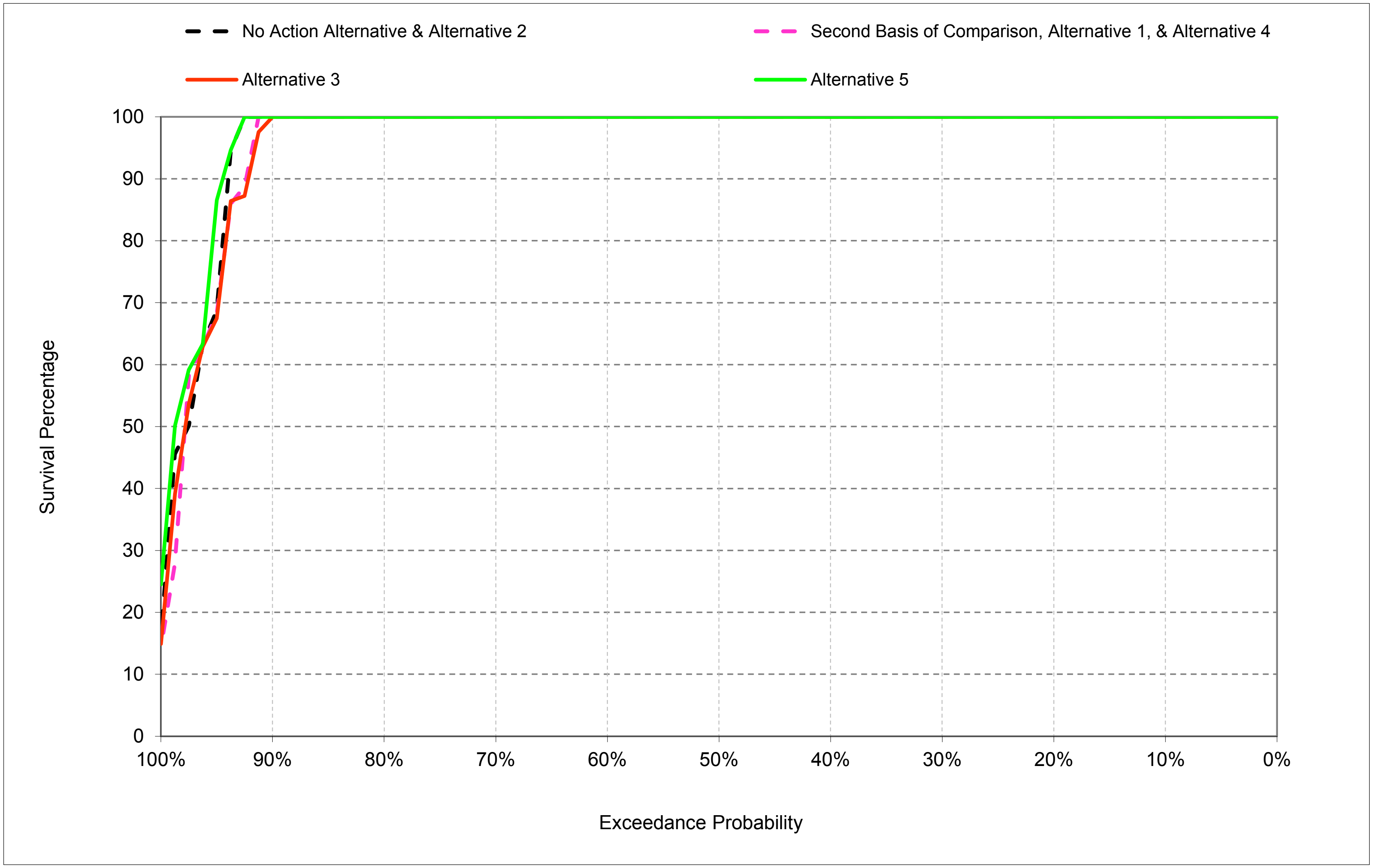
B.8. Oroville Small Mouth Bass Survival Percentage

Figure B-8-1. Oroville Small Mouth Bass Nest Survival Percentage, March



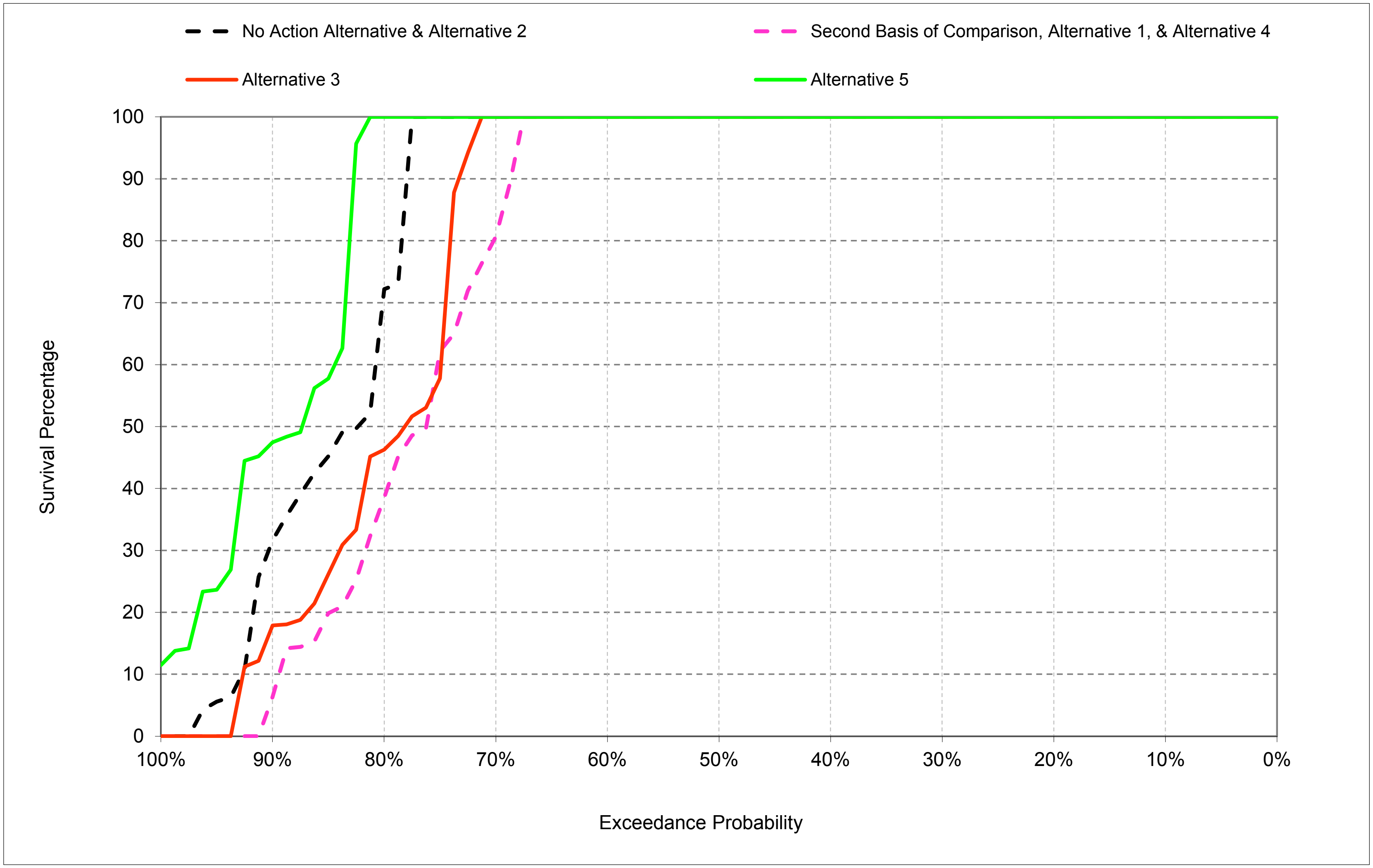
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-8-2. Oroville Small Mouth Bass Nest Survival Percentage, April



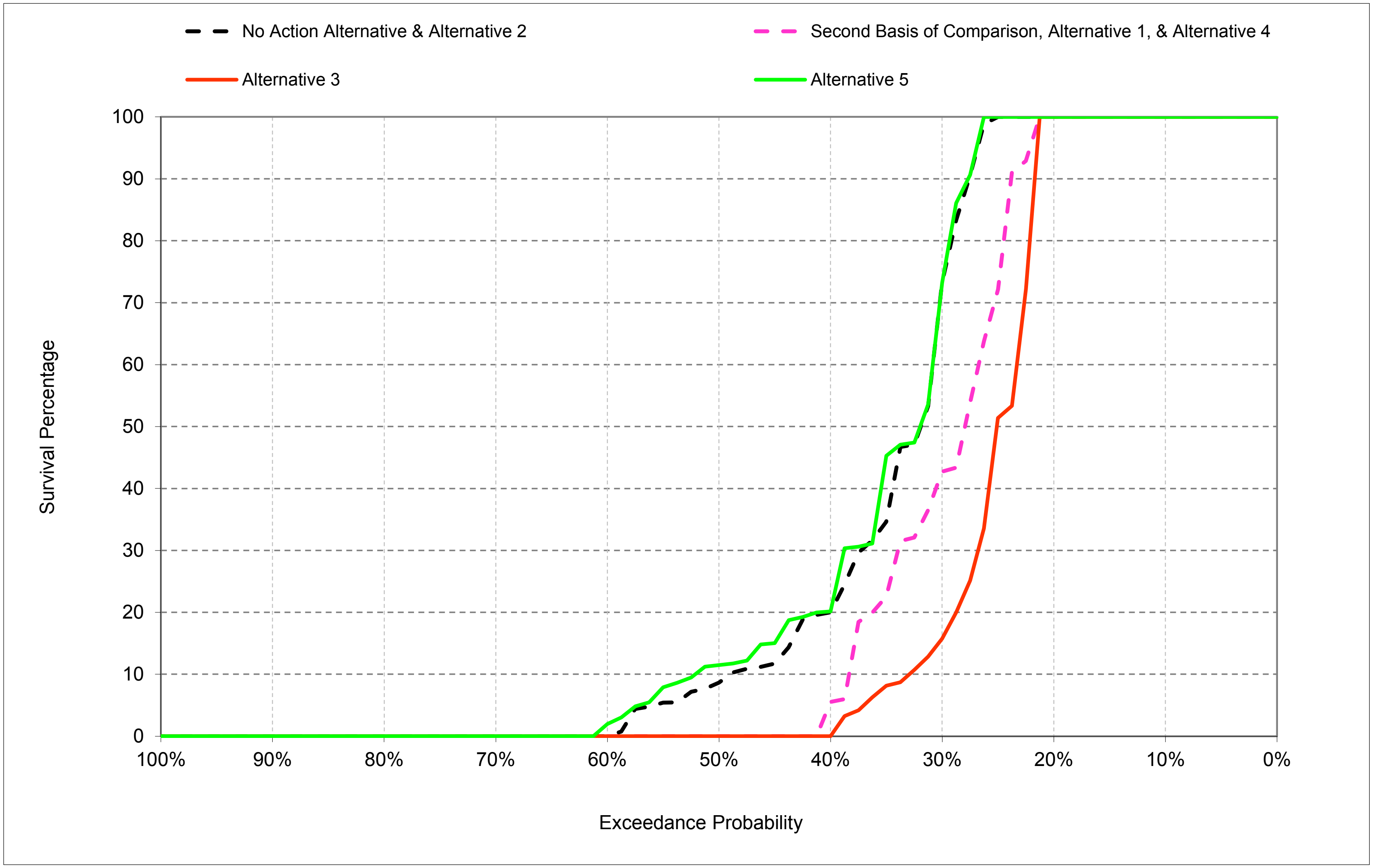
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-8-3. Oroville Small Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-8-4. Oroville Small Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-1. Oroville Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	67
40%	100	100	100	20
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	56	0
90%	100	100	26	0
Long Term				
Full Simulation Period[b]	96	96	83	35
Water Year Types[c]				
Wet (32%)	90	100	100	79
Above Normal (16%)	100	100	100	35
Below Normal (13%)	100	95	81	22
Dry (24%)	100	100	68	2
Critical (15%)	97	75	58	7

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	41
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	78	0
80%	100	100	34	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	96	95	77	30
Water Year Types[c]				
Wet (32%)	89	100	97	72
Above Normal (16%)	100	100	85	28
Below Normal (13%)	100	97	59	11
Dry (24%)	100	100	65	0
Critical (15%)	97	70	58	6

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-26
40%	0	0	0	-17
50%	0	0	0	-8
60%	0	0	0	0
70%	0	0	-22	0
80%	0	0	-23	0
90%	0	0	-26	0
Long Term				
Full Simulation Period[b]	0	0	-7	-5
Water Year Types[c]				
Wet (32%)	-1	0	-3	-8
Above Normal (16%)	0	0	-15	-7
Below Normal (13%)	0	2	-22	-10
Dry (24%)	0	0	-3	-1
Critical (15%)	0	-5	1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-2. Oroville Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	67
40%	100	100	100	20
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	56	0
90%	100	100	26	0
Long Term				
Full Simulation Period[b]	96	96	83	35
Water Year Types[c]				
Wet (32%)	90	100	100	79
Above Normal (16%)	100	100	100	35
Below Normal (13%)	100	95	81	22
Dry (24%)	100	100	68	2
Critical (15%)	97	75	58	7

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	15
40%	100	100	100	0
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	45	0
90%	100	98	13	0
Long Term				
Full Simulation Period[b]	96	95	79	26
Water Year Types[c]				
Wet (32%)	89	100	97	63
Above Normal (16%)	100	100	85	23
Below Normal (13%)	100	93	72	10
Dry (24%)	100	100	66	0
Critical (15%)	97	74	62	5

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-52
40%	0	0	0	-20
50%	0	0	0	-8
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	-11	0
90%	0	-2	-14	0
Long Term				
Full Simulation Period[b]	0	0	-4	-9
Water Year Types[c]				
Wet (32%)	0	0	-3	-16
Above Normal (16%)	0	0	-15	-12
Below Normal (13%)	0	-2	-9	-11
Dry (24%)	0	0	-2	-2
Critical (15%)	0	-1	4	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-3. Oroville Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	67
40%	100	100	100	20
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	56	0
90%	100	100	26	0
Long Term				
Full Simulation Period[b]	96	96	83	35
Water Year Types[c]				
Wet (32%)	90	100	100	79
Above Normal (16%)	100	100	100	35
Below Normal (13%)	100	95	81	22
Dry (24%)	100	100	68	2
Critical (15%)	97	75	58	7

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	67
40%	100	100	100	20
50%	100	100	100	11
60%	100	100	100	1
70%	100	100	100	0
80%	100	100	100	0
90%	100	100	45	0
Long Term				
Full Simulation Period[b]	96	96	88	36
Water Year Types[c]				
Wet (32%)	90	100	100	80
Above Normal (16%)	100	100	100	35
Below Normal (13%)	100	95	89	23
Dry (24%)	100	100	79	2
Critical (15%)	97	78	65	7

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	3
60%	0	0	0	1
70%	0	0	0	0
80%	0	0	44	0
90%	0	0	19	0
Long Term				
Full Simulation Period[b]	0	1	5	1
Water Year Types[c]				
Wet (32%)	0	0	0	1
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	8	2
Dry (24%)	0	0	11	1
Critical (15%)	0	4	7	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-4. Oroville Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	41
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	78	0
80%	100	100	34	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	96	95	77	30
Water Year Types[c]				
Wet (32%)	89	100	97	72
Above Normal (16%)	100	100	85	28
Below Normal (13%)	100	97	59	11
Dry (24%)	100	100	65	0
Critical (15%)	97	70	58	6

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	67
40%	100	100	100	20
50%	100	100	100	8
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	56	0
90%	100	100	26	0
Long Term				
Full Simulation Period[b]	96	96	83	35
Water Year Types[c]				
Wet (32%)	90	100	100	79
Above Normal (16%)	100	100	100	35
Below Normal (13%)	100	95	81	22
Dry (24%)	100	100	68	2
Critical (15%)	97	75	58	7

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	26
40%	0	0	0	17
50%	0	0	0	8
60%	0	0	0	0
70%	0	0	22	0
80%	0	0	23	0
90%	0	0	26	0
Long Term				
Full Simulation Period[b]	0	0	7	5
Water Year Types[c]				
Wet (32%)	1	0	3	8
Above Normal (16%)	0	0	15	7
Below Normal (13%)	0	-2	22	10
Dry (24%)	0	0	3	1
Critical (15%)	0	5	-1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-5. Oroville Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	41
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	78	0
80%	100	100	34	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	96	95	77	30
Water Year Types[c]				
Wet (32%)	89	100	97	72
Above Normal (16%)	100	100	85	28
Below Normal (13%)	100	97	59	11
Dry (24%)	100	100	65	0
Critical (15%)	97	70	58	6

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	15
40%	100	100	100	0
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	100	0
80%	100	100	45	0
90%	100	98	13	0
Long Term				
Full Simulation Period[b]	96	95	79	26
Water Year Types[c]				
Wet (32%)	89	100	97	63
Above Normal (16%)	100	100	85	23
Below Normal (13%)	100	93	72	10
Dry (24%)	100	100	66	0
Critical (15%)	97	74	62	5

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-26
40%	0	0	0	-3
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	22	0
80%	0	0	12	0
90%	0	-2	12	0
Long Term				
Full Simulation Period[b]	0	0	2	-4
Water Year Types[c]				
Wet (32%)	0	0	0	-9
Above Normal (16%)	0	0	0	-5
Below Normal (13%)	0	-4	13	-1
Dry (24%)	0	0	1	0
Critical (15%)	0	4	3	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-8-6. Oroville Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	41
40%	100	100	100	3
50%	100	100	100	0
60%	100	100	100	0
70%	100	100	78	0
80%	100	100	34	0
90%	100	100	1	0
Long Term				
Full Simulation Period[b]	96	95	77	30
Water Year Types[c]				
Wet (32%)	89	100	97	72
Above Normal (16%)	100	100	85	28
Below Normal (13%)	100	97	59	11
Dry (24%)	100	100	65	0
Critical (15%)	97	70	58	6

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	67
40%	100	100	100	20
50%	100	100	100	11
60%	100	100	100	1
70%	100	100	100	0
80%	100	100	100	0
90%	100	100	45	0
Long Term				
Full Simulation Period[b]	96	96	88	36
Water Year Types[c]				
Wet (32%)	90	100	100	80
Above Normal (16%)	100	100	100	35
Below Normal (13%)	100	95	89	23
Dry (24%)	100	100	79	2
Critical (15%)	97	78	65	7

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	26
40%	0	0	0	17
50%	0	0	0	11
60%	0	0	0	1
70%	0	0	22	0
80%	0	0	66	0
90%	0	0	45	0
Long Term				
Full Simulation Period[b]	0	1	12	6
Water Year Types[c]				
Wet (32%)	1	0	3	8
Above Normal (16%)	0	0	15	7
Below Normal (13%)	0	-2	30	12
Dry (24%)	0	0	14	2
Critical (15%)	0	8	7	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

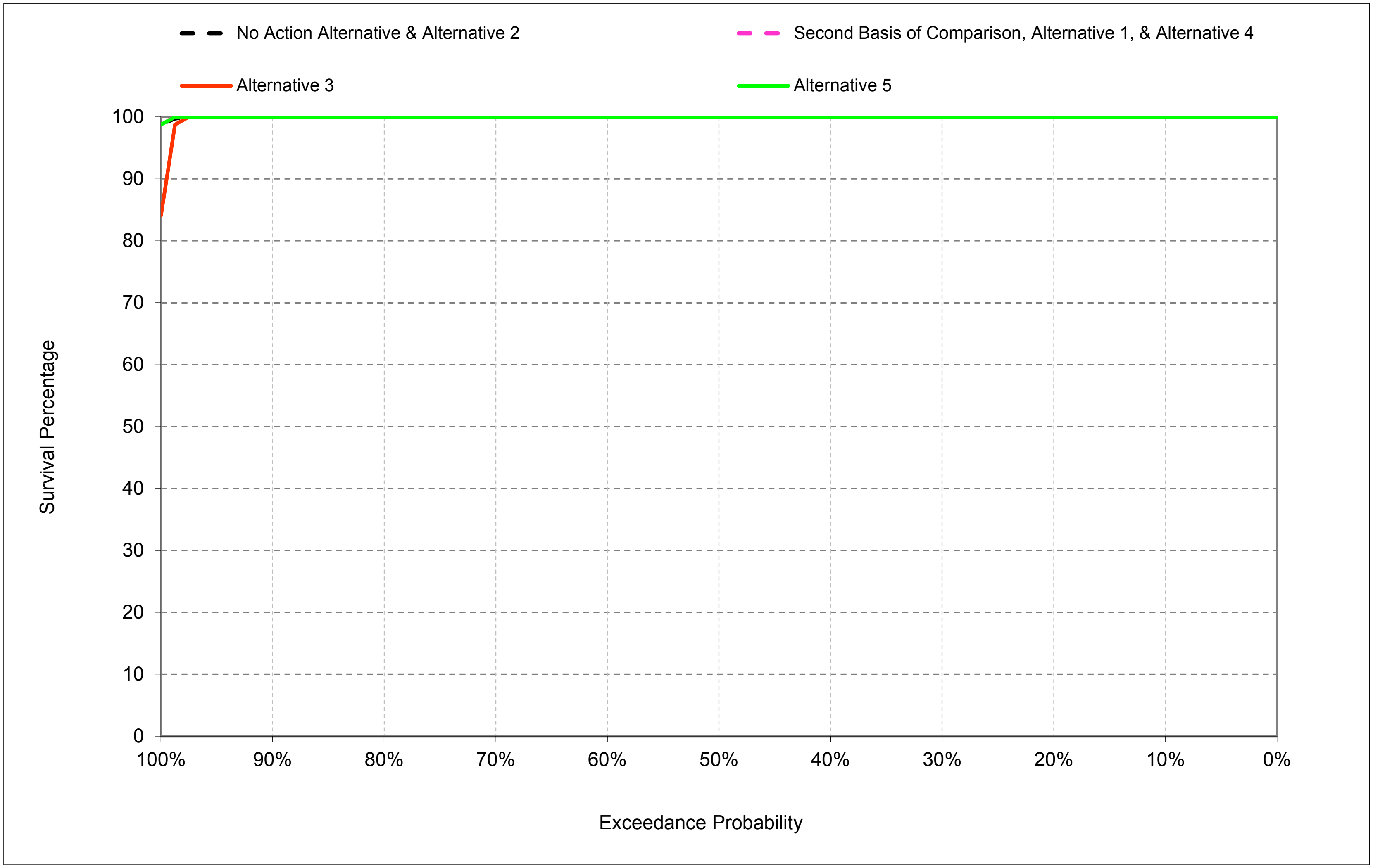
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

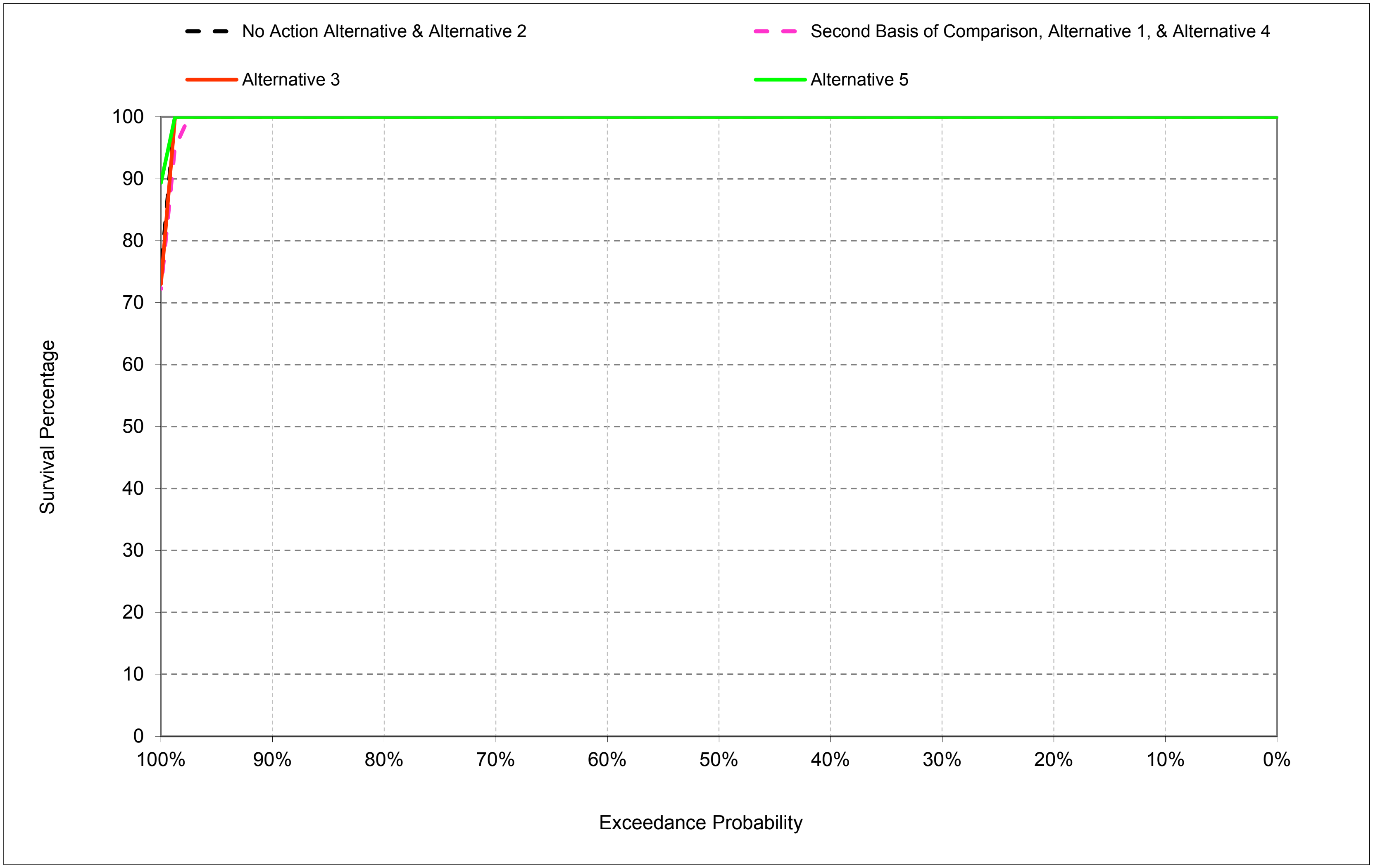
B.9. Oroville Spotted Bass Survival Percentage

Figure B-9-1. Oroville Spotted Bass Nest Survival Percentage, March



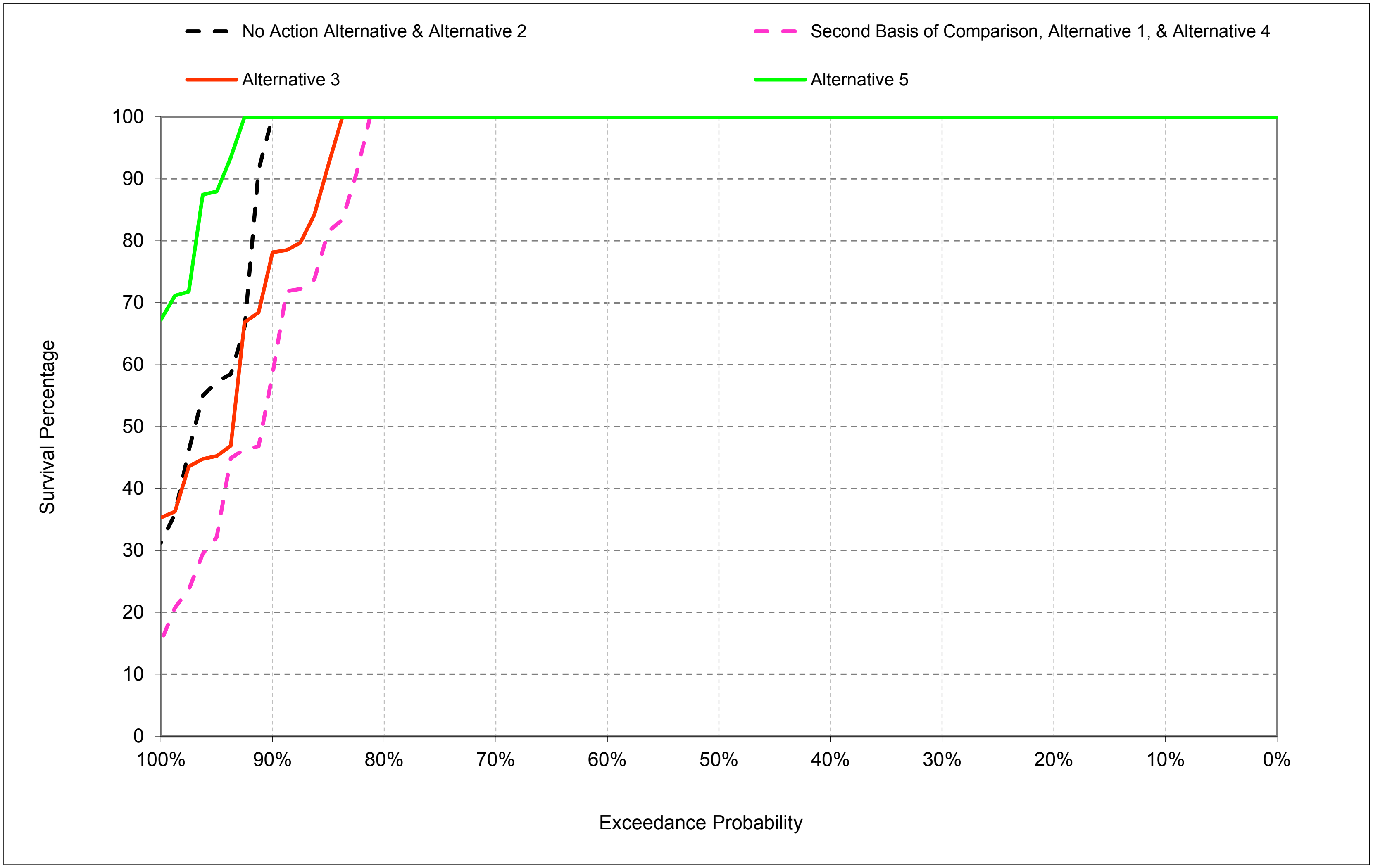
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-9-2. Oroville Spotted Bass Nest Survival Percentage, April



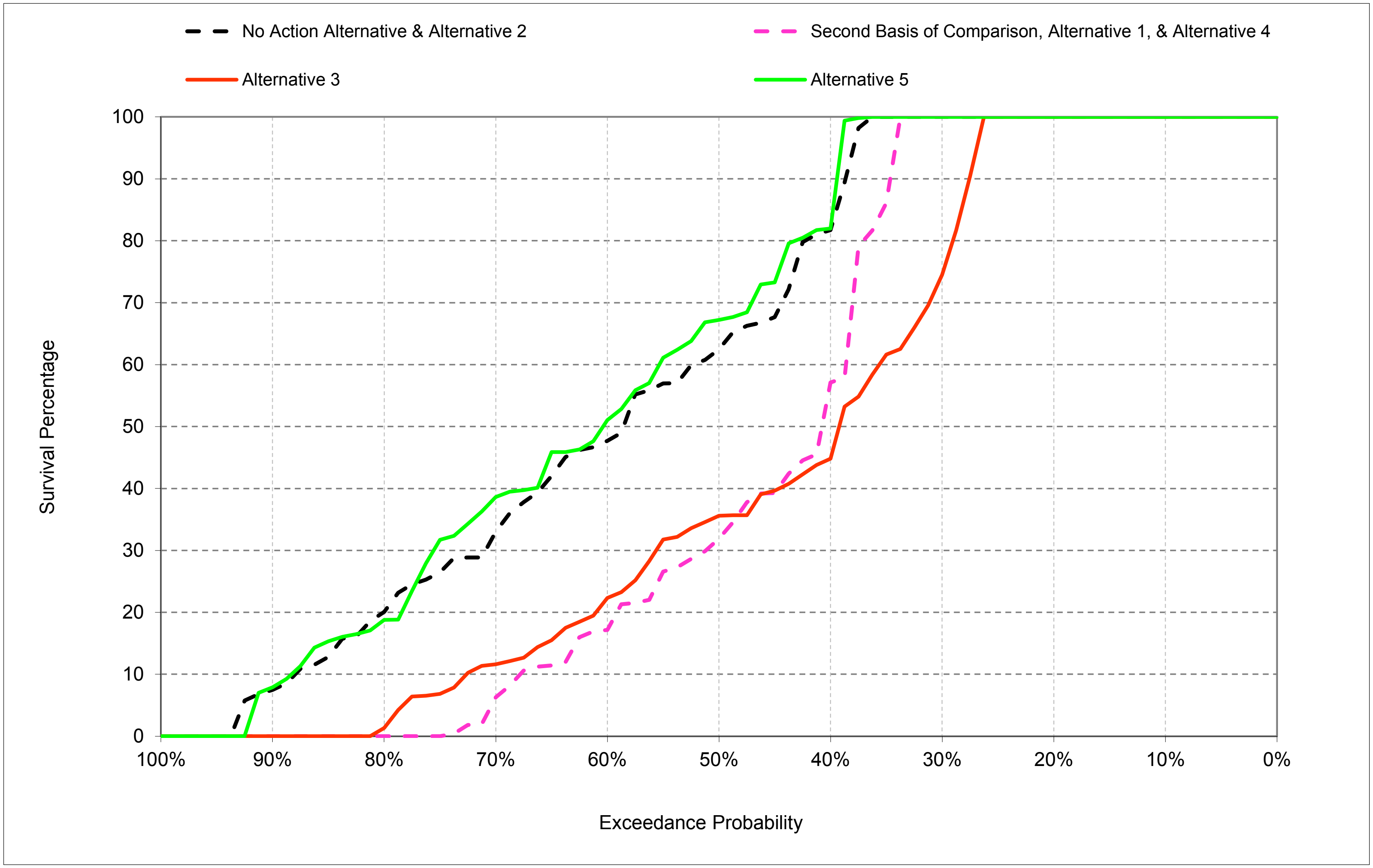
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-9-3. Oroville Spotted Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-9-4. Oroville Spotted Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-9-1. Oroville Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	81
50%	100	100	100	62
60%	100	100	100	47
70%	100	100	100	30
80%	100	100	100	19
90%	100	100	92	7
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	98	100	100	95
Above Normal (16%)	100	100	100	68
Below Normal (13%)	100	100	96	55
Dry (24%)	100	100	86	22
Critical (15%)	100	94	90	43

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	52
50%	100	100	100	31
60%	100	100	100	17
70%	100	100	100	3
80%	100	100	100	0
90%	100	100	48	0
Long Term				
Full Simulation Period[b]	99	99	90	46
Water Year Types[c]				
Wet (32%)	98	100	99	86
Above Normal (16%)	100	100	93	44
Below Normal (13%)	100	100	78	26
Dry (24%)	100	100	83	14
Critical (15%)	100	90	90	32

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-29
50%	0	0	0	-31
60%	0	0	0	-30
70%	0	0	0	-27
80%	0	0	0	-19
90%	0	0	-44	-7
Long Term				
Full Simulation Period[b]	0	-1	-4	-14
Water Year Types[c]				
Wet (32%)	0	0	-1	-9
Above Normal (16%)	0	0	-7	-24
Below Normal (13%)	0	0	-18	-29
Dry (24%)	0	0	-3	-8
Critical (15%)	0	-4	0	-11

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-9-2. Oroville Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	81
50%	100	100	100	62
60%	100	100	100	47
70%	100	100	100	30
80%	100	100	100	19
90%	100	100	92	7
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	98	100	100	95
Above Normal (16%)	100	100	100	68
Below Normal (13%)	100	100	96	55
Dry (24%)	100	100	86	22
Critical (15%)	100	94	90	43

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	73
40%	100	100	100	44
50%	100	100	100	35
60%	100	100	100	21
70%	100	100	100	11
80%	100	100	100	0
90%	100	100	69	0
Long Term				
Full Simulation Period[b]	99	99	93	44
Water Year Types[c]				
Wet (32%)	98	100	100	79
Above Normal (16%)	100	100	93	49
Below Normal (13%)	100	100	91	34
Dry (24%)	100	100	85	9
Critical (15%)	100	90	93	32

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-27
40%	0	0	0	-37
50%	0	0	0	-27
60%	0	0	0	-26
70%	0	0	0	-19
80%	0	0	0	-19
90%	0	0	-23	-7
Long Term				
Full Simulation Period[b]	0	-1	-2	-16
Water Year Types[c]				
Wet (32%)	-1	0	0	-16
Above Normal (16%)	0	0	-7	-19
Below Normal (13%)	0	0	-5	-21
Dry (24%)	0	0	-2	-13
Critical (15%)	0	-4	4	-10

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-9-3. Oroville Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	81
50%	100	100	100	62
60%	100	100	100	47
70%	100	100	100	30
80%	100	100	100	19
90%	100	100	92	7
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	98	100	100	95
Above Normal (16%)	100	100	100	68
Below Normal (13%)	100	100	96	55
Dry (24%)	100	100	86	22
Critical (15%)	100	94	90	43

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	82
50%	100	100	100	67
60%	100	100	100	49
70%	100	100	100	37
80%	100	100	100	17
90%	100	100	100	7
Long Term				
Full Simulation Period[b]	99	99	98	61
Water Year Types[c]				
Wet (32%)	98	100	100	95
Above Normal (16%)	100	100	100	69
Below Normal (13%)	100	100	97	59
Dry (24%)	100	100	97	23
Critical (15%)	100	96	94	46

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	5
60%	0	0	0	2
70%	0	0	0	7
80%	0	0	0	-1
90%	0	0	8	0
Long Term				
Full Simulation Period[b]	0	0	3	1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	2	4
Dry (24%)	0	0	11	0
Critical (15%)	0	2	4	3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-9-4. Oroville Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	52
50%	100	100	100	31
60%	100	100	100	17
70%	100	100	100	3
80%	100	100	100	0
90%	100	100	48	0
Long Term				
Full Simulation Period[b]	99	99	90	46
Water Year Types[c]				
Wet (32%)	98	100	99	86
Above Normal (16%)	100	100	93	44
Below Normal (13%)	100	100	78	26
Dry (24%)	100	100	83	14
Critical (15%)	100	90	90	32

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	81
50%	100	100	100	62
60%	100	100	100	47
70%	100	100	100	30
80%	100	100	100	19
90%	100	100	92	7
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	98	100	100	95
Above Normal (16%)	100	100	100	68
Below Normal (13%)	100	100	96	55
Dry (24%)	100	100	86	22
Critical (15%)	100	94	90	43

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	29
50%	0	0	0	31
60%	0	0	0	30
70%	0	0	0	27
80%	0	0	0	19
90%	0	0	44	7
Long Term				
Full Simulation Period[b]	0	1	4	14
Water Year Types[c]				
Wet (32%)	0	0	1	9
Above Normal (16%)	0	0	7	24
Below Normal (13%)	0	0	18	29
Dry (24%)	0	0	3	8
Critical (15%)	0	4	0	11

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-9-5. Oroville Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	52
50%	100	100	100	31
60%	100	100	100	17
70%	100	100	100	3
80%	100	100	100	0
90%	100	100	48	0
Long Term				
Full Simulation Period[b]	99	99	90	46
Water Year Types[c]				
Wet (32%)	98	100	99	86
Above Normal (16%)	100	100	93	44
Below Normal (13%)	100	100	78	26
Dry (24%)	100	100	83	14
Critical (15%)	100	90	90	32

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	73
40%	100	100	100	44
50%	100	100	100	35
60%	100	100	100	21
70%	100	100	100	11
80%	100	100	100	0
90%	100	100	69	0
Long Term				
Full Simulation Period[b]	99	99	93	44
Water Year Types[c]				
Wet (32%)	98	100	100	79
Above Normal (16%)	100	100	93	49
Below Normal (13%)	100	100	91	34
Dry (24%)	100	100	85	9
Critical (15%)	100	90	93	32

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	-27
40%	0	0	0	-8
50%	0	0	0	4
60%	0	0	0	4
70%	0	0	0	8
80%	0	0	0	0
90%	0	0	21	0
Long Term				
Full Simulation Period[b]	0	0	3	-2
Water Year Types[c]				
Wet (32%)	-1	0	0	-7
Above Normal (16%)	0	0	1	5
Below Normal (13%)	0	0	13	8
Dry (24%)	0	0	1	-5
Critical (15%)	0	1	3	1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-9-6. Oroville Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	52
50%	100	100	100	31
60%	100	100	100	17
70%	100	100	100	3
80%	100	100	100	0
90%	100	100	48	0
Long Term				
Full Simulation Period[b]	99	99	90	46
Water Year Types[c]				
Wet (32%)	98	100	99	86
Above Normal (16%)	100	100	93	44
Below Normal (13%)	100	100	78	26
Dry (24%)	100	100	83	14
Critical (15%)	100	90	90	32

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	82
50%	100	100	100	67
60%	100	100	100	49
70%	100	100	100	37
80%	100	100	100	17
90%	100	100	100	7
Long Term				
Full Simulation Period[b]	99	99	98	61
Water Year Types[c]				
Wet (32%)	98	100	100	95
Above Normal (16%)	100	100	100	69
Below Normal (13%)	100	100	97	59
Dry (24%)	100	100	97	23
Critical (15%)	100	96	94	46

Alternative 5 minus Second Basis of Comparison

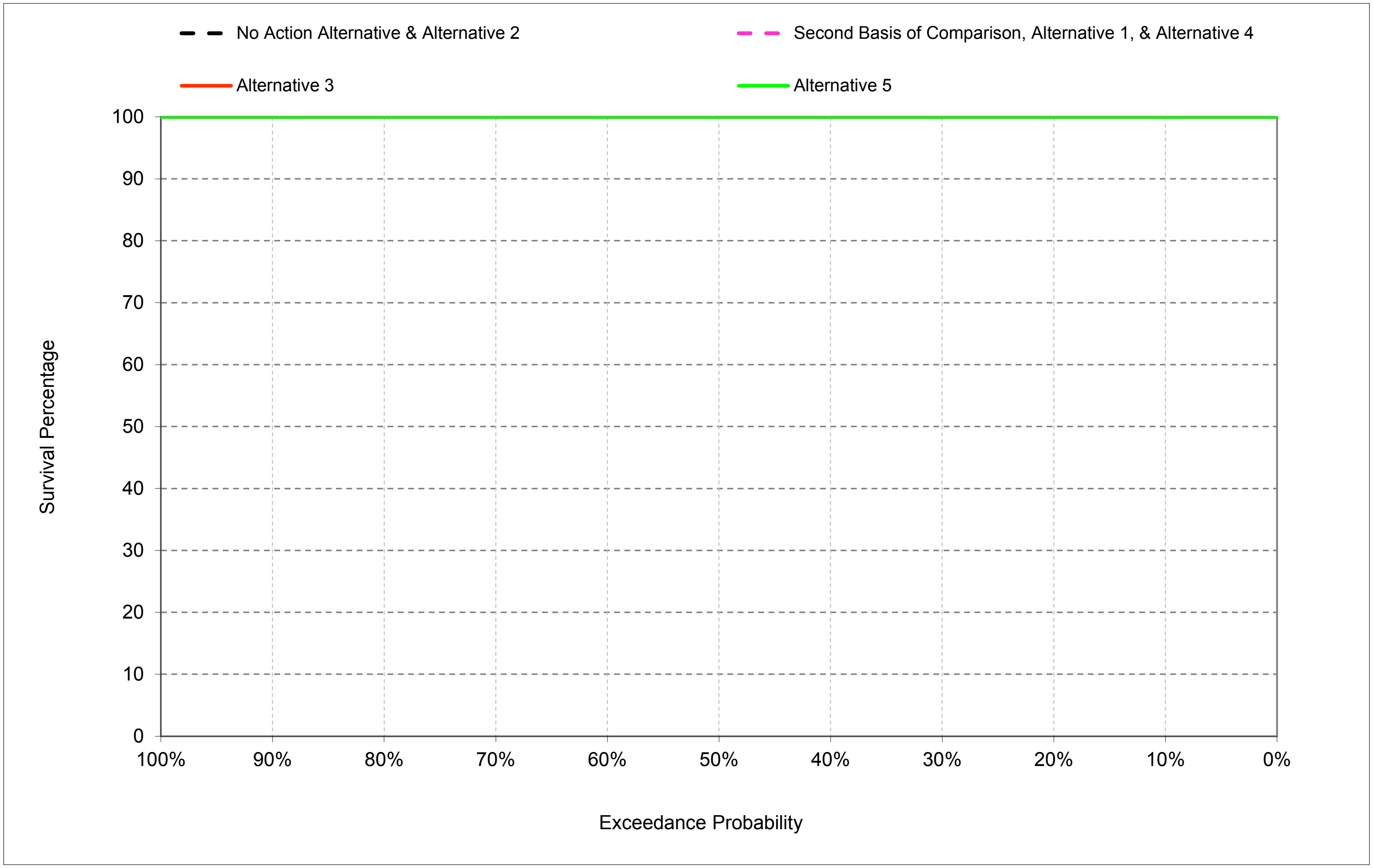
Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	29
50%	0	0	0	36
60%	0	0	0	32
70%	0	0	0	34
80%	0	0	0	17
90%	0	0	52	7
Long Term				
Full Simulation Period[b]	0	1	8	15
Water Year Types[c]				
Wet (32%)	0	0	1	9
Above Normal (16%)	0	0	7	24
Below Normal (13%)	0	0	19	34
Dry (24%)	0	0	14	8
Critical (15%)	0	6	3	14

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.
b Based on the 82-year simulation period.
c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

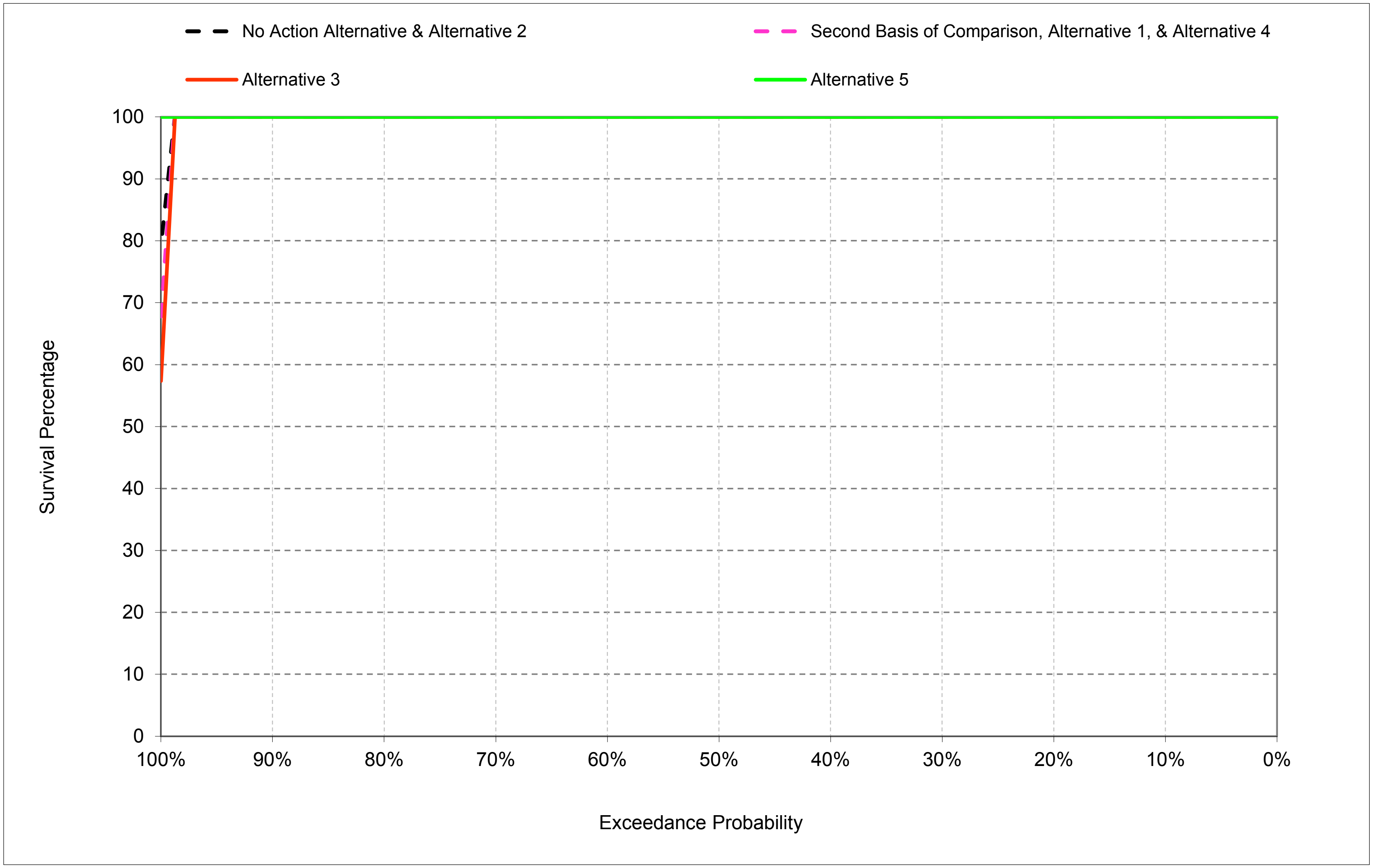
B.10. Folsom Large Mouth Bass Survival Percentage

Figure B-10-1. Folsom Large Mouth Bass Nest Survival Percentage, March



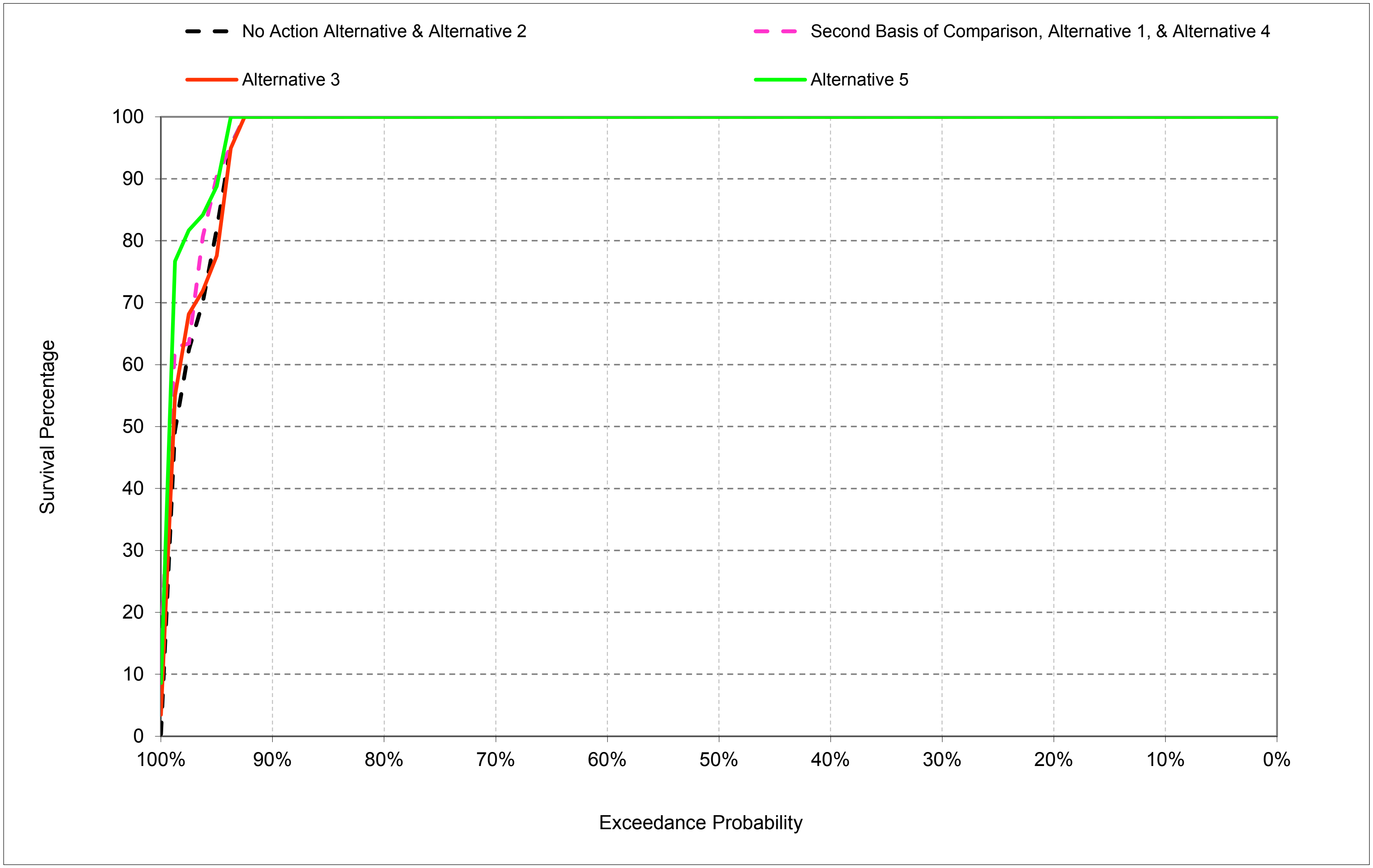
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-10-2. Folsom Large Mouth Bass Nest Survival Percentage, April



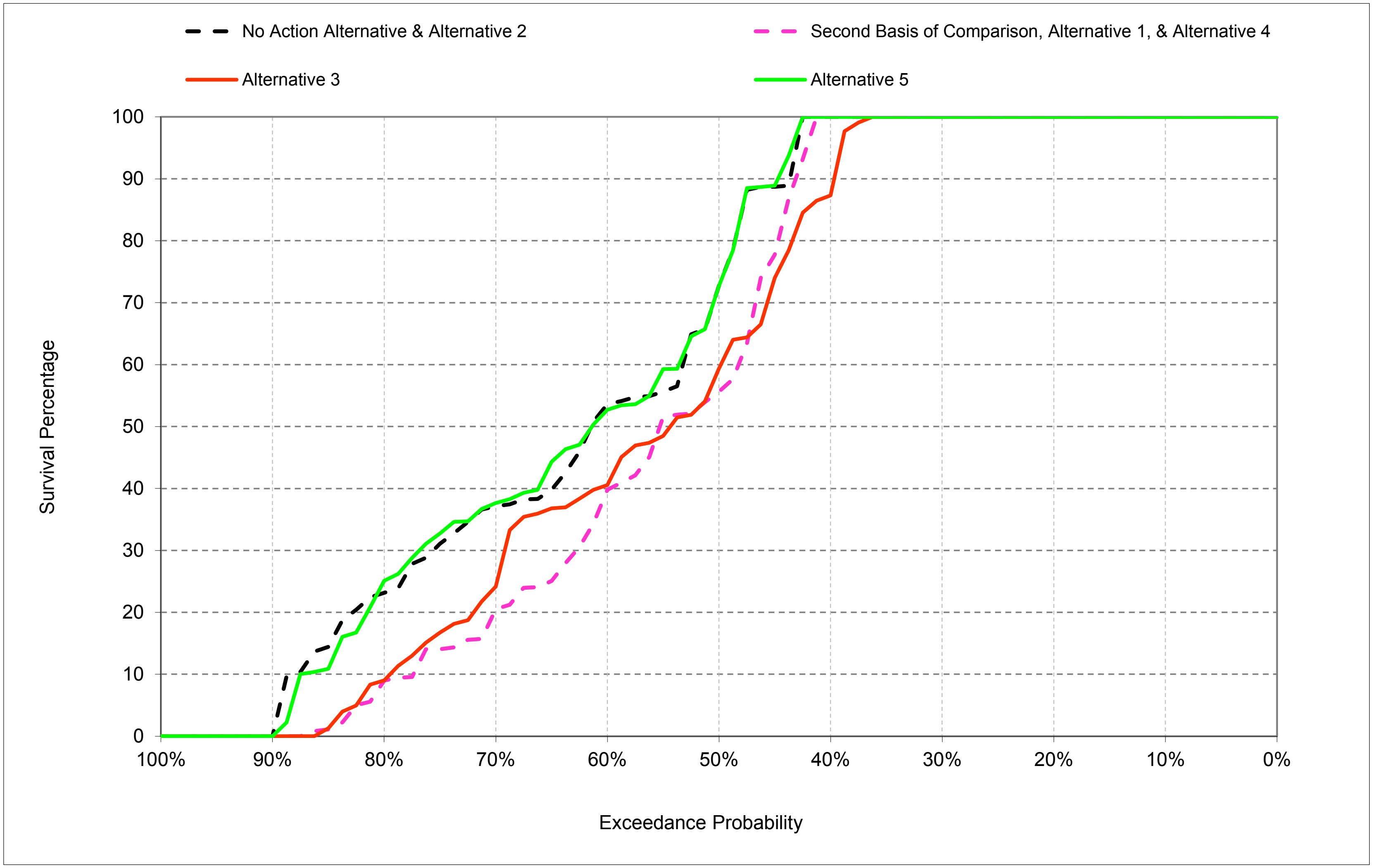
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-10-3. Folsom Large Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-10-4. Folsom Large Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-10-1. Folsom Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	69
60%	100	100	100	52
70%	100	100	100	37
80%	100	100	100	23
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	63
Water Year Types[c]				
Wet (32%)	100	100	100	93
Above Normal (16%)	100	100	100	61
Below Normal (13%)	100	100	100	61
Dry (24%)	100	100	94	35
Critical (15%)	97	93	82	46

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	55
60%	100	100	100	37
70%	100	100	100	17
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	56
Water Year Types[c]				
Wet (32%)	100	100	100	90
Above Normal (16%)	100	100	100	45
Below Normal (13%)	100	100	100	35
Dry (24%)	100	100	96	32
Critical (15%)	97	92	83	55

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	-14
60%	0	0	0	-15
70%	0	0	0	-20
80%	0	0	0	-16
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	1	-7
Water Year Types[c]				
Wet (32%)	0	0	0	-3
Above Normal (16%)	0	0	0	-16
Below Normal (13%)	0	0	0	-26
Dry (24%)	0	0	2	-3
Critical (15%)	0	-1	1	9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-10-2. Folsom Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	69
60%	100	100	100	52
70%	100	100	100	37
80%	100	100	100	23
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	63
Water Year Types[c]				
Wet (32%)	100	100	100	93
Above Normal (16%)	100	100	100	61
Below Normal (13%)	100	100	100	61
Dry (24%)	100	100	94	35
Critical (15%)	97	93	82	46

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	87
50%	100	100	100	57
60%	100	100	100	40
70%	100	100	100	22
80%	100	100	100	8
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	96	57
Water Year Types[c]				
Wet (32%)	100	100	100	85
Above Normal (16%)	100	100	100	45
Below Normal (13%)	100	100	98	50
Dry (24%)	100	100	96	34
Critical (15%)	96	91	81	54

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-13
50%	0	0	0	-13
60%	0	0	0	-12
70%	0	0	0	-14
80%	0	0	0	-14
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	-6
Water Year Types[c]				
Wet (32%)	0	0	0	-8
Above Normal (16%)	0	0	0	-16
Below Normal (13%)	0	0	-2	-11
Dry (24%)	0	0	2	-1
Critical (15%)	-1	-2	-1	8

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-10-3. Folsom Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	69
60%	100	100	100	52
70%	100	100	100	37
80%	100	100	100	23
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	63
Water Year Types[c]				
Wet (32%)	100	100	100	93
Above Normal (16%)	100	100	100	61
Below Normal (13%)	100	100	100	61
Dry (24%)	100	100	94	35
Critical (15%)	97	93	82	46

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	69
60%	100	100	100	51
70%	100	100	100	37
80%	100	100	100	22
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	97	63
Water Year Types[c]				
Wet (32%)	100	100	100	93
Above Normal (16%)	100	100	100	61
Below Normal (13%)	100	100	100	62
Dry (24%)	100	100	97	37
Critical (15%)	97	95	83	43

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	-1
70%	0	0	0	0
80%	0	0	0	-1
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	1	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	1
Dry (24%)	0	0	3	2
Critical (15%)	0	2	1	-3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-10-4. Folsom Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	55
60%	100	100	100	37
70%	100	100	100	17
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	56
Water Year Types[c]				
Wet (32%)	100	100	100	90
Above Normal (16%)	100	100	100	45
Below Normal (13%)	100	100	100	35
Dry (24%)	100	100	96	32
Critical (15%)	97	92	83	55

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	69
60%	100	100	100	52
70%	100	100	100	37
80%	100	100	100	23
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	63
Water Year Types[c]				
Wet (32%)	100	100	100	93
Above Normal (16%)	100	100	100	61
Below Normal (13%)	100	100	100	61
Dry (24%)	100	100	94	35
Critical (15%)	97	93	82	46

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	14
60%	0	0	0	15
70%	0	0	0	20
80%	0	0	0	16
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	-1	7
Water Year Types[c]				
Wet (32%)	0	0	0	3
Above Normal (16%)	0	0	0	16
Below Normal (13%)	0	0	0	26
Dry (24%)	0	0	-2	3
Critical (15%)	0	1	-1	-9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-10-5. Folsom Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	55
60%	100	100	100	37
70%	100	100	100	17
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	56
Water Year Types[c]				
Wet (32%)	100	100	100	90
Above Normal (16%)	100	100	100	45
Below Normal (13%)	100	100	100	35
Dry (24%)	100	100	96	32
Critical (15%)	97	92	83	55

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	87
50%	100	100	100	57
60%	100	100	100	40
70%	100	100	100	22
80%	100	100	100	8
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	96	57
Water Year Types[c]				
Wet (32%)	100	100	100	85
Above Normal (16%)	100	100	100	45
Below Normal (13%)	100	100	98	50
Dry (24%)	100	100	96	34
Critical (15%)	96	91	81	54

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-13
50%	0	0	0	2
60%	0	0	0	4
70%	0	0	0	5
80%	0	0	0	2
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	-5
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	-2	15
Dry (24%)	0	0	0	2
Critical (15%)	-1	-1	-2	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-10-6. Folsom Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	55
60%	100	100	100	37
70%	100	100	100	17
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	96	56
Water Year Types[c]				
Wet (32%)	100	100	100	90
Above Normal (16%)	100	100	100	45
Below Normal (13%)	100	100	100	35
Dry (24%)	100	100	96	32
Critical (15%)	97	92	83	55

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	69
60%	100	100	100	51
70%	100	100	100	37
80%	100	100	100	22
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	100	99	97	63
Water Year Types[c]				
Wet (32%)	100	100	100	93
Above Normal (16%)	100	100	100	61
Below Normal (13%)	100	100	100	62
Dry (24%)	100	100	97	37
Critical (15%)	97	95	83	43

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	14
60%	0	0	0	15
70%	0	0	0	20
80%	0	0	0	15
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	7
Water Year Types[c]				
Wet (32%)	0	0	0	3
Above Normal (16%)	0	0	0	17
Below Normal (13%)	0	0	0	27
Dry (24%)	0	0	2	4
Critical (15%)	0	3	0	-12

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

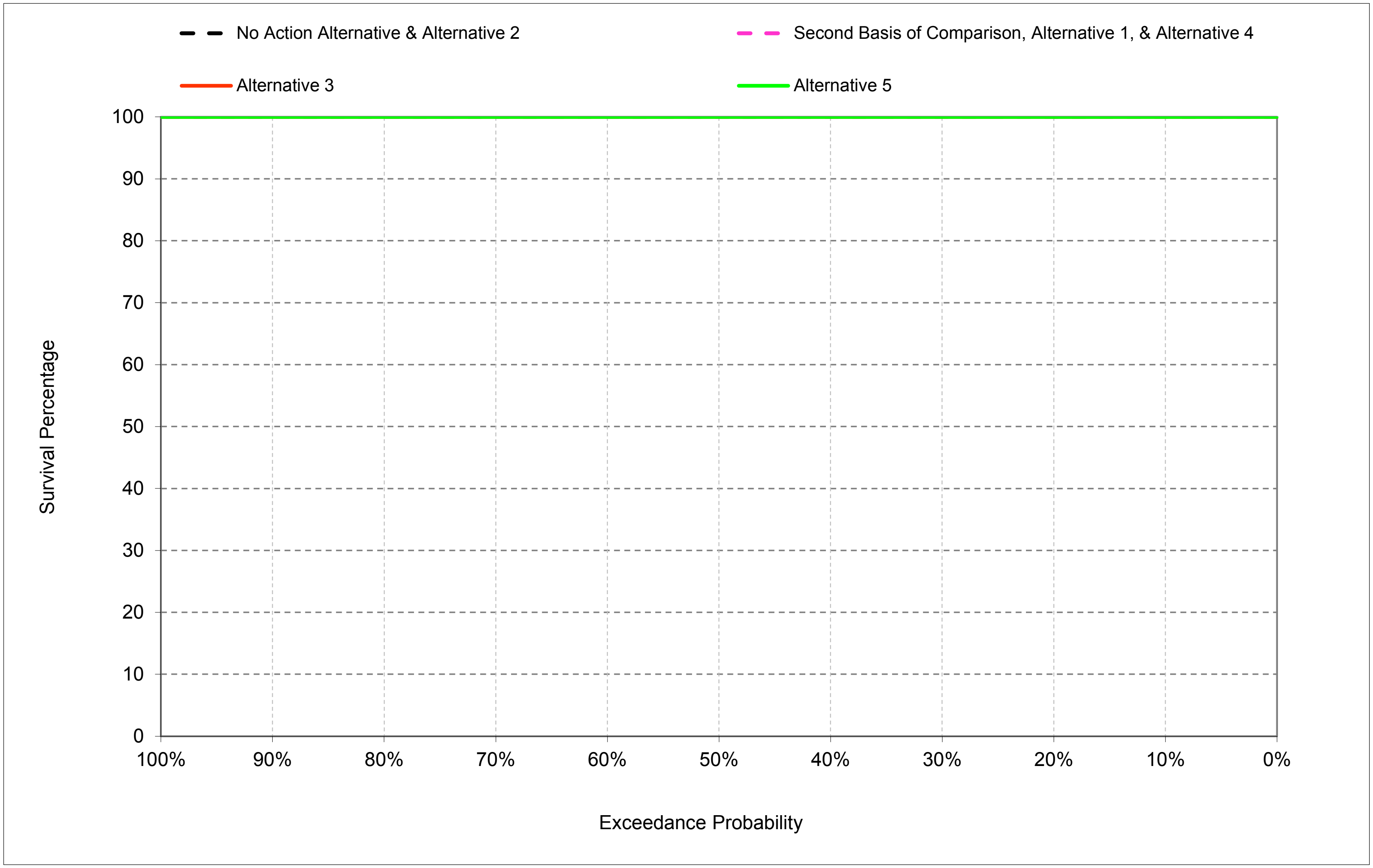
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

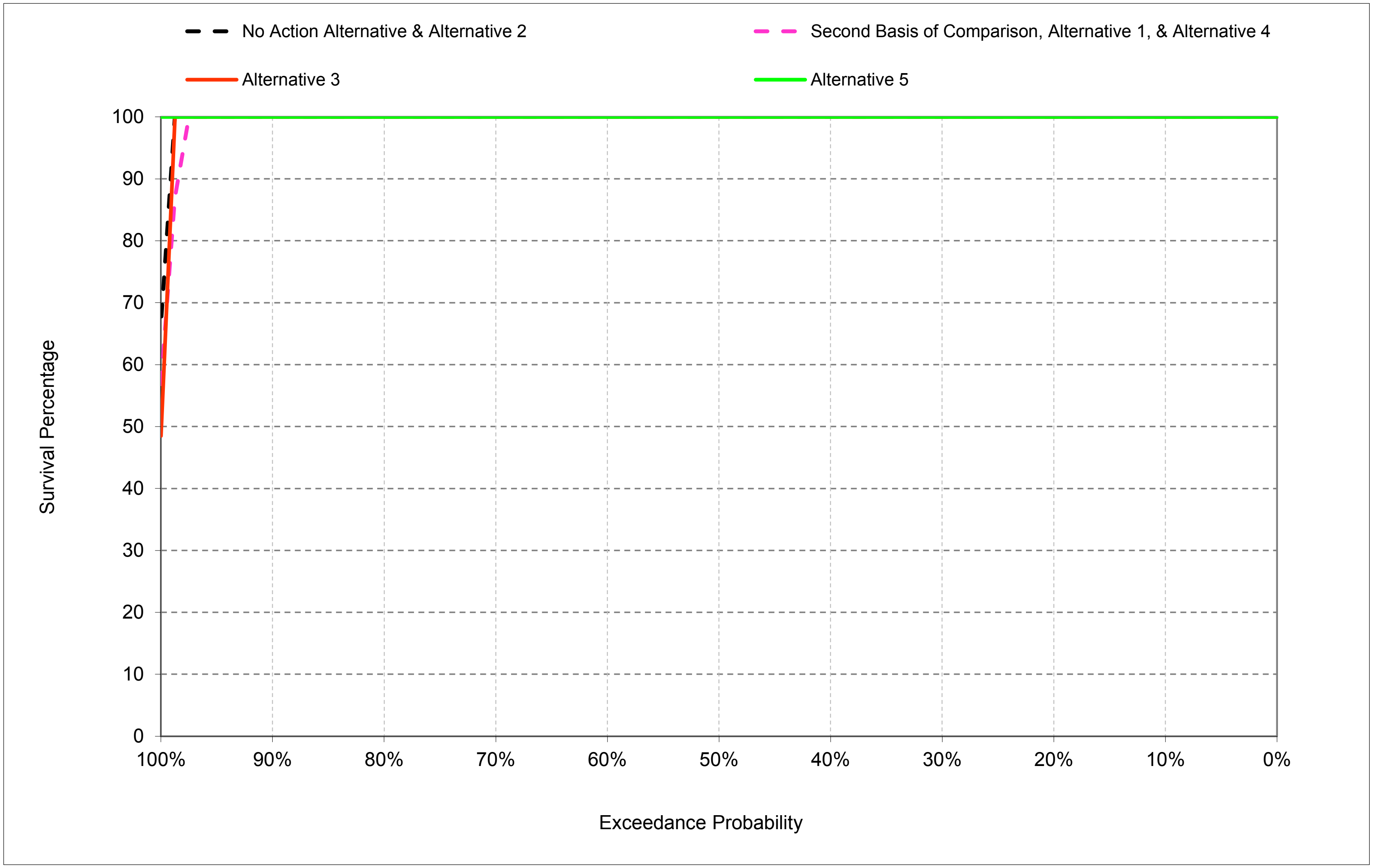
B.11. Folsom Small Mouth Bass Survival Percentage

Figure B-11-1. Folsom Small Mouth Bass Nest Survival Percentage, March



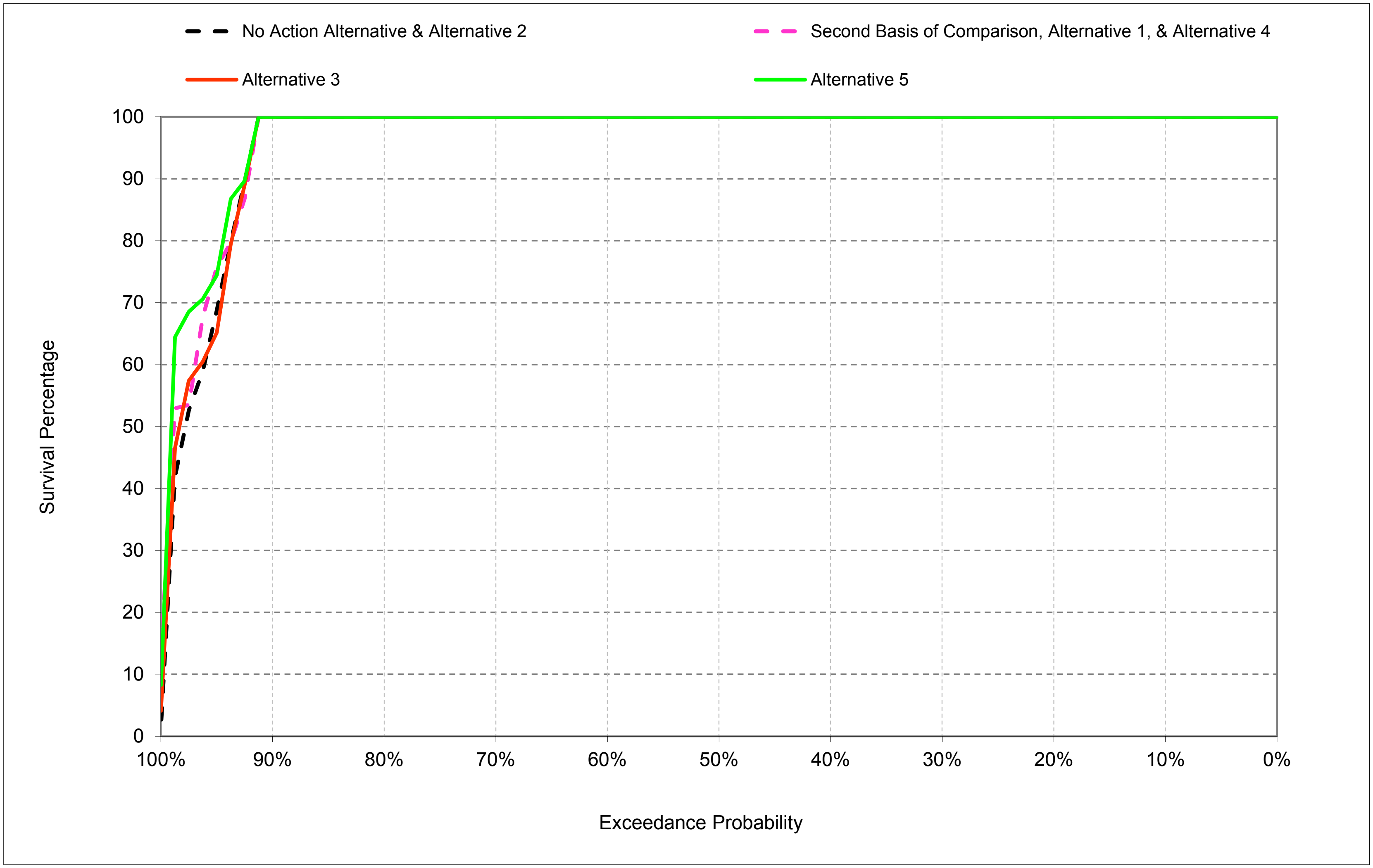
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-11-2. Folsom Small Mouth Bass Nest Survival Percentage, April



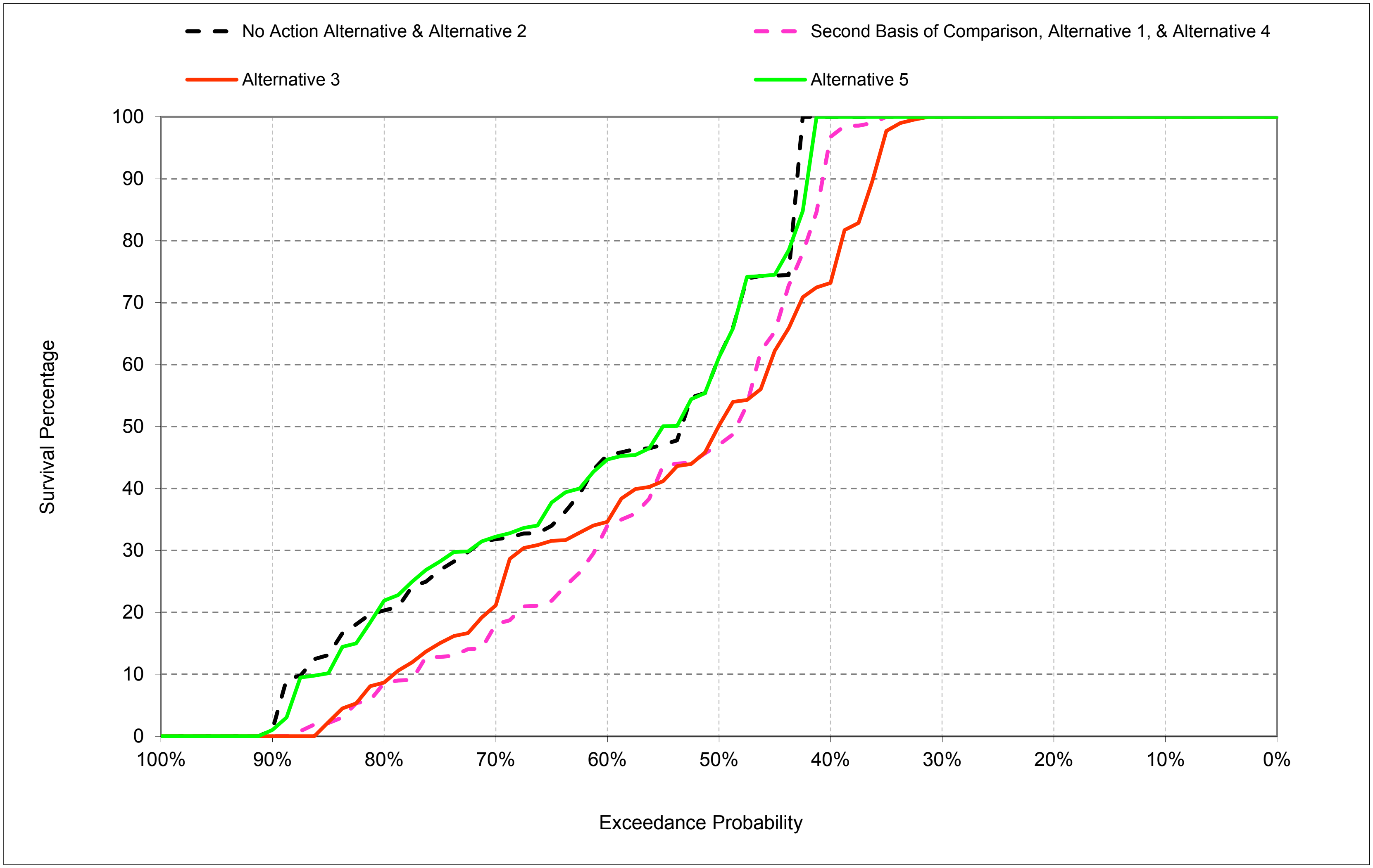
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-11-3. Folsom Small Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-11-4. Folsom Small Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-11-1. Folsom Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	58
60%	100	100	100	44
70%	100	100	100	32
80%	100	100	100	20
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	100	100	100	92
Above Normal (16%)	100	100	100	58
Below Normal (13%)	100	100	98	57
Dry (24%)	100	100	93	32
Critical (15%)	96	92	80	41

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	92
50%	100	100	100	46
60%	100	100	100	31
70%	100	100	100	15
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	54
Water Year Types[c]				
Wet (32%)	100	100	100	89
Above Normal (16%)	100	100	100	43
Below Normal (13%)	100	100	98	34
Dry (24%)	100	100	94	29
Critical (15%)	96	90	81	50

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-8
50%	0	0	0	-12
60%	0	0	0	-13
70%	0	0	0	-16
80%	0	0	0	-13
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	-6
Water Year Types[c]				
Wet (32%)	0	0	0	-3
Above Normal (16%)	0	0	0	-15
Below Normal (13%)	0	0	0	-24
Dry (24%)	0	0	1	-2
Critical (15%)	0	-2	1	9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-11-2. Folsom Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	58
60%	100	100	100	44
70%	100	100	100	32
80%	100	100	100	20
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	100	100	100	92
Above Normal (16%)	100	100	100	58
Below Normal (13%)	100	100	98	57
Dry (24%)	100	100	93	32
Critical (15%)	96	92	80	41

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	73
50%	100	100	100	48
60%	100	100	100	34
70%	100	100	100	20
80%	100	100	100	8
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	54
Water Year Types[c]				
Wet (32%)	100	100	100	82
Above Normal (16%)	100	100	100	43
Below Normal (13%)	100	100	97	46
Dry (24%)	100	100	94	31
Critical (15%)	95	90	79	50

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-27
50%	0	0	0	-10
60%	0	0	0	-10
70%	0	0	0	-12
80%	0	0	0	-12
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	-6
Water Year Types[c]				
Wet (32%)	0	0	0	-10
Above Normal (16%)	0	0	0	-15
Below Normal (13%)	0	0	-1	-12
Dry (24%)	0	0	2	-1
Critical (15%)	-1	-2	-1	8

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-11-3. Folsom Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	58
60%	100	100	100	44
70%	100	100	100	32
80%	100	100	100	20
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	100	100	100	92
Above Normal (16%)	100	100	100	58
Below Normal (13%)	100	100	98	57
Dry (24%)	100	100	93	32
Critical (15%)	96	92	80	41

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	58
60%	100	100	100	43
70%	100	100	100	32
80%	100	100	100	19
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	96	60
Water Year Types[c]				
Wet (32%)	100	100	100	92
Above Normal (16%)	100	100	100	58
Below Normal (13%)	100	100	99	58
Dry (24%)	100	100	95	33
Critical (15%)	96	95	81	38

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	-1
70%	0	0	0	0
80%	0	0	0	-1
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	1	0
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	1	1
Dry (24%)	0	0	3	1
Critical (15%)	0	3	1	-4

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-11-4. Folsom Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	92
50%	100	100	100	46
60%	100	100	100	31
70%	100	100	100	15
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	54
Water Year Types[c]				
Wet (32%)	100	100	100	89
Above Normal (16%)	100	100	100	43
Below Normal (13%)	100	100	98	34
Dry (24%)	100	100	94	29
Critical (15%)	96	90	81	50

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	58
60%	100	100	100	44
70%	100	100	100	32
80%	100	100	100	20
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	60
Water Year Types[c]				
Wet (32%)	100	100	100	92
Above Normal (16%)	100	100	100	58
Below Normal (13%)	100	100	98	57
Dry (24%)	100	100	93	32
Critical (15%)	96	92	80	41

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	8
50%	0	0	0	12
60%	0	0	0	13
70%	0	0	0	16
80%	0	0	0	13
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	6
Water Year Types[c]				
Wet (32%)	0	0	0	3
Above Normal (16%)	0	0	0	15
Below Normal (13%)	0	0	0	24
Dry (24%)	0	0	-1	2
Critical (15%)	0	2	-1	-9

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-11-5. Folsom Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	92
50%	100	100	100	46
60%	100	100	100	31
70%	100	100	100	15
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	54
Water Year Types[c]				
Wet (32%)	100	100	100	89
Above Normal (16%)	100	100	100	43
Below Normal (13%)	100	100	98	34
Dry (24%)	100	100	94	29
Critical (15%)	96	90	81	50

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	73
50%	100	100	100	48
60%	100	100	100	34
70%	100	100	100	20
80%	100	100	100	8
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	54
Water Year Types[c]				
Wet (32%)	100	100	100	82
Above Normal (16%)	100	100	100	43
Below Normal (13%)	100	100	97	46
Dry (24%)	100	100	94	31
Critical (15%)	95	90	79	50

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-19
50%	0	0	0	2
60%	0	0	0	3
70%	0	0	0	4
80%	0	0	0	2
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	0
Water Year Types[c]				
Wet (32%)	0	0	0	-6
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	-1	12
Dry (24%)	0	0	0	2
Critical (15%)	-1	0	-1	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-11-6. Folsom Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	92
50%	100	100	100	46
60%	100	100	100	31
70%	100	100	100	15
80%	100	100	100	6
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	95	54
Water Year Types[c]				
Wet (32%)	100	100	100	89
Above Normal (16%)	100	100	100	43
Below Normal (13%)	100	100	98	34
Dry (24%)	100	100	94	29
Critical (15%)	96	90	81	50

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	58
60%	100	100	100	43
70%	100	100	100	32
80%	100	100	100	19
90%	100	100	100	0
Long Term				
Full Simulation Period[b]	99	99	96	60
Water Year Types[c]				
Wet (32%)	100	100	100	92
Above Normal (16%)	100	100	100	58
Below Normal (13%)	100	100	99	58
Dry (24%)	100	100	95	33
Critical (15%)	96	95	81	38

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	8
50%	0	0	0	12
60%	0	0	0	12
70%	0	0	0	16
80%	0	0	0	13
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	1	0	6
Water Year Types[c]				
Wet (32%)	0	0	0	3
Above Normal (16%)	0	0	0	15
Below Normal (13%)	0	0	1	24
Dry (24%)	0	0	1	4
Critical (15%)	0	5	1	-12

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

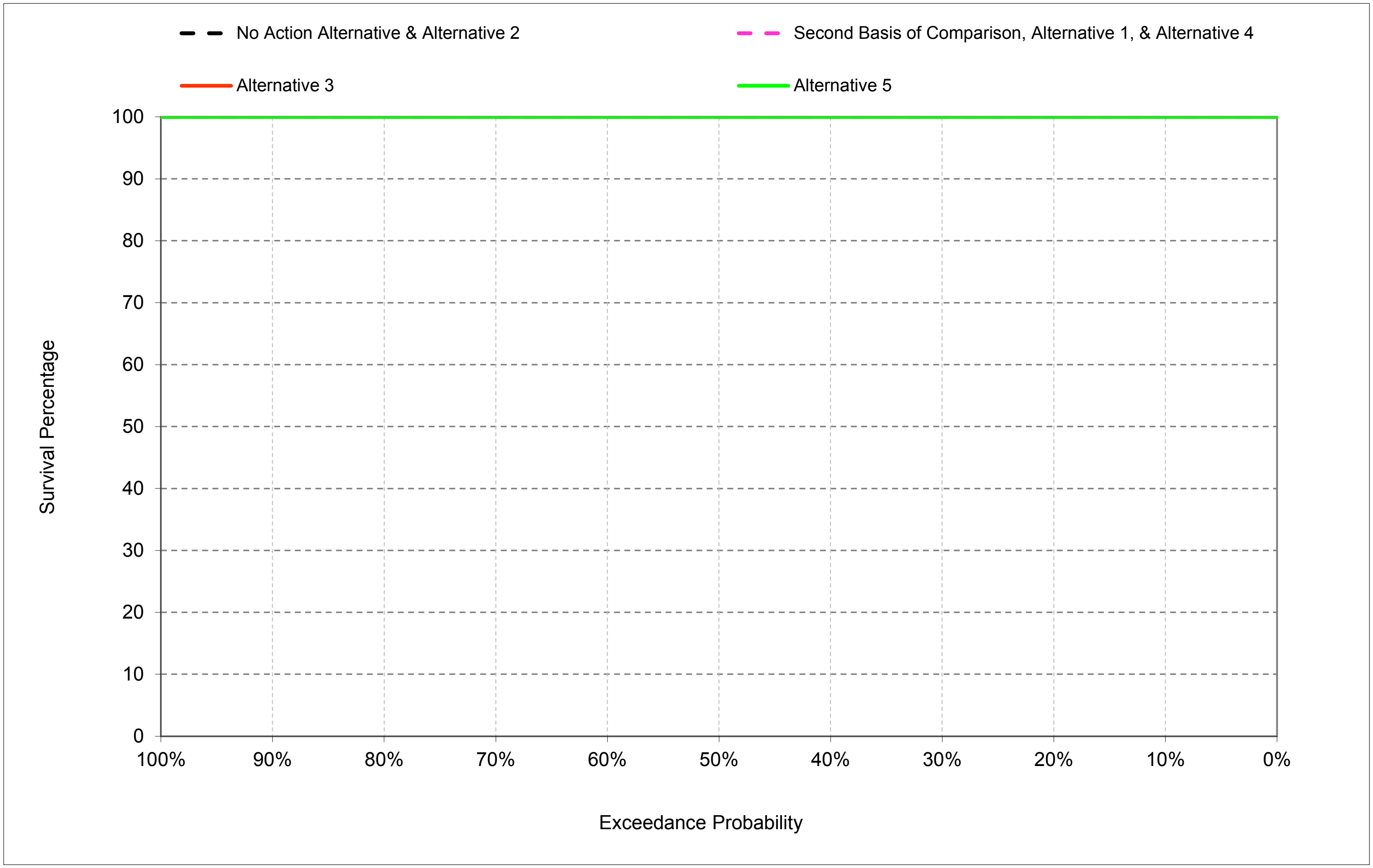
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

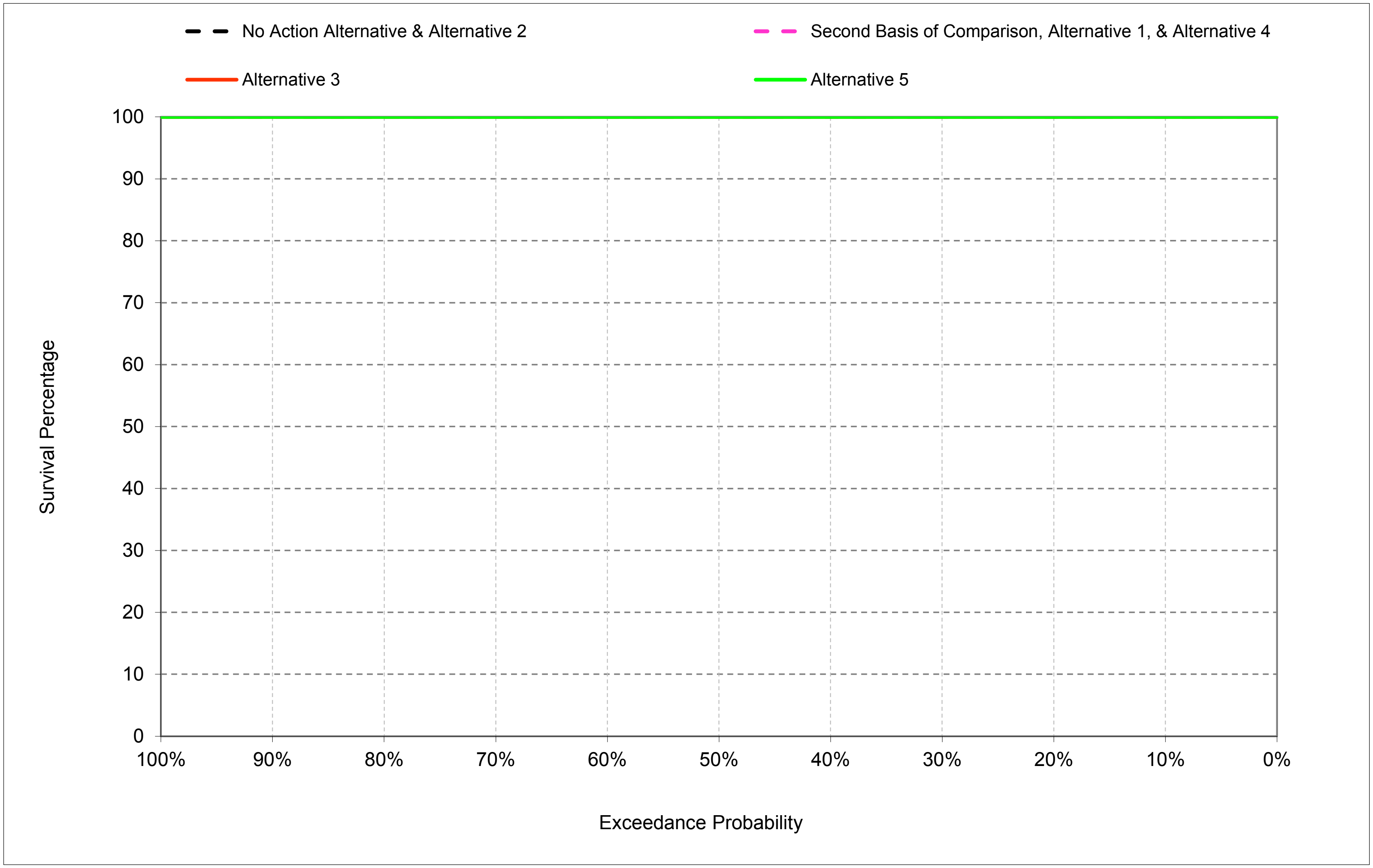
B.12. Folsom Spotted Bass Survival Percentage

Figure B-12-1. Folsom Spotted Bass Nest Survival Percentage, March



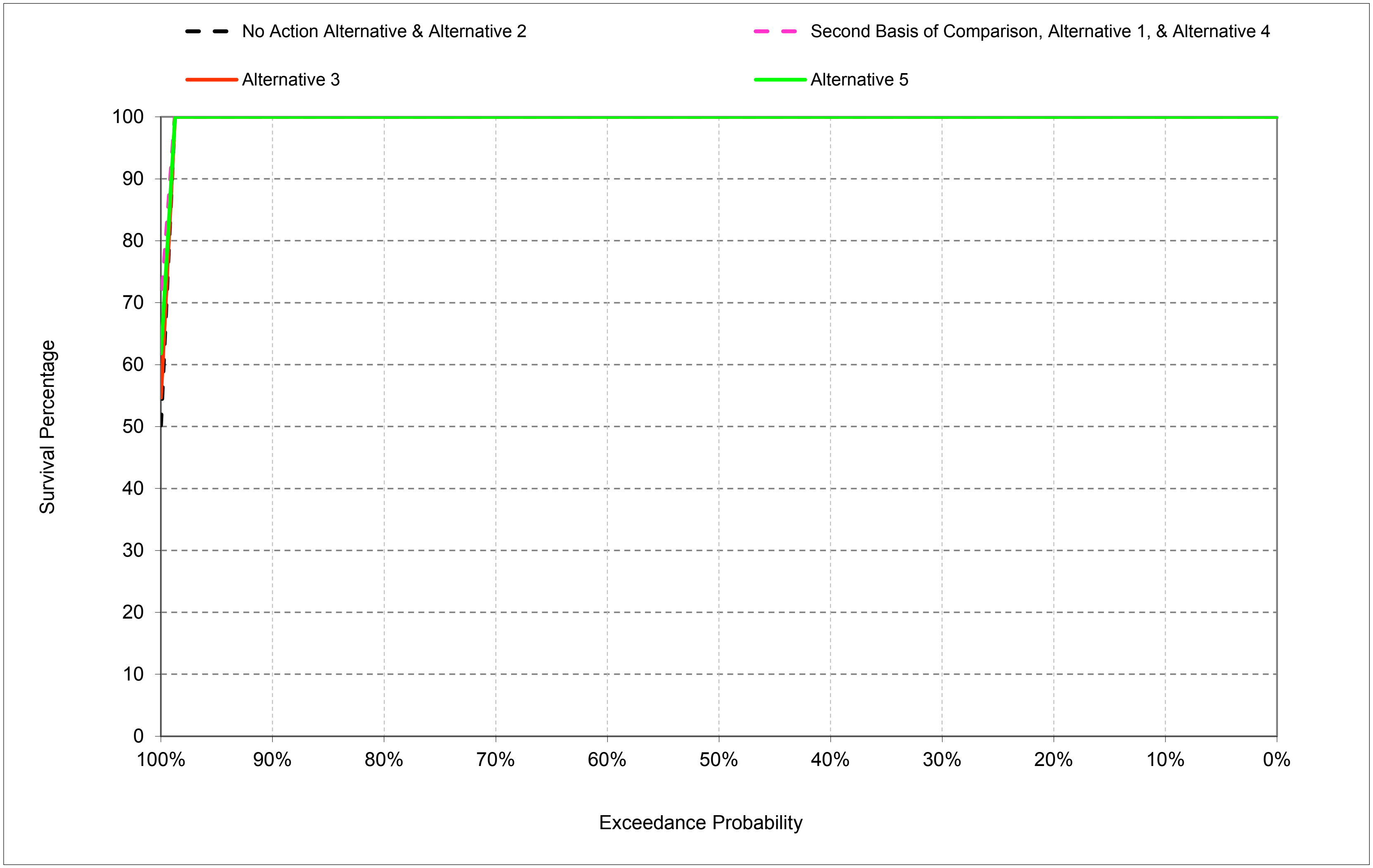
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-12-2. Folsom Spotted Bass Nest Survival Percentage, April



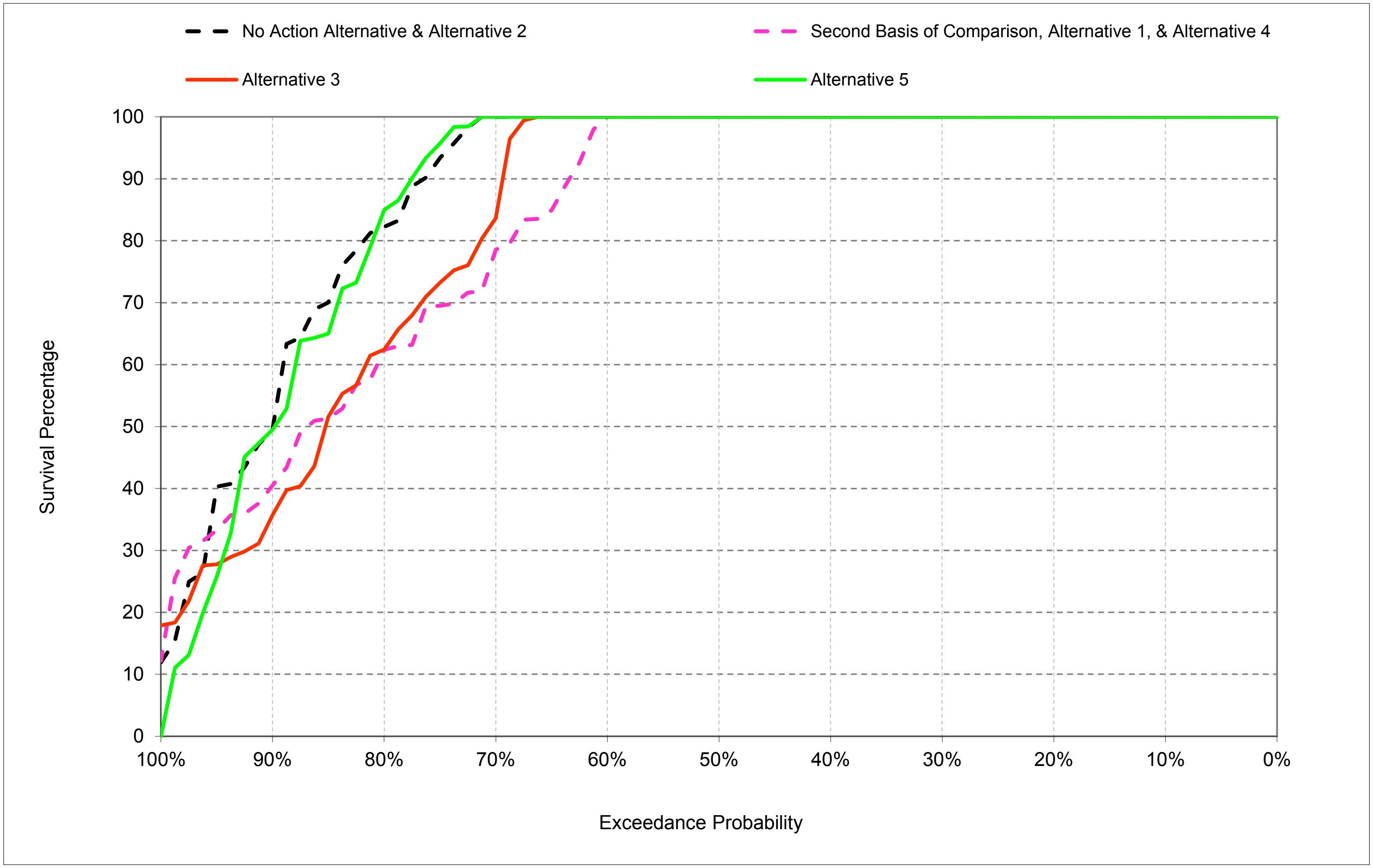
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-12-3. Folsom Spotted Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-12-4. Folsom Spotted Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-12-1. Folsom Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	81
90%	100	100	100	47
Long Term				
Full Simulation Period[b]	100	100	99	88
Water Year Types[c]				
Wet (32%)	100	100	100	100
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	100	90
Dry (24%)	100	100	100	73
Critical (15%)	100	100	91	80

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	99
70%	100	100	100	74
80%	100	100	100	59
90%	100	100	100	38
Long Term				
Full Simulation Period[b]	100	100	99	83
Water Year Types[c]				
Wet (32%)	100	100	100	99
Above Normal (16%)	100	100	100	78
Below Normal (13%)	100	100	100	68
Dry (24%)	100	100	100	72
Critical (15%)	100	100	93	85

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	-1
70%	0	0	0	-26
80%	0	0	0	-23
90%	0	0	0	-9
Long Term				
Full Simulation Period[b]	0	0	0	-6
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	0	-16
Below Normal (13%)	0	0	0	-22
Dry (24%)	0	0	0	-1
Critical (15%)	0	0	2	4

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-12-2. Folsom Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	81
90%	100	100	100	47
Long Term				
Full Simulation Period[b]	100	100	99	88
Water Year Types[c]				
Wet (32%)	100	100	100	100
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	100	90
Dry (24%)	100	100	100	73
Critical (15%)	100	100	91	80

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	81
80%	100	100	100	62
90%	100	100	100	32
Long Term				
Full Simulation Period[b]	100	100	99	84
Water Year Types[c]				
Wet (32%)	100	100	100	98
Above Normal (16%)	100	100	100	75
Below Normal (13%)	100	100	100	84
Dry (24%)	100	100	100	70
Critical (15%)	100	100	91	83

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	-19
80%	0	0	0	-20
90%	0	0	0	-16
Long Term				
Full Simulation Period[b]	0	0	0	-5
Water Year Types[c]				
Wet (32%)	0	0	0	-2
Above Normal (16%)	0	0	0	-19
Below Normal (13%)	0	0	0	-6
Dry (24%)	0	0	0	-3
Critical (15%)	0	0	0	3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-12-3. Folsom Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	81
90%	100	100	100	47
Long Term				
Full Simulation Period[b]	100	100	99	88
Water Year Types[c]				
Wet (32%)	100	100	100	100
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	100	90
Dry (24%)	100	100	100	73
Critical (15%)	100	100	91	80

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	80
90%	100	100	100	48
Long Term				
Full Simulation Period[b]	100	100	99	87
Water Year Types[c]				
Wet (32%)	100	100	100	100
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	100	91
Dry (24%)	100	100	100	73
Critical (15%)	100	100	94	73

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	0
80%	0	0	0	-1
90%	0	0	0	0
Long Term				
Full Simulation Period[b]	0	0	0	-1
Water Year Types[c]				
Wet (32%)	0	0	0	0
Above Normal (16%)	0	0	0	0
Below Normal (13%)	0	0	0	0
Dry (24%)	0	0	0	0
Critical (15%)	0	0	3	-7

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-12-4. Folsom Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	99
70%	100	100	100	74
80%	100	100	100	59
90%	100	100	100	38
Long Term				
Full Simulation Period[b]	100	100	99	83
Water Year Types[c]				
Wet (32%)	100	100	100	99
Above Normal (16%)	100	100	100	78
Below Normal (13%)	100	100	100	68
Dry (24%)	100	100	100	72
Critical (15%)	100	100	93	85

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	81
90%	100	100	100	47
Long Term				
Full Simulation Period[b]	100	100	99	88
Water Year Types[c]				
Wet (32%)	100	100	100	100
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	100	90
Dry (24%)	100	100	100	73
Critical (15%)	100	100	91	80

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	1
70%	0	0	0	26
80%	0	0	0	23
90%	0	0	0	9
Long Term				
Full Simulation Period[b]	0	0	0	6
Water Year Types[c]				
Wet (32%)	0	0	0	1
Above Normal (16%)	0	0	0	16
Below Normal (13%)	0	0	0	22
Dry (24%)	0	0	0	1
Critical (15%)	0	0	-2	-4

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-12-5. Folsom Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	99
70%	100	100	100	74
80%	100	100	100	59
90%	100	100	100	38
Long Term				
Full Simulation Period[b]	100	100	99	83
Water Year Types[c]				
Wet (32%)	100	100	100	99
Above Normal (16%)	100	100	100	78
Below Normal (13%)	100	100	100	68
Dry (24%)	100	100	100	72
Critical (15%)	100	100	93	85

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	81
80%	100	100	100	62
90%	100	100	100	32
Long Term				
Full Simulation Period[b]	100	100	99	84
Water Year Types[c]				
Wet (32%)	100	100	100	98
Above Normal (16%)	100	100	100	75
Below Normal (13%)	100	100	100	84
Dry (24%)	100	100	100	70
Critical (15%)	100	100	91	83

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	1
70%	0	0	0	7
80%	0	0	0	3
90%	0	0	0	-6
Long Term				
Full Simulation Period[b]	0	0	0	1
Water Year Types[c]				
Wet (32%)	0	0	0	-1
Above Normal (16%)	0	0	0	-3
Below Normal (13%)	0	0	0	16
Dry (24%)	0	0	0	-2
Critical (15%)	0	0	-2	-1

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-12-6. Folsom Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	99
70%	100	100	100	74
80%	100	100	100	59
90%	100	100	100	38
Long Term				
Full Simulation Period[b]	100	100	99	83
Water Year Types[c]				
Wet (32%)	100	100	100	99
Above Normal (16%)	100	100	100	78
Below Normal (13%)	100	100	100	68
Dry (24%)	100	100	100	72
Critical (15%)	100	100	93	85

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	100	100	80
90%	100	100	100	48
Long Term				
Full Simulation Period[b]	100	100	99	87
Water Year Types[c]				
Wet (32%)	100	100	100	100
Above Normal (16%)	100	100	100	94
Below Normal (13%)	100	100	100	91
Dry (24%)	100	100	100	73
Critical (15%)	100	100	94	73

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	1
70%	0	0	0	26
80%	0	0	0	22
90%	0	0	0	10
Long Term				
Full Simulation Period[b]	0	0	0	5
Water Year Types[c]				
Wet (32%)	0	0	0	1
Above Normal (16%)	0	0	0	16
Below Normal (13%)	0	0	0	23
Dry (24%)	0	0	0	1
Critical (15%)	0	0	1	-11

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

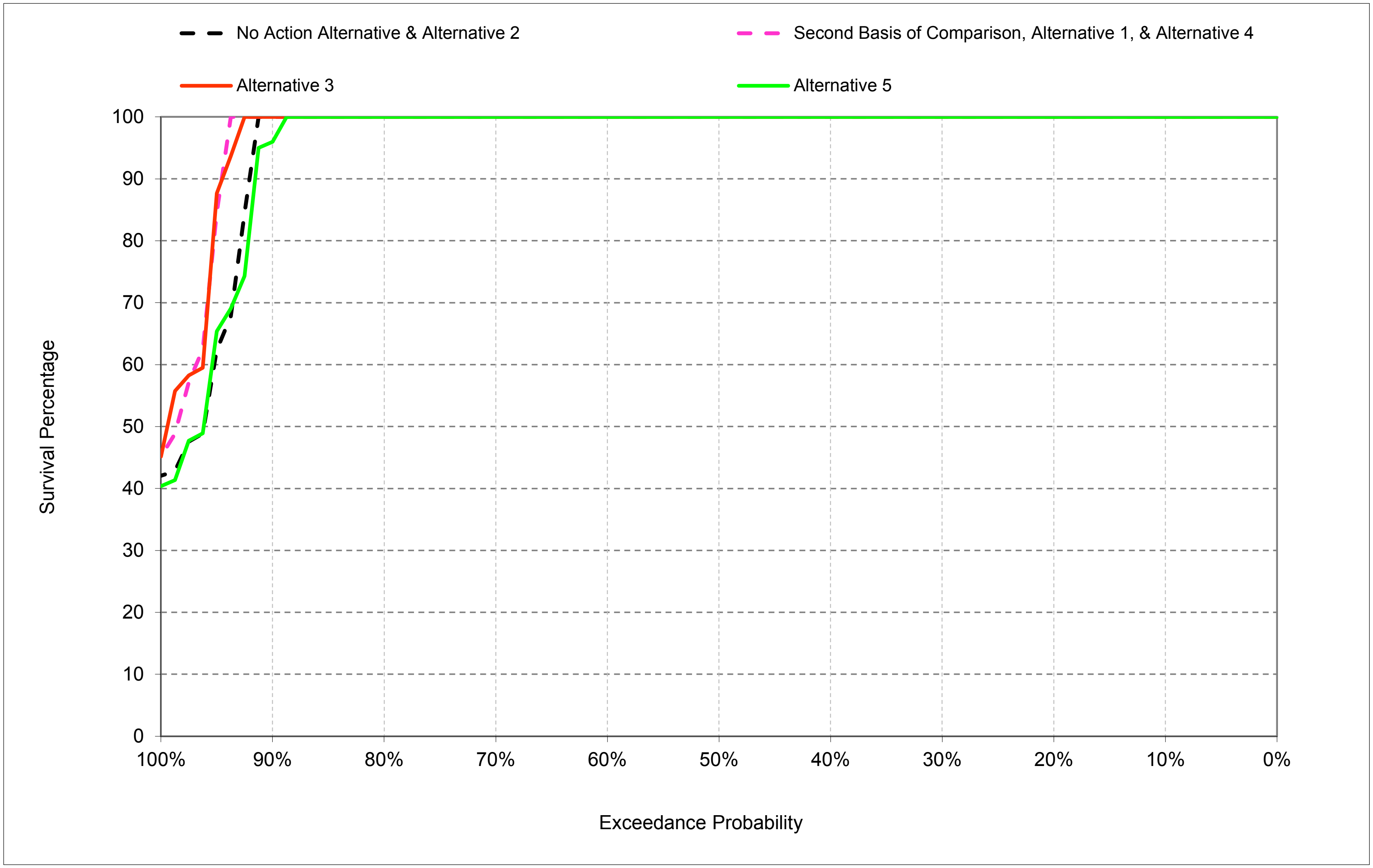
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

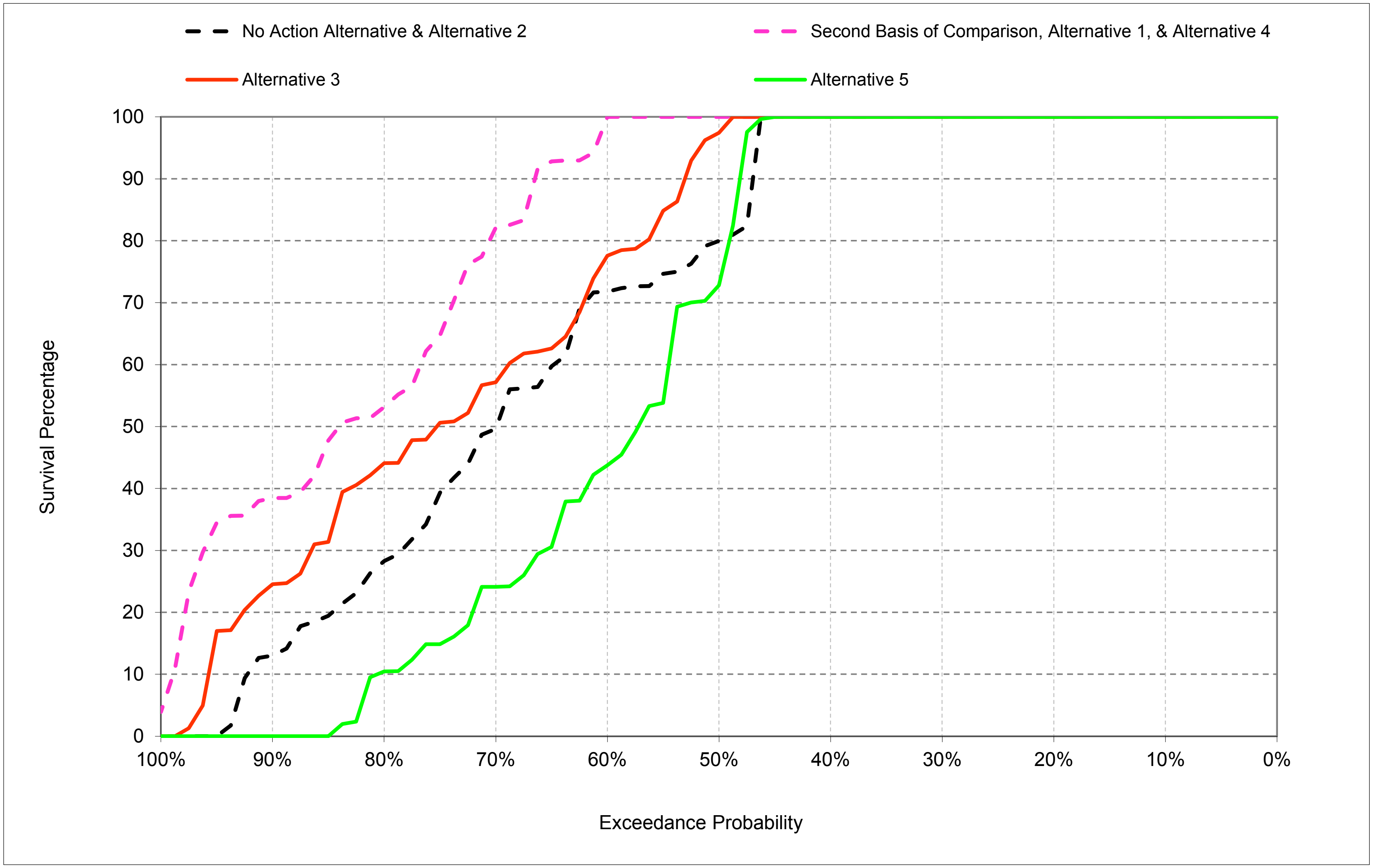
B.13. New Melones Large Mouth Bass Survival Percentage

Figure B-13-1. New Melones Large Mouth Bass Nest Survival Percentage, March



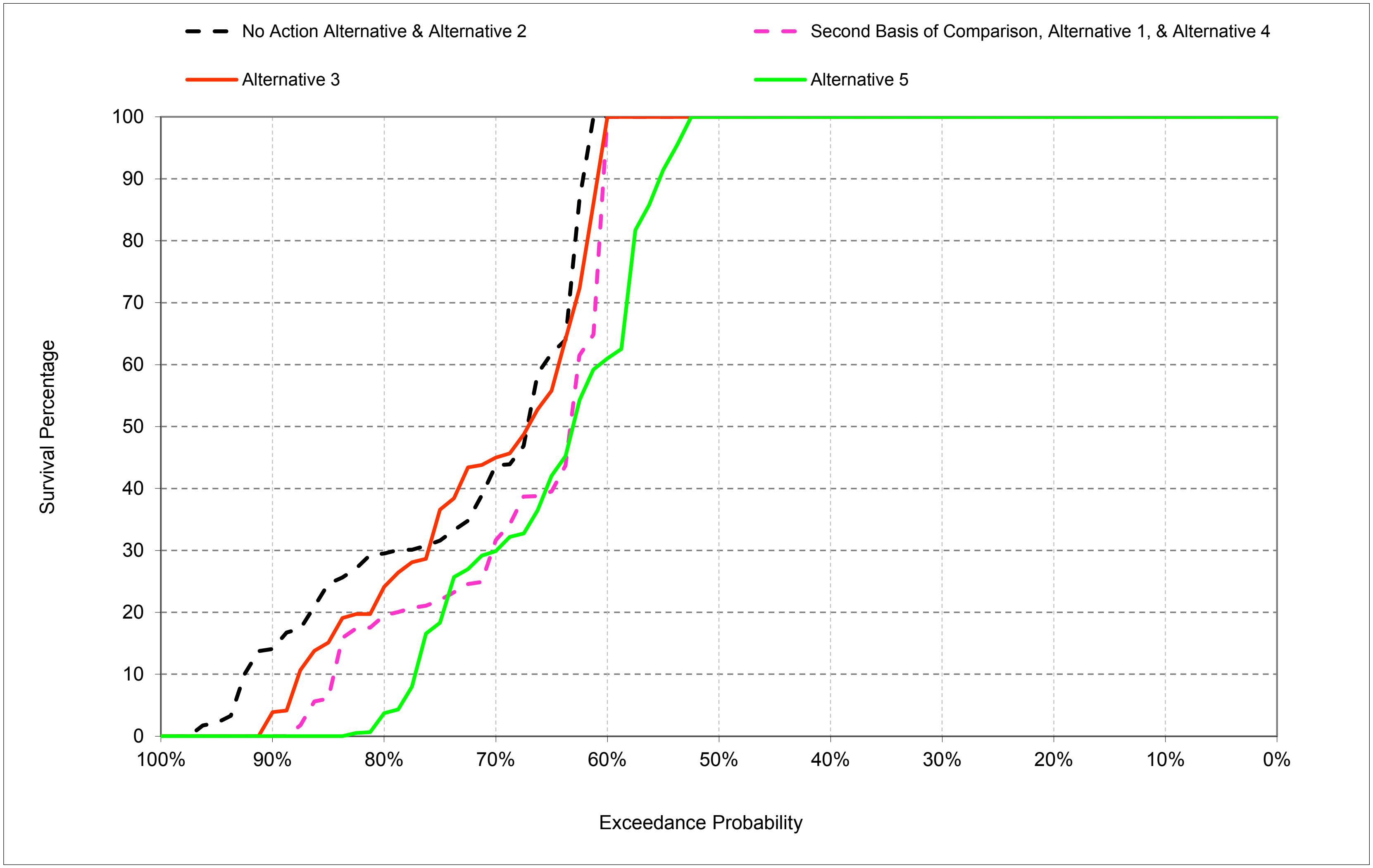
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-13-2. New Melones Large Mouth Bass Nest Survival Percentage, April



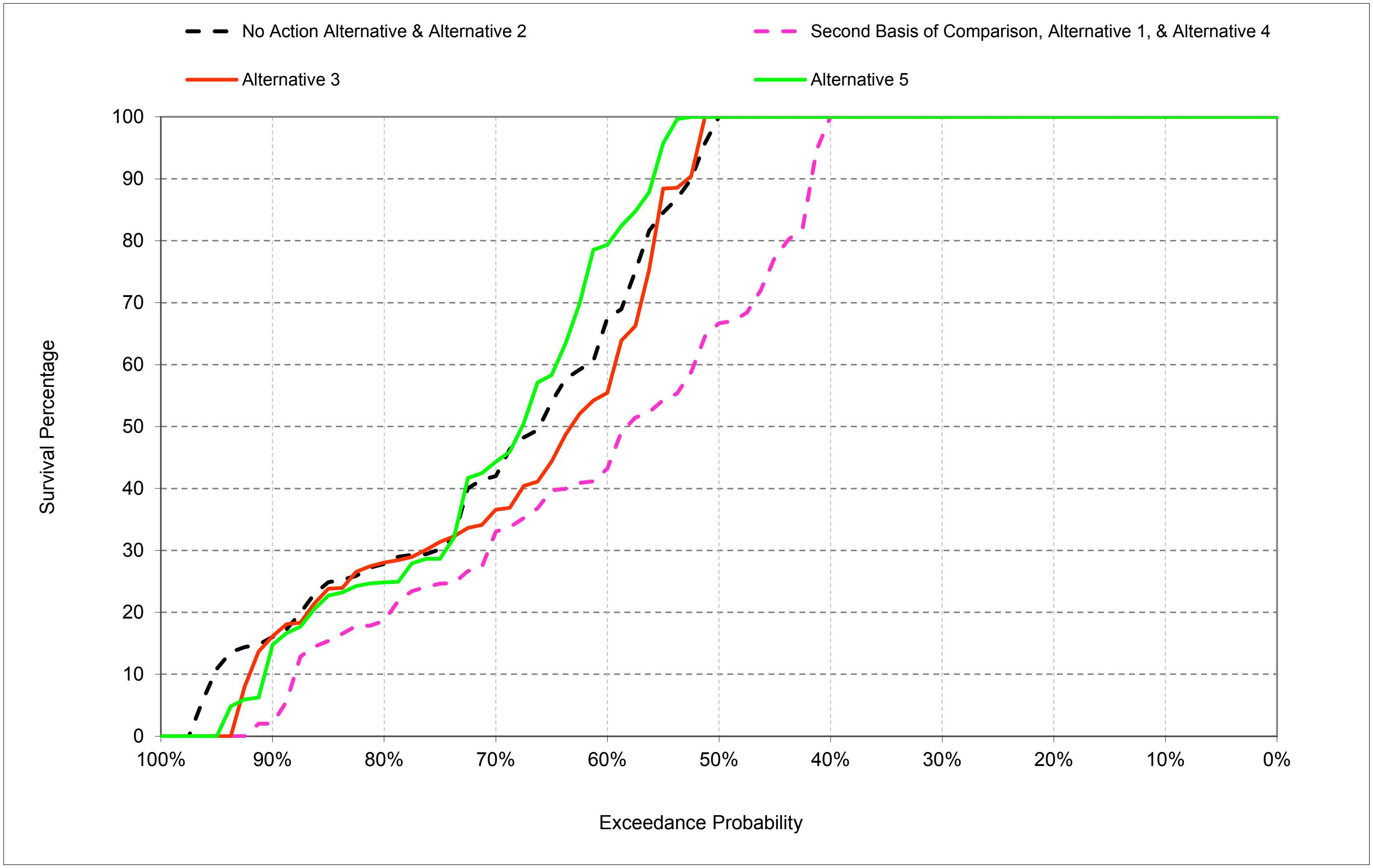
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-13-3. New Melones Large Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-13-4. New Melones Large Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-13-1. New Melones Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	80	100	98
60%	100	72	100	63
70%	100	49	40	42
80%	100	27	29	27
90%	100	13	14	15
Long Term				
Full Simulation Period[b]	95	68	72	69
Water Year Types[c]				
Wet (32%)	94	83	98	95
Above Normal (16%)	100	88	100	72
Below Normal (13%)	95	58	65	61
Dry (24%)	98	66	51	54
Critical (15%)	87	29	25	43

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	98
50%	100	100	100	66
60%	100	97	79	42
70%	100	79	27	29
80%	100	52	18	18
90%	100	38	0	2
Long Term				
Full Simulation Period[b]	97	82	67	60
Water Year Types[c]				
Wet (32%)	98	93	94	76
Above Normal (16%)	100	95	100	68
Below Normal (13%)	100	77	62	50
Dry (24%)	98	84	43	51
Critical (15%)	86	44	17	43

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-2
50%	0	20	0	-32
60%	0	25	-21	-21
70%	0	30	-13	-13
80%	0	25	-11	-9
90%	0	25	-14	-13
Long Term				
Full Simulation Period[b]	2	14	-5	-9
Water Year Types[c]				
Wet (32%)	4	10	-4	-19
Above Normal (16%)	0	7	0	-5
Below Normal (13%)	5	19	-4	-10
Dry (24%)	0	18	-7	-4
Critical (15%)	-1	15	-8	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-13-2. New Melones Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	80	100	98
60%	100	72	100	63
70%	100	49	40	42
80%	100	27	29	27
90%	100	13	14	15
Long Term				
Full Simulation Period[b]	95	68	72	69
Water Year Types[c]				
Wet (32%)	94	83	98	95
Above Normal (16%)	100	88	100	72
Below Normal (13%)	95	58	65	61
Dry (24%)	98	66	51	54
Critical (15%)	87	29	25	43

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	97	100	100
60%	100	75	92	55
70%	100	57	44	35
80%	100	43	21	28
90%	100	23	0	14
Long Term				
Full Simulation Period[b]	96	73	70	67
Water Year Types[c]				
Wet (32%)	98	92	91	77
Above Normal (16%)	100	94	100	90
Below Normal (13%)	100	62	73	64
Dry (24%)	98	68	46	59
Critical (15%)	83	30	30	40

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	17	0	2
60%	0	4	-8	-9
70%	0	8	4	-7
80%	0	16	-9	0
90%	0	10	-13	-1
Long Term				
Full Simulation Period[b]	1	5	-2	-2
Water Year Types[c]				
Wet (32%)	4	9	-7	-18
Above Normal (16%)	0	6	0	17
Below Normal (13%)	5	4	7	3
Dry (24%)	0	2	-4	5
Critical (15%)	-4	1	5	-2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-13-3. New Melones Large Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	80	100	98
60%	100	72	100	63
70%	100	49	40	42
80%	100	27	29	27
90%	100	13	14	15
Long Term				
Full Simulation Period[b]	95	68	72	69
Water Year Types[c]				
Wet (32%)	94	83	98	95
Above Normal (16%)	100	88	100	72
Below Normal (13%)	95	58	65	61
Dry (24%)	98	66	51	54
Critical (15%)	87	29	25	43

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	72	100	100
60%	100	43	60	79
70%	100	24	29	43
80%	100	10	1	25
90%	95	0	0	7
Long Term				
Full Simulation Period[b]	95	60	64	70
Water Year Types[c]				
Wet (32%)	95	87	93	97
Above Normal (16%)	100	79	94	61
Below Normal (13%)	95	50	58	59
Dry (24%)	98	45	37	52
Critical (15%)	85	14	19	60

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	-8	0	2
60%	0	-29	-40	15
70%	0	-25	-11	1
80%	0	-17	-28	-3
90%	-5	-13	-14	-8
Long Term				
Full Simulation Period[b]	0	-9	-8	1
Water Year Types[c]				
Wet (32%)	1	4	-5	2
Above Normal (16%)	0	-9	-6	-12
Below Normal (13%)	0	-8	-7	-2
Dry (24%)	0	-21	-13	-2
Critical (15%)	-1	-15	-6	17

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-13-4. New Melones Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	98
50%	100	100	100	66
60%	100	97	79	42
70%	100	79	27	29
80%	100	52	18	18
90%	100	38	0	2
Long Term				
Full Simulation Period[b]	97	82	67	60
Water Year Types[c]				
Wet (32%)	98	93	94	76
Above Normal (16%)	100	95	100	68
Below Normal (13%)	100	77	62	50
Dry (24%)	98	84	43	51
Critical (15%)	86	44	17	43

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	80	100	98
60%	100	72	100	63
70%	100	49	40	42
80%	100	27	29	27
90%	100	13	14	15
Long Term				
Full Simulation Period[b]	95	68	72	69
Water Year Types[c]				
Wet (32%)	94	83	98	95
Above Normal (16%)	100	88	100	72
Below Normal (13%)	95	58	65	61
Dry (24%)	98	66	51	54
Critical (15%)	87	29	25	43

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	2
50%	0	-20	0	32
60%	0	-25	21	21
70%	0	-30	13	13
80%	0	-25	11	9
90%	0	-25	14	13
Long Term				
Full Simulation Period[b]	-2	-14	5	9
Water Year Types[c]				
Wet (32%)	-4	-10	4	19
Above Normal (16%)	0	-7	0	5
Below Normal (13%)	-5	-19	4	10
Dry (24%)	0	-18	7	4
Critical (15%)	1	-15	8	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-13-5. New Melones Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	98
50%	100	100	100	66
60%	100	97	79	42
70%	100	79	27	29
80%	100	52	18	18
90%	100	38	0	2
Long Term				
Full Simulation Period[b]	97	82	67	60
Water Year Types[c]				
Wet (32%)	98	93	94	76
Above Normal (16%)	100	95	100	68
Below Normal (13%)	100	77	62	50
Dry (24%)	98	84	43	51
Critical (15%)	86	44	17	43

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	97	100	100
60%	100	75	92	55
70%	100	57	44	35
80%	100	43	21	28
90%	100	23	0	14
Long Term				
Full Simulation Period[b]	96	73	70	67
Water Year Types[c]				
Wet (32%)	98	92	91	77
Above Normal (16%)	100	94	100	90
Below Normal (13%)	100	62	73	64
Dry (24%)	98	68	46	59
Critical (15%)	83	30	30	40

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	2
50%	0	-3	0	34
60%	0	-21	13	13
70%	0	-22	17	6
80%	0	-9	3	10
90%	0	-15	0	12
Long Term				
Full Simulation Period[b]	0	-8	3	7
Water Year Types[c]				
Wet (32%)	0	-1	-3	1
Above Normal (16%)	0	-1	0	22
Below Normal (13%)	0	-15	11	13
Dry (24%)	0	-16	3	8
Critical (15%)	-3	-13	13	-2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-13-6. New Melones Large Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	98
50%	100	100	100	66
60%	100	97	79	42
70%	100	79	27	29
80%	100	52	18	18
90%	100	38	0	2
Long Term				
Full Simulation Period[b]	97	82	67	60
Water Year Types[c]				
Wet (32%)	98	93	94	76
Above Normal (16%)	100	95	100	68
Below Normal (13%)	100	77	62	50
Dry (24%)	98	84	43	51
Critical (15%)	86	44	17	43

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	72	100	100
60%	100	43	60	79
70%	100	24	29	43
80%	100	10	1	25
90%	95	0	0	7
Long Term				
Full Simulation Period[b]	95	60	64	70
Water Year Types[c]				
Wet (32%)	95	87	93	97
Above Normal (16%)	100	79	94	61
Below Normal (13%)	95	50	58	59
Dry (24%)	98	45	37	52
Critical (15%)	85	14	19	60

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	2
50%	0	-28	0	34
60%	0	-54	-19	37
70%	0	-55	2	14
80%	0	-42	-17	7
90%	-5	-38	0	5
Long Term				
Full Simulation Period[b]	-2	-22	-3	10
Water Year Types[c]				
Wet (32%)	-3	-6	-1	21
Above Normal (16%)	0	-16	-6	-7
Below Normal (13%)	-5	-27	-4	9
Dry (24%)	0	-39	-6	2
Critical (15%)	-1	-30	2	17

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

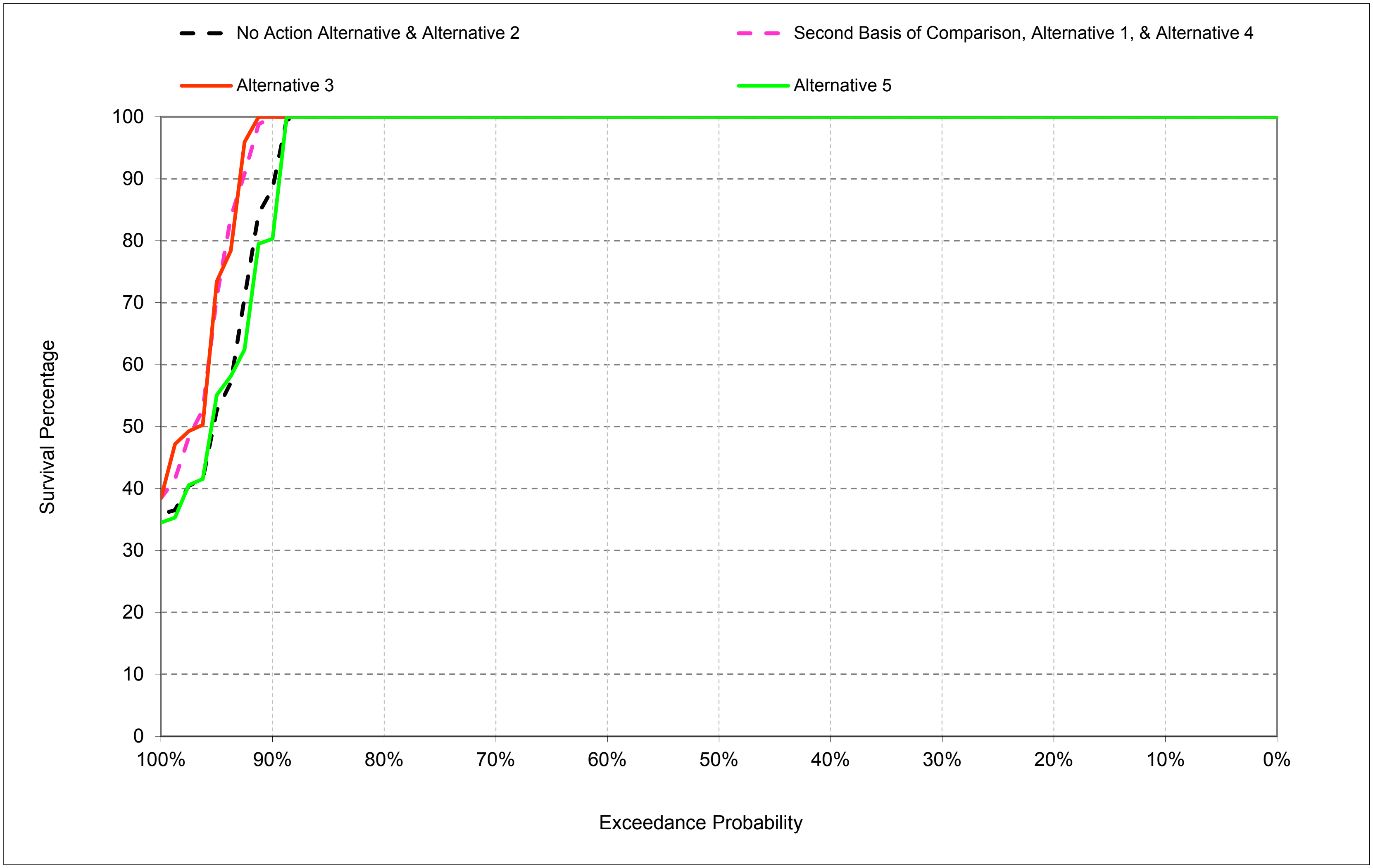
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

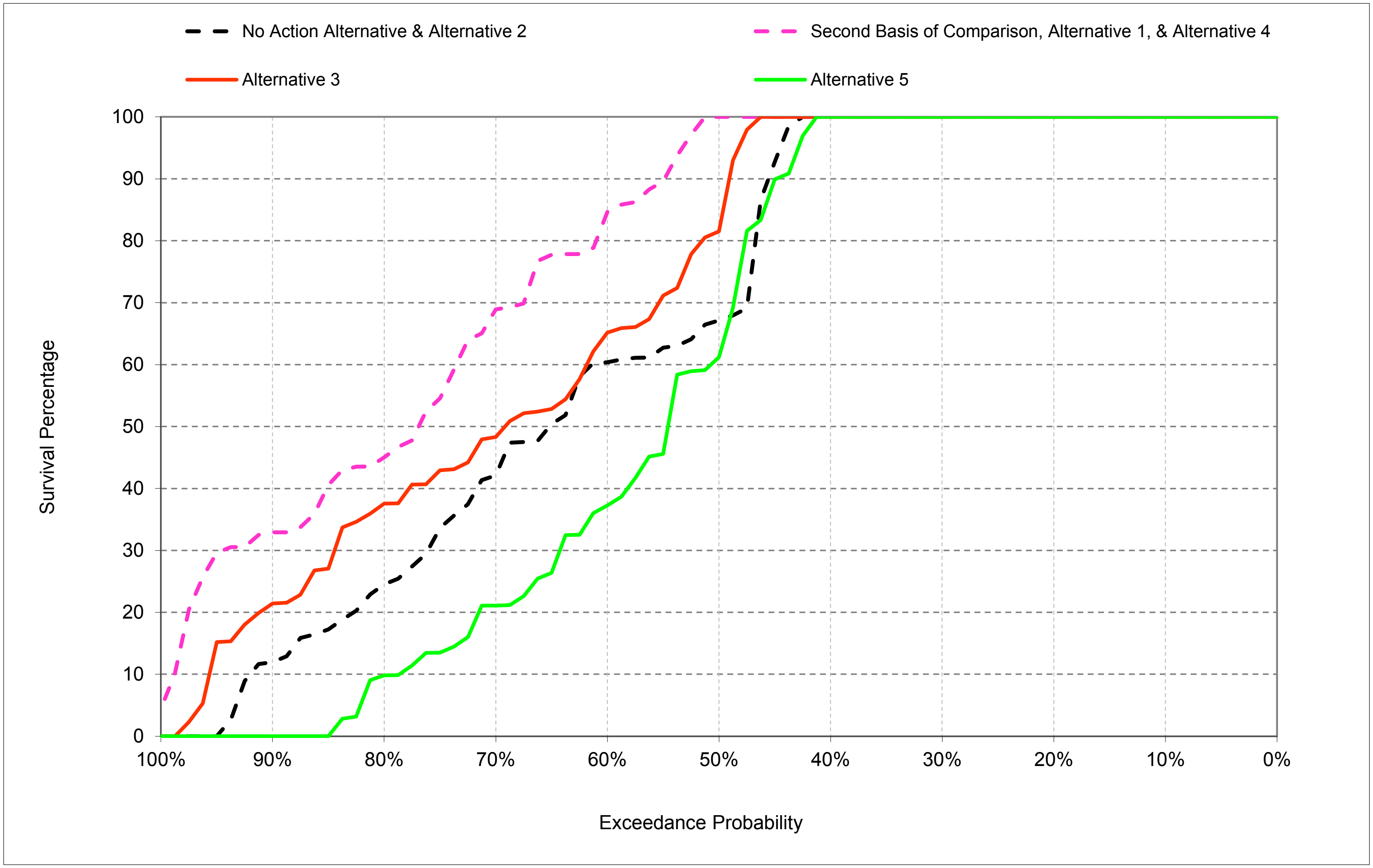
1 # B.14. New Melones Small Mouth Bass Survival Percentage

Figure B-14-1. New Melones Small Mouth Bass Nest Survival Percentage, March



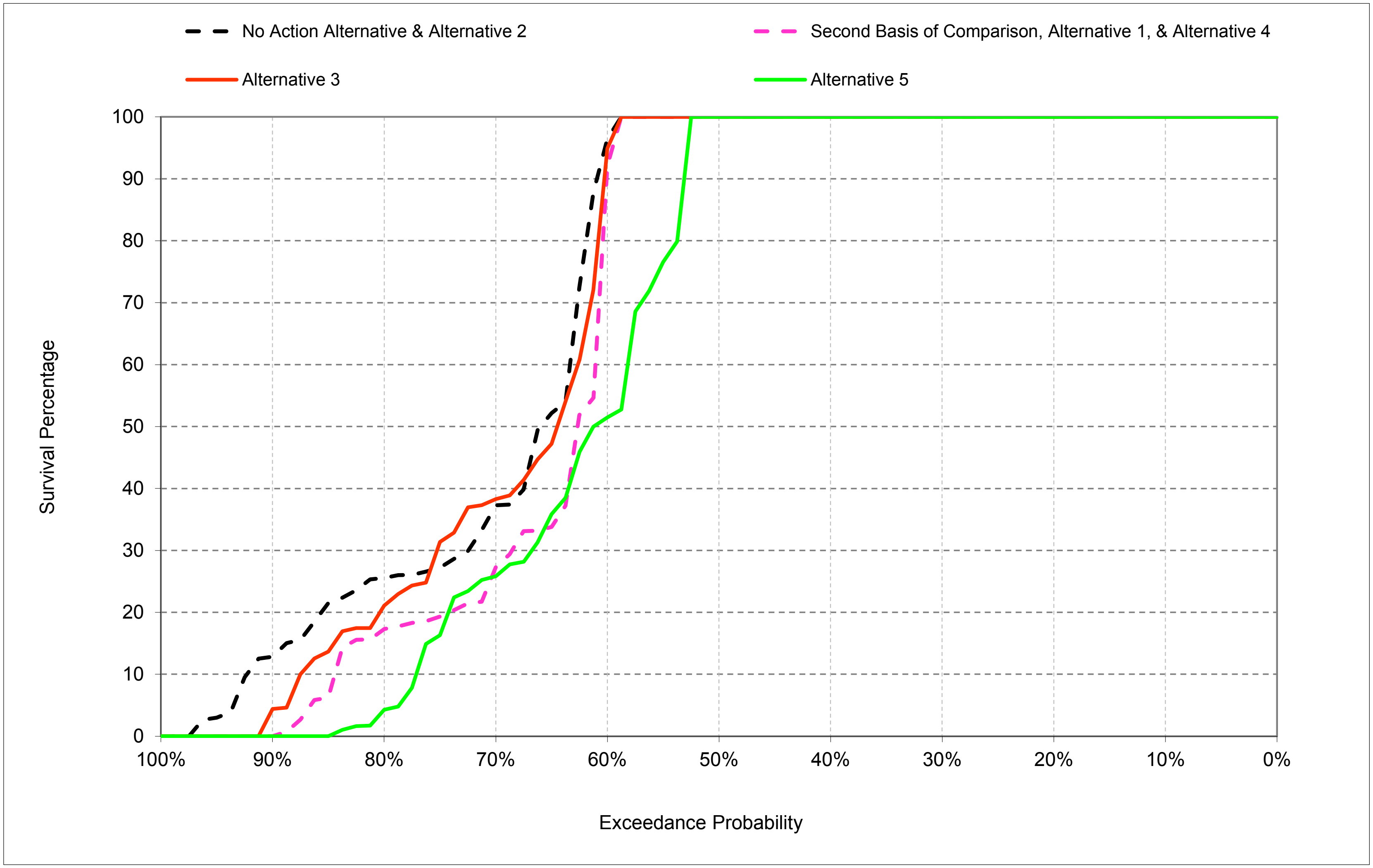
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-14-2. New Melones Small Mouth Bass Nest Survival Percentage, April



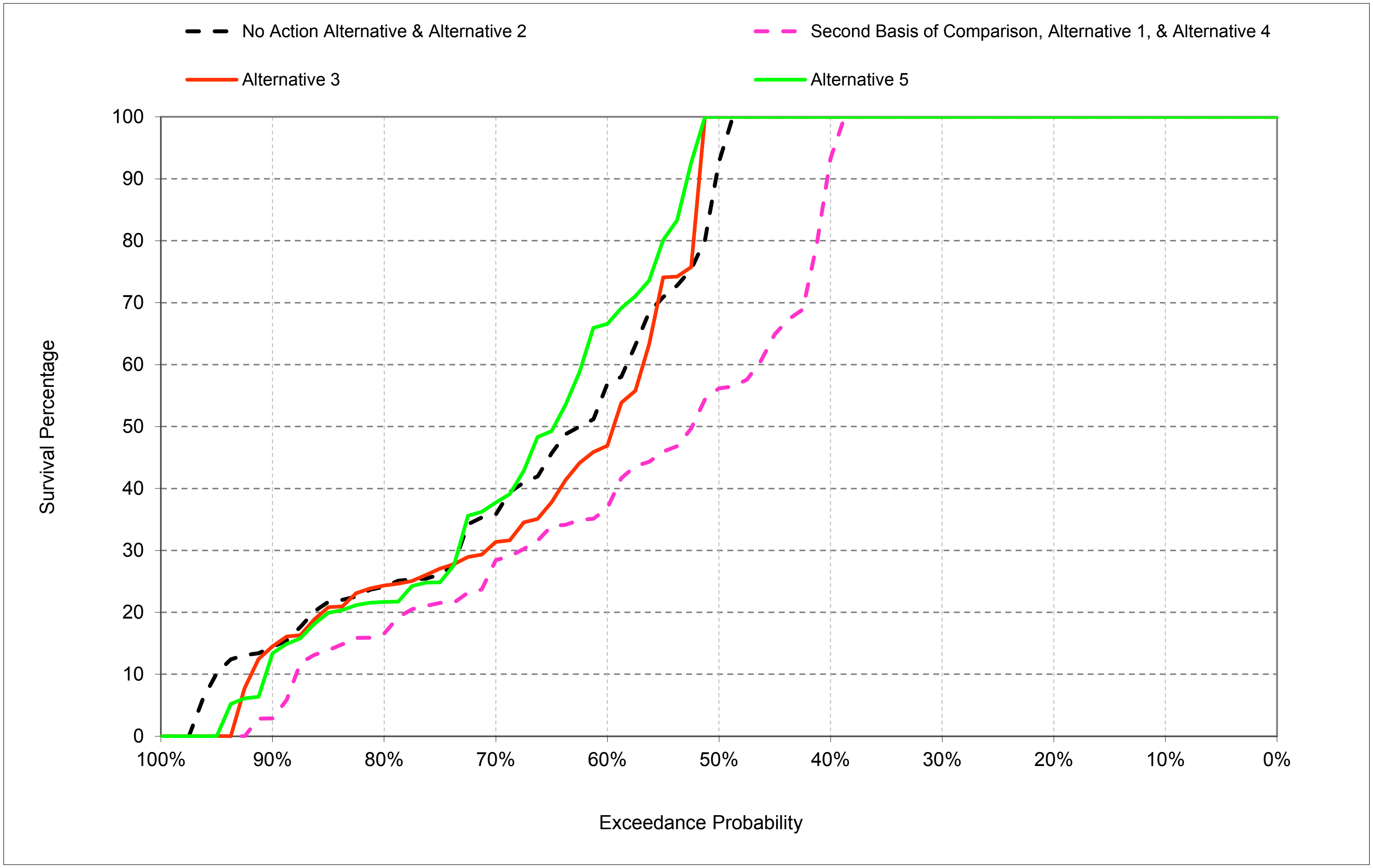
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-14-3. New Melones Small Mouth Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-14-4. New Melones Small Mouth Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-14-1. New Melones Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	67	100	86
60%	100	60	91	53
70%	100	42	34	35
80%	100	23	25	24
90%	85	12	13	14
Long Term				
Full Simulation Period[b]	94	65	70	66
Water Year Types[c]				
Wet (32%)	93	81	97	93
Above Normal (16%)	100	86	99	68
Below Normal (13%)	94	55	63	59
Dry (24%)	98	59	48	50
Critical (15%)	82	26	23	40

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	88
50%	100	100	100	55
60%	100	81	70	36
70%	100	66	23	25
80%	100	44	16	16
90%	99	33	0	3
Long Term				
Full Simulation Period[b]	96	77	66	57
Water Year Types[c]				
Wet (32%)	98	90	94	73
Above Normal (16%)	100	94	99	64
Below Normal (13%)	100	72	59	49
Dry (24%)	97	77	42	47
Critical (15%)	82	39	16	40

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	-12
50%	0	33	0	-31
60%	0	21	-22	-18
70%	0	25	-11	-10
80%	0	21	-9	-8
90%	14	21	-13	-11
Long Term				
Full Simulation Period[b]	2	13	-4	-9
Water Year Types[c]				
Wet (32%)	4	9	-4	-20
Above Normal (16%)	0	8	0	-4
Below Normal (13%)	6	17	-3	-10
Dry (24%)	-1	18	-6	-3
Critical (15%)	0	13	-7	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-14-2. New Melones Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	67	100	86
60%	100	60	91	53
70%	100	42	34	35
80%	100	23	25	24
90%	85	12	13	14
Long Term				
Full Simulation Period[b]	94	65	70	66
Water Year Types[c]				
Wet (32%)	93	81	97	93
Above Normal (16%)	100	86	99	68
Below Normal (13%)	94	55	63	59
Dry (24%)	98	59	48	50
Critical (15%)	82	26	23	40

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	81	100	100
60%	100	63	81	46
70%	100	48	38	30
80%	100	36	18	24
90%	100	20	0	13
Long Term				
Full Simulation Period[b]	96	70	69	65
Water Year Types[c]				
Wet (32%)	98	89	90	77
Above Normal (16%)	100	93	100	88
Below Normal (13%)	100	57	69	61
Dry (24%)	97	62	44	54
Critical (15%)	79	27	27	37

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	14	0	14
60%	0	3	-10	-7
70%	0	6	3	-6
80%	0	13	-7	0
90%	15	8	-12	-1
Long Term				
Full Simulation Period[b]	2	5	-1	-1
Water Year Types[c]				
Wet (32%)	4	8	-7	-16
Above Normal (16%)	0	7	1	20
Below Normal (13%)	6	2	7	2
Dry (24%)	0	3	-4	4
Critical (15%)	-3	1	4	-3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-14-3. New Melones Small Mouth Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	67	100	86
60%	100	60	91	53
70%	100	42	34	35
80%	100	23	25	24
90%	85	12	13	14
Long Term				
Full Simulation Period[b]	94	65	70	66
Water Year Types[c]				
Wet (32%)	93	81	97	93
Above Normal (16%)	100	86	99	68
Below Normal (13%)	94	55	63	59
Dry (24%)	98	59	48	50
Critical (15%)	82	26	23	40

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	60	100	100
60%	100	37	51	66
70%	100	21	25	37
80%	100	9	2	22
90%	80	0	0	7
Long Term				
Full Simulation Period[b]	94	57	62	67
Water Year Types[c]				
Wet (32%)	95	84	90	94
Above Normal (16%)	100	76	93	58
Below Normal (13%)	94	47	56	57
Dry (24%)	97	43	36	49
Critical (15%)	81	13	19	58

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	-7	0	14
60%	0	-24	-41	13
70%	0	-20	-9	1
80%	0	-14	-23	-2
90%	-5	-12	-13	-6
Long Term				
Full Simulation Period[b]	0	-7	-8	1
Water Year Types[c]				
Wet (32%)	1	3	-7	1
Above Normal (16%)	0	-10	-7	-10
Below Normal (13%)	0	-8	-6	-2
Dry (24%)	-1	-16	-12	-1
Critical (15%)	-1	-13	-4	18

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-14-4. New Melones Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	88
50%	100	100	100	55
60%	100	81	70	36
70%	100	66	23	25
80%	100	44	16	16
90%	99	33	0	3
Long Term				
Full Simulation Period[b]	96	77	66	57
Water Year Types[c]				
Wet (32%)	98	90	94	73
Above Normal (16%)	100	94	99	64
Below Normal (13%)	100	72	59	49
Dry (24%)	97	77	42	47
Critical (15%)	82	39	16	40

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	67	100	86
60%	100	60	91	53
70%	100	42	34	35
80%	100	23	25	24
90%	85	12	13	14
Long Term				
Full Simulation Period[b]	94	65	70	66
Water Year Types[c]				
Wet (32%)	93	81	97	93
Above Normal (16%)	100	86	99	68
Below Normal (13%)	94	55	63	59
Dry (24%)	98	59	48	50
Critical (15%)	82	26	23	40

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	12
50%	0	-33	0	31
60%	0	-21	22	18
70%	0	-25	11	10
80%	0	-21	9	8
90%	-14	-21	13	11
Long Term				
Full Simulation Period[b]	-2	-13	4	9
Water Year Types[c]				
Wet (32%)	-4	-9	4	20
Above Normal (16%)	0	-8	0	4
Below Normal (13%)	-6	-17	3	10
Dry (24%)	1	-18	6	3
Critical (15%)	0	-13	7	0

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-14-5. New Melones Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	88
50%	100	100	100	55
60%	100	81	70	36
70%	100	66	23	25
80%	100	44	16	16
90%	99	33	0	3
Long Term				
Full Simulation Period[b]	96	77	66	57
Water Year Types[c]				
Wet (32%)	98	90	94	73
Above Normal (16%)	100	94	99	64
Below Normal (13%)	100	72	59	49
Dry (24%)	97	77	42	47
Critical (15%)	82	39	16	40

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	81	100	100
60%	100	63	81	46
70%	100	48	38	30
80%	100	36	18	24
90%	100	20	0	13
Long Term				
Full Simulation Period[b]	96	70	69	65
Water Year Types[c]				
Wet (32%)	98	89	90	77
Above Normal (16%)	100	93	100	88
Below Normal (13%)	100	57	69	61
Dry (24%)	97	62	44	54
Critical (15%)	79	27	27	37

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	12
50%	0	-19	0	45
60%	0	-18	12	10
70%	0	-18	14	5
80%	0	-8	2	8
90%	1	-12	0	10
Long Term				
Full Simulation Period[b]	0	-8	3	8
Water Year Types[c]				
Wet (32%)	0	-1	-3	4
Above Normal (16%)	0	-1	1	24
Below Normal (13%)	0	-16	10	13
Dry (24%)	0	-15	2	7
Critical (15%)	-3	-12	11	-3

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-14-6. New Melones Small Mouth Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	88
50%	100	100	100	55
60%	100	81	70	36
70%	100	66	23	25
80%	100	44	16	16
90%	99	33	0	3
Long Term				
Full Simulation Period[b]	96	77	66	57
Water Year Types[c]				
Wet (32%)	98	90	94	73
Above Normal (16%)	100	94	99	64
Below Normal (13%)	100	72	59	49
Dry (24%)	97	77	42	47
Critical (15%)	82	39	16	40

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	60	100	100
60%	100	37	51	66
70%	100	21	25	37
80%	100	9	2	22
90%	80	0	0	7
Long Term				
Full Simulation Period[b]	94	57	62	67
Water Year Types[c]				
Wet (32%)	95	84	90	94
Above Normal (16%)	100	76	93	58
Below Normal (13%)	94	47	56	57
Dry (24%)	97	43	36	49
Critical (15%)	81	13	19	58

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	12
50%	0	-40	0	45
60%	0	-45	-19	30
70%	0	-45	2	12
80%	0	-35	-14	6
90%	-19	-33	0	4
Long Term				
Full Simulation Period[b]	-2	-20	-4	10
Water Year Types[c]				
Wet (32%)	-3	-6	-3	21
Above Normal (16%)	0	-18	-7	-6
Below Normal (13%)	-6	-26	-3	9
Dry (24%)	0	-34	-6	2
Critical (15%)	-1	-26	3	18

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

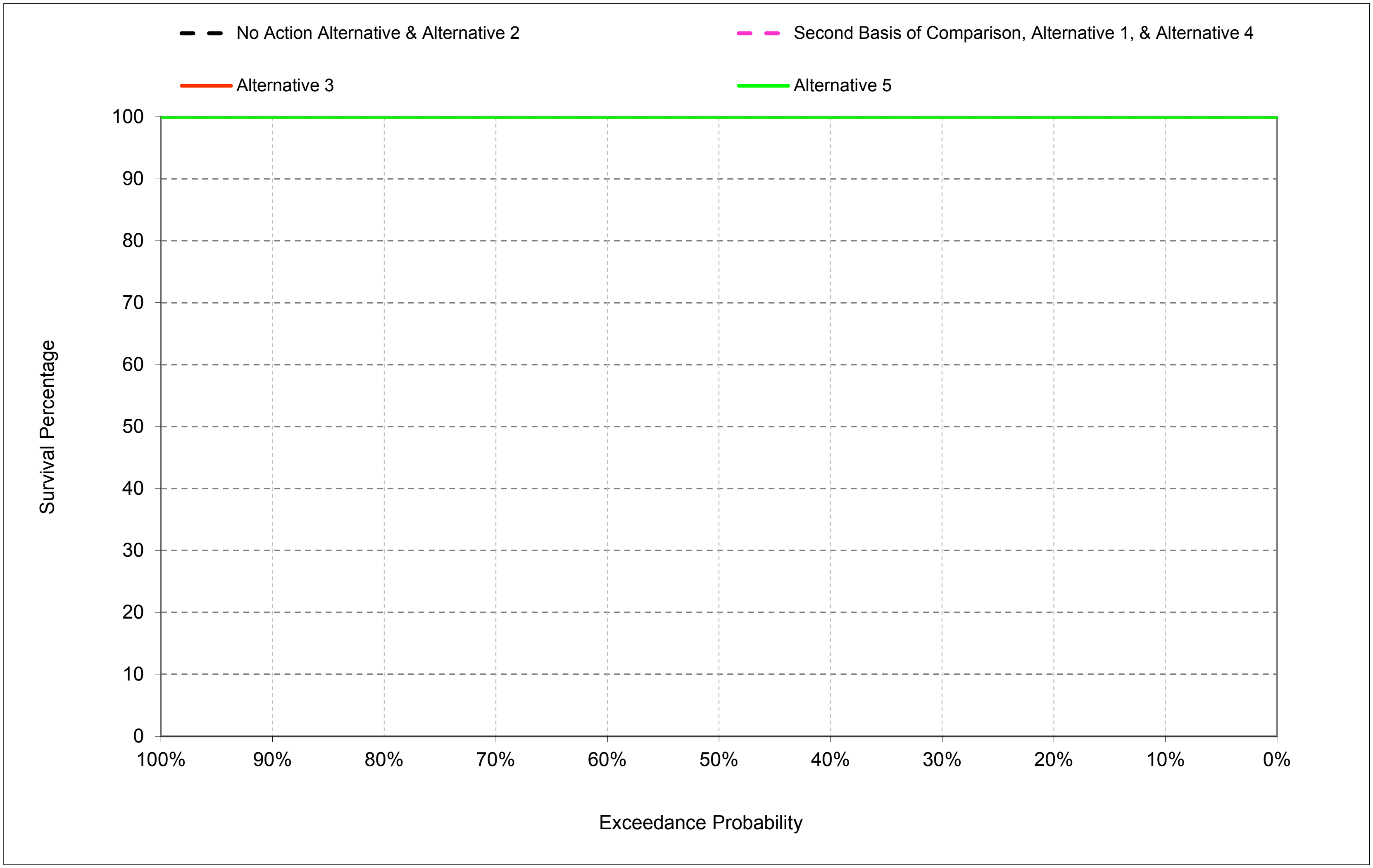
b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

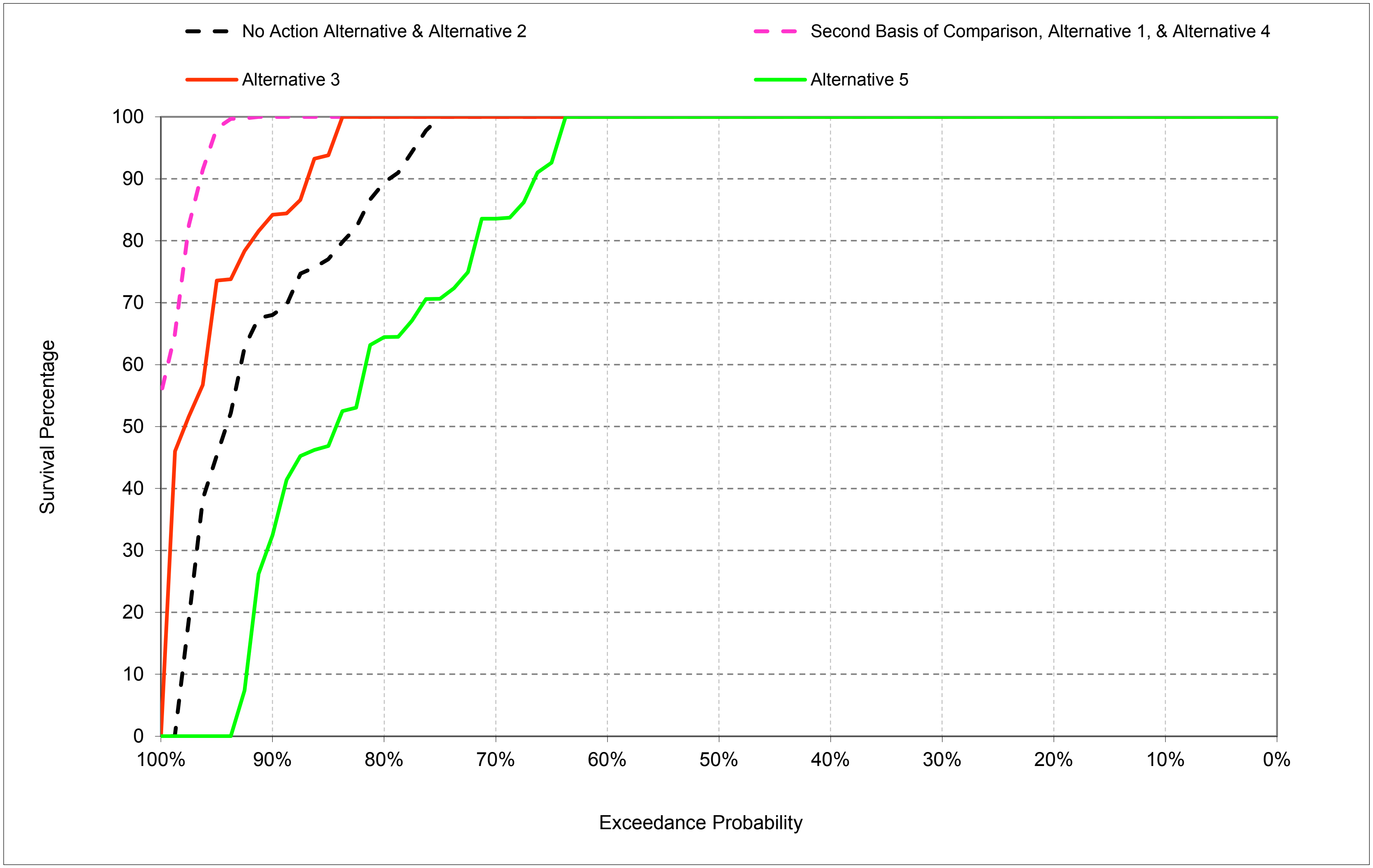
B.15. New Melones Spotted Bass Survival Percentage

Figure B-15-1. New Melones Spotted Bass Nest Survival Percentage, March



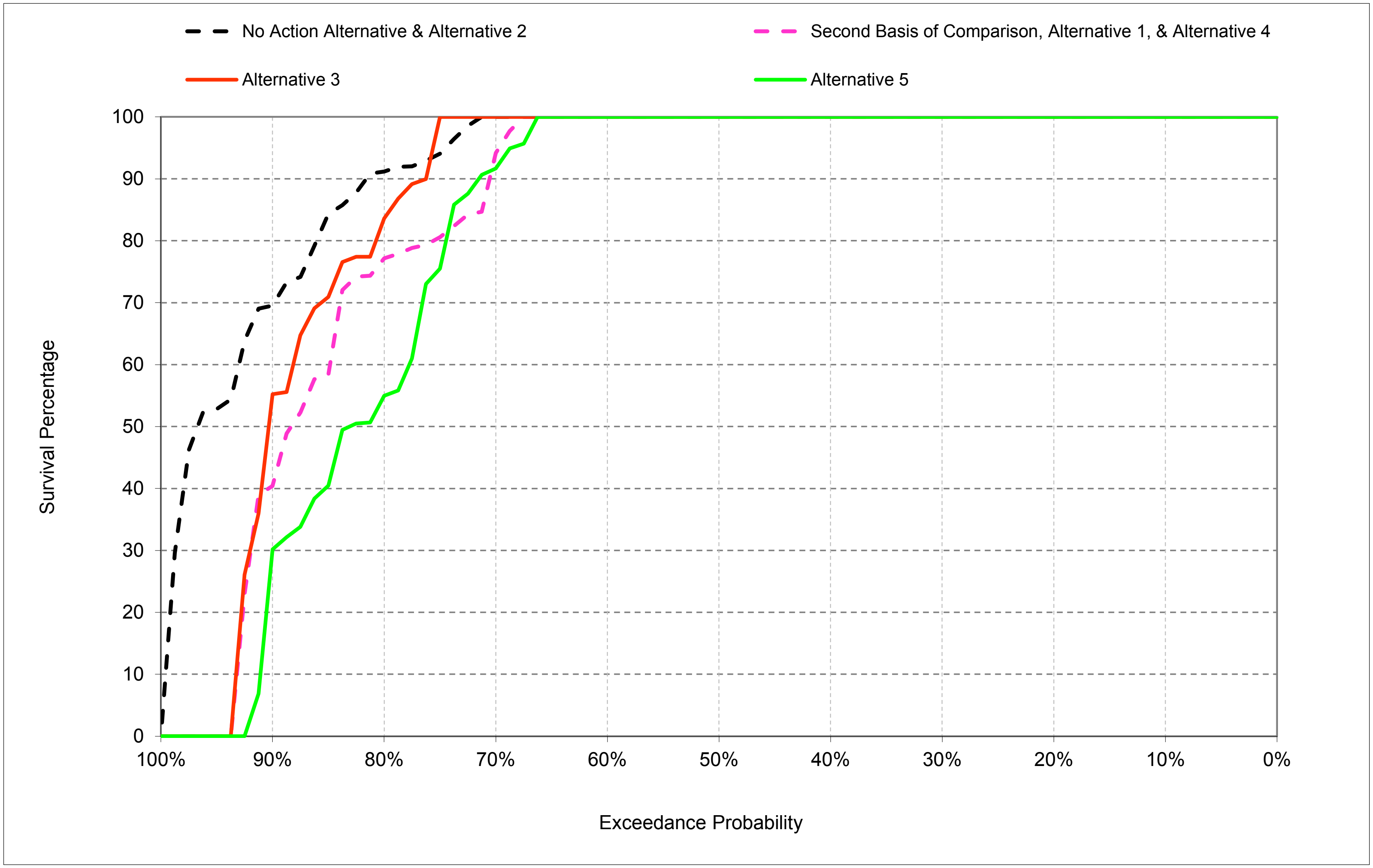
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-15-2. New Melones Spotted Bass Nest Survival Percentage, April



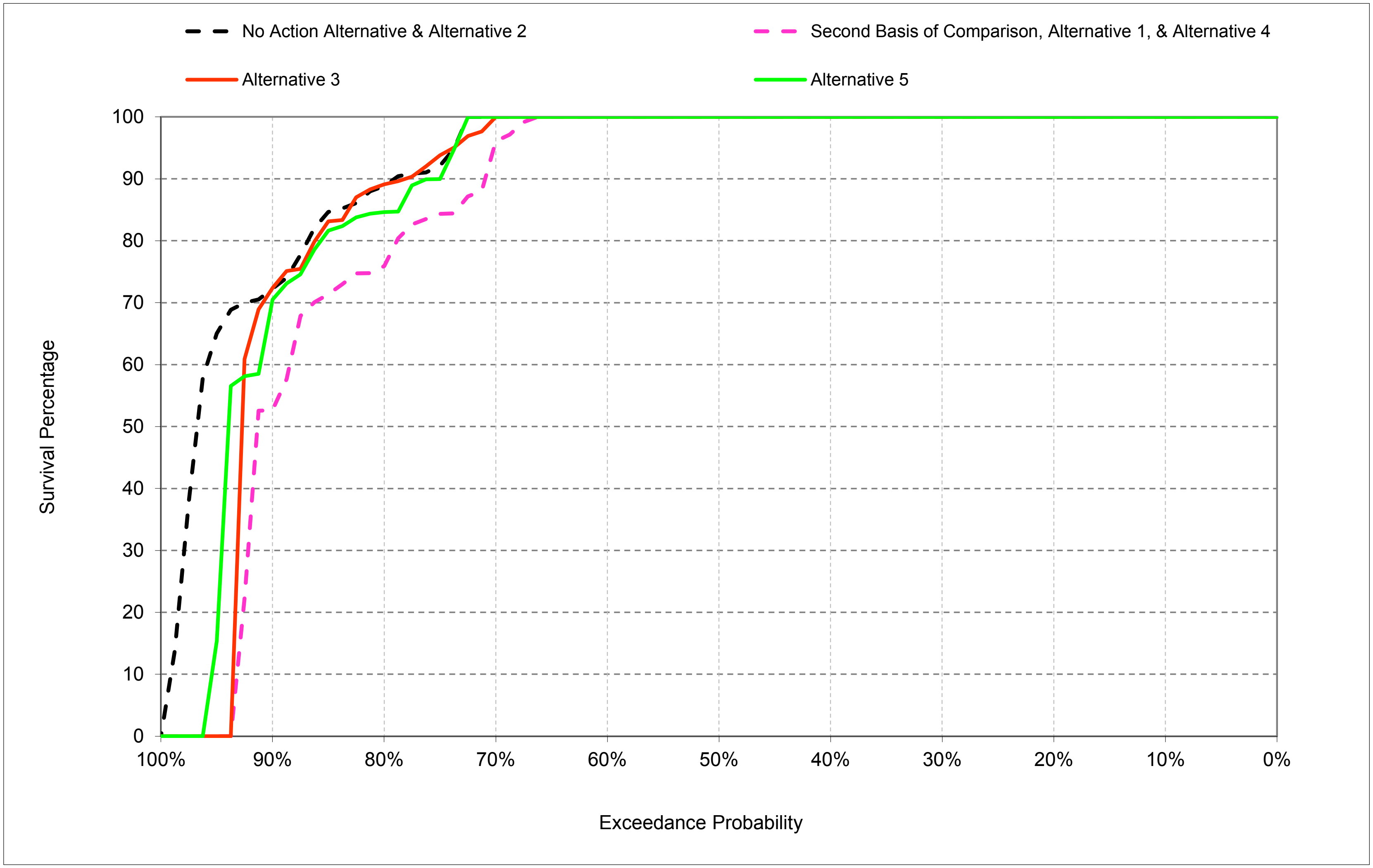
Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-15-3. New Melones Spotted Bass Nest Survival Percentage, May



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure B-15-4. New Melones Spotted Bass Nest Survival Percentage, June



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-15-1. New Melones Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	87	91	88
90%	100	68	69	71
Long Term				
Full Simulation Period[b]	99	90	91	91
Water Year Types[c]				
Wet (32%)	96	88	100	96
Above Normal (16%)	100	98	100	99
Below Normal (13%)	100	90	90	94
Dry (24%)	100	97	92	89
Critical (15%)	100	73	62	72

Alternative 1

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	88	90
80%	100	100	75	75
90%	100	100	39	53
Long Term				
Full Simulation Period[b]	100	98	84	85
Water Year Types[c]				
Wet (32%)	100	100	96	92
Above Normal (16%)	100	100	100	96
Below Normal (13%)	100	100	88	76
Dry (24%)	100	100	79	78
Critical (15%)	100	87	45	78

Alternative 1 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	-12	-10
80%	0	13	-16	-13
90%	0	32	-30	-18
Long Term				
Full Simulation Period[b]	1	8	-7	-6
Water Year Types[c]				
Wet (32%)	4	12	-4	-4
Above Normal (16%)	0	2	0	-3
Below Normal (13%)	0	10	-2	-18
Dry (24%)	0	3	-13	-12
Critical (15%)	0	15	-17	6

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Second Basis of Comparison and Alternative 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-15-2. New Melones Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	87	91	88
90%	100	68	69	71
Long Term				
Full Simulation Period[b]	99	90	91	91
Water Year Types[c]				
Wet (32%)	96	88	100	96
Above Normal (16%)	100	98	100	99
Below Normal (13%)	100	90	90	94
Dry (24%)	100	97	92	89
Critical (15%)	100	73	62	72

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	98
80%	100	100	79	88
90%	100	82	38	69
Long Term				
Full Simulation Period[b]	99	94	86	88
Water Year Types[c]				
Wet (32%)	100	100	92	77
Above Normal (16%)	100	100	100	99
Below Normal (13%)	100	90	95	97
Dry (24%)	100	93	73	93
Critical (15%)	92	79	71	83

Alternative 3 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	0	-2
80%	0	13	-12	0
90%	0	14	-31	-1
Long Term				
Full Simulation Period[b]	0	4	-5	-3
Water Year Types[c]				
Wet (32%)	4	12	-8	-19
Above Normal (16%)	0	2	0	0
Below Normal (13%)	0	0	4	3
Dry (24%)	0	-4	-18	4
Critical (15%)	-8	6	9	11

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-15-3. New Melones Spotted Bass Nest Survival Percentage, Monthly Percentage

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	87	91	88
90%	100	68	69	71
Long Term				
Full Simulation Period[b]	99	90	91	91
Water Year Types[c]				
Wet (32%)	96	88	100	96
Above Normal (16%)	100	98	100	99
Below Normal (13%)	100	90	90	94
Dry (24%)	100	97	92	89
Critical (15%)	100	73	62	72

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	84	91	100
80%	100	63	52	84
90%	100	27	9	60
Long Term				
Full Simulation Period[b]	100	81	80	88
Water Year Types[c]				
Wet (32%)	99	99	100	100
Above Normal (16%)	100	90	100	76
Below Normal (13%)	100	78	74	92
Dry (24%)	100	78	71	85
Critical (15%)	100	38	38	80

Alternative 5 minus No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	-16	-9	0
80%	0	-24	-39	-4
90%	0	-41	-60	-11
Long Term				
Full Simulation Period[b]	1	-9	-11	-3
Water Year Types[c]				
Wet (32%)	3	11	0	4
Above Normal (16%)	0	-9	0	-23
Below Normal (13%)	0	-12	-17	-3
Dry (24%)	0	-19	-20	-5
Critical (15%)	0	-35	-24	8

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-15-4. New Melones Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	88	90
80%	100	100	75	75
90%	100	100	39	53
Long Term				
Full Simulation Period[b]	100	98	84	85
Water Year Types[c]				
Wet (32%)	100	100	96	92
Above Normal (16%)	100	100	100	96
Below Normal (13%)	100	100	88	76
Dry (24%)	100	100	79	78
Critical (15%)	100	87	45	78

No Action Alternative

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	100
80%	100	87	91	88
90%	100	68	69	71
Long Term				
Full Simulation Period[b]	99	90	91	91
Water Year Types[c]				
Wet (32%)	96	88	100	96
Above Normal (16%)	100	98	100	99
Below Normal (13%)	100	90	90	94
Dry (24%)	100	97	92	89
Critical (15%)	100	73	62	72

No Action Alternative minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	12	10
80%	0	-13	16	13
90%	0	-32	30	18
Long Term				
Full Simulation Period[b]	-1	-8	7	6
Water Year Types[c]				
Wet (32%)	-4	-12	4	4
Above Normal (16%)	0	-2	0	3
Below Normal (13%)	0	-10	2	18
Dry (24%)	0	-3	13	12
Critical (15%)	0	-15	17	-6

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-15-5. New Melones Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	88	90
80%	100	100	75	75
90%	100	100	39	53
Long Term				
Full Simulation Period[b]	100	98	84	85
Water Year Types[c]				
Wet (32%)	100	100	96	92
Above Normal (16%)	100	100	100	96
Below Normal (13%)	100	100	88	76
Dry (24%)	100	100	79	78
Critical (15%)	100	87	45	78

Alternative 3

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	100	98
80%	100	100	79	88
90%	100	82	38	69
Long Term				
Full Simulation Period[b]	99	94	86	88
Water Year Types[c]				
Wet (32%)	100	100	92	77
Above Normal (16%)	100	100	100	99
Below Normal (13%)	100	90	95	97
Dry (24%)	100	93	73	93
Critical (15%)	92	79	71	83

Alternative 3 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	0	12	8
80%	0	0	4	13
90%	0	-18	-1	17
Long Term				
Full Simulation Period[b]	-1	-4	2	3
Water Year Types[c]				
Wet (32%)	0	0	-4	-15
Above Normal (16%)	0	0	0	3
Below Normal (13%)	0	-10	6	21
Dry (24%)	0	-7	-5	16
Critical (15%)	-8	-8	26	4

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table B-15-6. New Melones Spotted Bass Nest Survival Percentage, Monthly Percentage

Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	100	88	90
80%	100	100	75	75
90%	100	100	39	53
Long Term				
Full Simulation Period[b]	100	98	84	85
Water Year Types[c]				
Wet (32%)	100	100	96	92
Above Normal (16%)	100	100	100	96
Below Normal (13%)	100	100	88	76
Dry (24%)	100	100	79	78
Critical (15%)	100	87	45	78

Alternative 5

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	100	100	100	100
20%	100	100	100	100
30%	100	100	100	100
40%	100	100	100	100
50%	100	100	100	100
60%	100	100	100	100
70%	100	84	91	100
80%	100	63	52	84
90%	100	27	9	60
Long Term				
Full Simulation Period[b]	100	81	80	88
Water Year Types[c]				
Wet (32%)	99	99	100	100
Above Normal (16%)	100	90	100	76
Below Normal (13%)	100	78	74	92
Dry (24%)	100	78	71	85
Critical (15%)	100	38	38	80

Alternative 5 minus Second Basis of Comparison

Statistic	Mar	Apr	May	Jun
Probability of Exceedance[a]				
10%	0	0	0	0
20%	0	0	0	0
30%	0	0	0	0
40%	0	0	0	0
50%	0	0	0	0
60%	0	0	0	0
70%	0	-16	3	10
80%	0	-37	-23	9
90%	0	-73	-30	7
Long Term				
Full Simulation Period[b]	0	-17	-3	3
Water Year Types[c]				
Wet (32%)	-1	-1	4	8
Above Normal (16%)	0	-10	0	-20
Below Normal (13%)	0	-22	-15	15
Dry (24%)	0	-22	-7	7
Critical (15%)	0	-50	-6	2

a Exceedance probability is defined as the probability a given value will be exceeded in any one year.

b Based on the 82-year simulation period.

c As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Appendix 9G

Smelt Analysis

This appendix provides information about the methods and the assumptions used for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis of Delta Smelt entrainment and Longfin Smelt abundance.

This appendix is organized into two main sections that are briefly described below:

- Section 9G.1: Smelt Modeling Methodology
  - This section presents the entrainment analysis for Delta Smelt adults, larvae and juveniles. The Delta Smelt entrainment analysis is based on regression equations that take into account the combined Old and Middle River (OMR) flow and X2[1] location. This section also describes longfin smelt abundance analysis, which is based on a regression equation that correlates an abundance index based on the X2 location.
- Section 9G.2: Smelt Modeling Results
  - This section presents the simulated Delta Smelt entrainment percentages and longfin smelt abundance indexes for each EIS alternative.

9G.1 Smelt Modeling Methodology and Assumptions

This section summarizes the modeling methodology used for simulating Delta Smelt entrainment, and longfin smelt abundance for the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5. It describes the approach used in the quantitative evaluation of potential impacts on Delta Smelt entrainment.

9G.1.1 Delta Smelt Entrainment

Assumptions for adults, and for larvae and juveniles are discussed separately in the following sections.

9G.1.1.1 Methodology for Migrating and Spawning Adults (December-March)

The entrainment of migrating and spawning adult Delta Smelt is primarily affected by the combined OMR flow in December through March. Water exported at the Banks and Jones pumping plants typically flows through the Old and Middle River channels. A positive OMR flow indicates a northward flow in the natural direction, toward the San Francisco Bay, and contributing to the Delta

[1] The location of X2 is described in terms of the average distance of the two practical salinity units isohaline from the Golden Gate Bridge.

outflow. A negative OMR flow indicates a southward flow induced by pumping, and subtracts from the Delta outflow.

In order to simulate Delta Smelt entrainment as influenced by OMR flow, the U.S. Fish and Wildlife Service (2008) developed a regression model based on Kimmerer (2008). This regression model is subject to uncertainty and scientific dispute (Kimmerer 2011; Miller 2011), and is being revisited in the CSAMP process. The equation developed by the U.S. Fish and Wildlife Service (2008) uses the average December through March OMR flow (in units of cubic feet per second [cfs]) and yields the percentage of adult Delta Smelt that may become entrained in the pumps. The equation is:

$$\text{Adult entrainment loss [percentage]} = 6.243 - 0.000957 * \text{OMR Flow}$$
$$\text{(average OMR from December through March)}$$

Kimmerer's (2008) original estimates of entrainment loss had large confidence limits, which Kimmerer (2008:24) noted could be reduced by additional sampling. Miller (2011) assessed the explicit and implicit assumptions of Kimmerer's estimation methods and found that of eight assumptions, there were three that may have biased the estimates of adult proportional entrainment upward and one that may have biased the estimates downward. Miller (2011) suggested methodological adjustments for three of the four assumptions that could have resulted in biased estimates of adult proportional entrainment. In response, a reanalysis by Kimmerer (2011) suggested the above equation should be reduced by 24 percent. In the event that a negative entrainment percentage was calculated, the result was changed to zero.

9G.1.1.2 Methodology for Larvae and Early Juveniles (March-June)

Larvae and early juvenile smelt (generally <60 mm) are most prevalent in the Delta in the spring months of March through June. The U.S. Fish and Wildlife Service (2008) developed a regression model based on Kimmerer (2008) to calculate the percentage entrainment of larval and early juvenile Delta Smelt in South Delta pumping facilities. This regression is dependent on two variables: March through June average OMR flow, and March through June average X2:

$$\text{Larvae and early juvenile entrainment loss [percentage]} = [0.00933 * \text{X2 (March through June)} - 0.0000207 * \text{OMR Flow (March through June)} - 0.556] * 100$$

Similar to described of the concerns associated with the original adult entrainment loss estimates, Miller (2011) suggested that of 10 assumptions made by Kimmerer (2008), eight would have resulted in upward bias and two would not have resulted in bias. However, Miller only provided a quantitative adjustment for only one of the assumptions resulting in bias. Subsequent review by Kimmerer (2011) rejected this adjustment such that the above equation for larval and early juvenile entrainment was used without adjustment. In the event that a negative entrainment percentage was calculated, the result was changed to zero. OMR and X2 values simulated in the CalSim II model for each alternative were used in estimating the entrainment loss.

9G.1.2 Delta Smelt Fall Abiotic Habitat Index

Feyrer et al. (2010) demonstrated that Delta Smelt abiotic habitat availability in the fall in the West Delta, Suisun Bay, and Suisun Marsh subregions, as well as smaller portions of the Cache Slough, South Delta, and North Delta subregions, is correlated with X2 location. Feyrer et al. (2010) used X2 as an indicator of the suitable salinity and water transparency for rearing older juvenile Delta Smelt. Feyrer et al. (2010) concluded that when X2 is located downstream (west) of the confluence of the Sacramento and San Joaquin rivers, at a distance of 70 to 80 km from the Golden Gate Bridge, there is a larger area of suitable habitat. The overlap of the low salinity zone (or X2) with the Suisun Bay/Marsh results in a two-fold increase in the habitat index (Feyrer et al 2010); however others (see Manly et al. 2015) have questioned the use of outflow and X2 location as an indicator of Delta Smelt habitat because other factors may be influencing survival.

In evaluating the fall abiotic habitat availability for Delta Smelt under the alternatives, average September through December X2 position in kilometers was used. X2 values simulated in the CalSim II model for each alternative were averaged over September through December, and compared for the expected changes.

9G.1.3 Longfin Smelt Abundance

Kimmerer et al. (2009) correlated log-transformed Longfin Smelt abundance based on the Fall Midwater Trawl (FMWT) data with the winter and spring location of X2. The correlation is based on the following regression equation:

*Longfin Smelt abundance index value = 10 ^ [-0.05 * (January through June X2 average position) + 7]*

The equation is based on the assumption that a lower X2 value indicates higher flows transporting longfin farther downstream, which would lead to greater longfin smelt survival. The index value indicates the relative abundance of Longfin Smelt and not the size of the population.

9G.2 Smelt Modeling Results

Modeling results are presented in tabular format for Delta Smelt entrainment, September through December X2, and Longfin Smelt abundance. The Delta Smelt analysis results show the percent entrainment for the long-term average and for each water year type for the No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5 in Tables B-1 and B-2. Each alternative is also compared to each of the bases of comparison (No Action Alternative and Second Basis of Comparison). Results are provided separately for adults and larvae/juveniles. Long-term average fall X2 (September through December) and average for each water year type, in KM, are presented in Table B-3. Differences between alternatives with a minus sign are closer to the Golden Gate Bridge. The Longfin Smelt abundance shown in Table B-4 provides the abundance index value for long-term average and for each water year type for the different alternatives.

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

The EIS impact analysis starts with use of the monthly CalSim II model to project CVP and SWP water deliveries. Because this regional model uses monthly time steps to simulate requirements that change weekly or change through observations, it was determined that changes in the model of 5 percent or less were related to the uncertainties in the model processing. Therefore, reductions of 5 percent or less in this comparative analysis are considered to be not substantially different, or "similar."

9G.3 References

Feyrer, F., K. Newman, M. Nobriga, and T. Sommer. 2010. Modeling the Effects of Future Outflow on the Abiotic Habitat of an Imperiled Estuarine Fish. *Estuaries and Coasts* 34:120–128.

Kimmerer, W. J. 2008. Losses of Sacramento River Chinook Salmon and Delta Smelt to Entrainment in Water Diversions in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 6(2), 29.

Kimmerer, W. J., E. S. Gross, and M. L. MacWilliams. 2009. Is the Response of Estuarine Nekton to Freshwater Flow in the San Francisco Estuary Explained by Variation in Habitat Volume? *Coastal and Estuarine Research Federation, 2009*.

Kimmerer, W. J. 2011. Modeling Delta Smelt Losses at the South Delta Export Facilities. *San Francisco Estuary and Watershed Science* 9(1).

USFWS (U.S. Fish and Wildlife Service). 2008. Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Sacramento, CA.

Table B-1. Adult Delta Smelt Entrainment (Dec-Mar).

	Smelt Entrainment	Difference from No Action Alternative	Difference from Second Basis of Comparison
	Percent Entrainment	Percent Entrainment	Percent Entrainment
No Action Alternative			
Long-term Average	7.60	---	-1.41
Wet	6.94	---	-1.13
Above Normal	8.00	---	-1.77
Below Normal	8.28	---	-1.54
Dry	8.01	---	-1.65
Critical	7.30	---	-1.10
Second Basis of Comparison			
Long-term Average	9.01	1.41	
Wet	8.07	1.13	---
Above Normal	9.77	1.77	---
Below Normal	9.82	1.54	---
Dry	9.66	1.65	---
Critical	8.41	1.10	---
Alternative 3			
Long-term Average	7.85	0.25	-1.16
Wet	7.31	0.37	-0.76
Above Normal	8.41	0.41	-1.36
Below Normal	8.52	0.24	-1.30
Dry	8.09	0.08	-1.57
Critical	7.38	0.08	-1.02
Alternative 5			
Long-term Average	7.61	0.01	-1.40
Wet	6.94	0.00	-1.13
Above Normal	8.01	0.01	-1.76
Below Normal	8.30	0.02	-1.52
Dry	8.02	0.01	-1.64
Critical	7.31	0.01	-1.09

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-2. Juvenile Delta Smelt Entrainment (Mar-Jun).

	Smelt Entrainment	Difference from No Action Alternative	Difference from Second Basis of Comparison
	Percent Entrainment	Percent Entrainment	Percent Entrainment
No Action Alternative			
Long-term Average	8.59	---	-6.91
Wet	1.34	---	-5.56
Above Normal	3.64	---	-9.31
Below Normal	11.98	---	-9.38
Dry	12.99	---	-7.30
Critical	19.25	---	-4.32
Second Basis of Comparison			
Long-term Average	15.50	6.91	
Wet	6.90	5.56	---
Above Normal	12.95	9.31	---
Below Normal	21.36	9.38	---
Dry	20.29	7.30	---
Critical	23.58	4.32	---
Alternative 3			
Long-term Average	12.69	4.09	-2.82
Wet	5.64	4.30	-1.26
Above Normal	10.07	6.43	-2.88
Below Normal	16.93	4.95	-4.43
Dry	16.52	3.54	-3.76
Critical	20.50	1.25	-3.08
Alternative 5			
Long-term Average	7.72	-0.87	-7.78
Wet	1.23	-0.11	-5.67
Above Normal	3.39	-0.25	-9.56
Below Normal	11.01	-0.97	-10.35
Dry	11.27	-1.71	-9.01
Critical	17.56	-1.69	-6.01

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-3. X2 Position (Sep-Dec).

	X2 Position	Difference from No Action Alternative	Difference from Second Basis of Comparison
	km	km	km
No Action Alternative			
Long-term Average	84.0	---	-4.2
Wet	75.9	---	-9.8
Above Normal	81.2	---	-6.1
Below Normal	87.8	---	-0.6
Dry	89.1	---	-0.2
Critical	92.4	---	0.1
Second Basis of Comparison			
Long-term Average	88.1	4.2	
Wet	85.6	9.8	---
Above Normal	87.3	6.1	---
Below Normal	88.4	0.6	---
Dry	89.3	0.2	---
Critical	92.3	-0.1	---
Alternative 3			
Long-term Average	88.1	4.1	-0.1
Wet	85.5	9.7	-0.1
Above Normal	87.2	6.0	-0.1
Below Normal	88.1	0.3	-0.3
Dry	89.4	0.2	0.0
Critical	92.5	0.1	0.1
Alternative 5			
Long-term Average	83.9	0.0	-4.2
Wet	75.8	0.0	-9.8
Above Normal	81.2	0.0	-6.1
Below Normal	87.6	-0.2	-0.8
Dry	89.1	0.0	-0.2
Critical	92.3	-0.1	0.0

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Table B-4. Longfin Smelt Abundance Index.

	Longfin Smelt Abundance Index Value	Percent Difference from No Action Alternative	Percent Difference from Second Basis of Comparison
No Action Alternative			
Long-term Average	7951	---	9.6%
Wet	16635	---	5.1%
Above Normal	8989	---	15.8%
Below Normal	3166	---	21.6%
Dry	2702	---	26.2%
Critical	1147	---	21.0%
Second Basis of Comparison			
Long-term Average	7257	-8.7%	
Wet	15822	-4.9%	---
Above Normal	7762	-13.7%	---
Below Normal	2604	-17.8%	---
Dry	2140	-20.8%	---
Critical	947	-17.4%	---
Alternative 3			
Long-term Average	7345	-7.6%	1.2%
Wet	15638	-6.0%	-1.2%
Above Normal	7882	-12.3%	1.5%
Below Normal	2857	-9.8%	9.7%
Dry	2435	-9.9%	13.8%
Critical	1094	-4.6%	15.5%
Alternative 5			
Long-term Average	8015	0.8%	10.4%
Wet	16683	0.3%	5.4%
Above Normal	9037	0.5%	16.4%
Below Normal	3231	2.0%	24.1%
Dry	2800	3.6%	30.8%
Critical	1204	5.0%	27.1%

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

Appendix 9H

IOS Model Documentation

Information about the methods and assumptions used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the IOS model is provided in this appendix. The appendix comprises two main sections as follows:

- Section 9H.1: IOS Methodology and Assumptions
  - The IOS model analysis is used to quantify winter-run Chinook Salmon escapement and egg survival. The approach and assumptions for the IOS analysis are described in this section.
- Section 9H.2: IOS Model Analysis Results
  - The results of the IOS analysis are presented in this section in a series of figures for each alternative comparison.

9H.1 IOS Model Methodology and Assumptions

9H.1.1 IOS Model Methodology

The IOS model simulates the entire life cycle of winter-run Chinook Salmon through successive generations. This approach allows for the evaluation of individual life-stage effects on the long-term trajectory of the population. A detailed description of the model and sensitivity analysis can be found in Zeug et al. (2012).

The IOS model is composed of six model stages that are arranged sequentially to account for the entire life cycle of the winter run, from eggs to returning spawners. In sequential order, the IOS model stages are: (1) spawning, which models the number and temporal distribution of eggs deposited in the gravel at the spawning grounds; (2) early development, which models the impact of temperature on maturation timing and mortality of eggs at the spawning grounds; (3) fry rearing, which models the relationship between temperature and mortality of salmon fry during the river-rearing period; (4) river migration, which estimates the mortality of migrating salmon smolts in the Sacramento River between the spawning and rearing grounds and the Delta; (5) Delta passage, which models the impact of flow, route selection, and water exports on the survival of salmon smolts migrating through the Delta to San Francisco Bay; and (6) ocean survival, which estimates the impact of natural mortality and ocean harvest to predict survival and spawning returns (escapement) by age. Below is a detailed description of each model stage.

The IOS model uses a system dynamics modeling framework, a technique that is used for framing and understanding the behavior of complex systems over time. System dynamics models are made up of stocks (e.g., number of fish) and flows (e.g., sources of mortality) that are informed by mathematical equations. IOS was implemented in the software GoldSim, which enables the simulation of complex processes through creation of simple object relationships, while incorporating Monte Carlo stochastic methods.

The Delta portion of the model is composed of eight reaches and four junctions (see Figure 9H.1 and Table 9H.1) selected to represent primary salmonid migration corridors where high quality fish and hydrodynamic data were available. For simplification, Sutter Slough and Steamboat Slough are combined as the reach "SS," and the forks of the Mokelumne River and Georgiana Slough are combined as "Geo/DCC." The Geo/DCC reach can be entered by the Mokelumne River fall-run at the head of the South and North forks of the Mokelumne River or by Sacramento runs through the combined junction of Georgiana Slough and Delta Cross Channel (Junction C). The Interior Delta reach can be entered from three different pathways: (1) Geo/DCC, (2) San Joaquin River via Old River Junction (Junction D), or (3) Old River via Junction D. Due to lack of data informing specific routes through the Interior Delta, or tributary-specific survival, the entire Interior Delta region is treated as a single model reach. The four distributary junctions depicted in the Delta portion of the model are: (1) Sacramento River at Freemont Weir (head of Yolo Bypass), (2) Sacramento River at head of Sutter and Steamboat Sloughs, (3) Sacramento River at the combined junction with Georgiana Slough and Delta Cross Channel, and (4) San Joaquin River at the head of Old River (see Figure 9H.1 at the end of this appendix and Table 9H.1). Due to lack of data informing specific routes through the Interior Delta, or tributary-specific survival, the entire Interior Delta region is treated as a single model reach.

The IOS model uses scenario-specific daily DSM2, CalSim II, and Sacramento River Basin Water Temperature Model (HEC-5Q) data as model input. Daily DSM2 data inform fish migration speed, reach-specific survival, and routing at Delta junctions. Daily export data from CalSim II are used to inform export-dependent survival of salmon smolts that enter the Interior Delta from the Geo/DCC reach. Sacramento River Basin Water Temperature Model data at Bend Bridge, California are used to inform temperature-dependent egg and fry survival in the egg development and fry rearing stages of the model.

For Delta reaches where acoustic tagging data supported migration speed responses to flow (Sac1, Sac2, Geo/DCC), daily migration speed is influenced by mean daily flow. Migration speed is modeled as a logarithmic function of reach-specific flow occurring on the first day smolts entered a particular reach.

Table 9H.1 Descriptions of Modeled Delta Reaches and Junctions in the IOS Model

Reach/Junction	Description	Reach Length (kilometers)
Sac1	Sacramento River from Freeport to junction with Sutter Slough	41.04
Sac2	Sacramento River from Sutter Slough junction to junction with DCC	10.78
Sac3	Sacramento River from DCC to Rio Vista	22.37
Sac4	Sacramento River from Rio Vista to Chipps Island	23.98
Yolo	Yolo Bypass from entrance at Fremont Weir to Rio Vista	- [a]
SS	Combined reach of Sutter Slough and Steamboat Slough ending at Rio Vista	26.72
Geo/DCC	Combined reach of Georgiana Slough, DCC, and Sough and North forks of the Mokelumne River ending at confluence with San Joaquin River	25.59
Interior Delta	Begins at end of reach Geo/DCC, San Joaquin River via Junction D, or Old River via Junction D, and ends at Chipps Island	- [b]
A	Junction of Yolo Bypass and Sacramento River	Not applicable
B	Combined junction of Sutter Slough and Steamboat Slough with Sacramento River	Not applicable
C	Combined junction of DCC and Georgiana Slough with Sacramento River	Not applicable
D	Junction of Old River with San Joaquin River	Not applicable

Notes:

a. Reach length for Yolo Bypass is currently undefined because reach length is not currently used to calculate Yolo Bypass speed and ultimate travel time.

b. Reach length for the Interior Delta is undefined due to multiple pathways salmon can take. Timing through the Interior Delta does not affect Delta survival because there are no Delta reaches located downstream of the Interior Delta.

DCC = Delta Cross Channel

Reach-specific survival through a given Delta reach is calculated and applied the first day smolts enter the reach. For reaches where literature or available tagging data showed support for reach-level responses to environmental variables, survival is influenced by flow (Sac1, Sac2, Sac3, Sac4, SS, Interior Delta via San Joaquin River, and Interior Delta via Old River) or water exports (Interior Delta via Geo/DCC). For these reaches, daily flow (DSM2 data) or exports (CalSim II data) occurring the day of reach-entry is used to predict reach survival through the entire reach. For all other reaches (Geo/DCC and Yolo), reach survival is uninfluenced by Delta conditions and is informed by means and standard deviations of survival from acoustic tagging studies.

At each Delta junction in the model, smolts move in relation to the proportional movement of flow entering each route. Daily DSM2 flow data entering each route are used to inform the proportion of smolts entering each route at a junction. Smolts move in direct proportion to flow at all junctions except Junction C, where a non-proportional relationship is applied as defined by acoustic tagging study data.

Daily simulated water temperature data at Bend Bridge from the Sacramento River Basin Water Temperature Model were applied to inform temperature-dependent egg and fry survival. Daily mortality of eggs and fry is exponentially related to daily water temperature at Bend Bridge

9H.1.2 Model Analysis Scenario Assumptions

A major assumption of the IOS model is that surrogate fish data can be used to inform many model relationships. When local data are limited, model relationships can often be informed by field data from outside the study region, laboratory studies in controlled experimental settings, or artificially raised (hatchery) surrogates. For example, many model relationships rely on data from tagged hatchery surrogates because experimental studies often rely on easily accessible hatchery-origin fish and assume that fish responses are at least similar among individuals of different natal origins. In addition to limited data on wild fish, many of the model relationships are informed by data from a single Chinook Salmon race, thereby making the assumption that all races move, grow, and survive according to the same rules.

9H.2 Model Analysis Results

IOS model results are displayed as comparisons between scenarios. Differences in escapement and egg survival are displayed as time histories across all 81 water years (1922-2002) and box plots of median survival across all years. The following scenario comparisons are presented in Figures 9H.2 through 9H.21 at the end of this appendix.

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 3 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the No Action Alternative
- Alternative 5 compared to the Second Basis of Comparison

9H.3 Reference

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

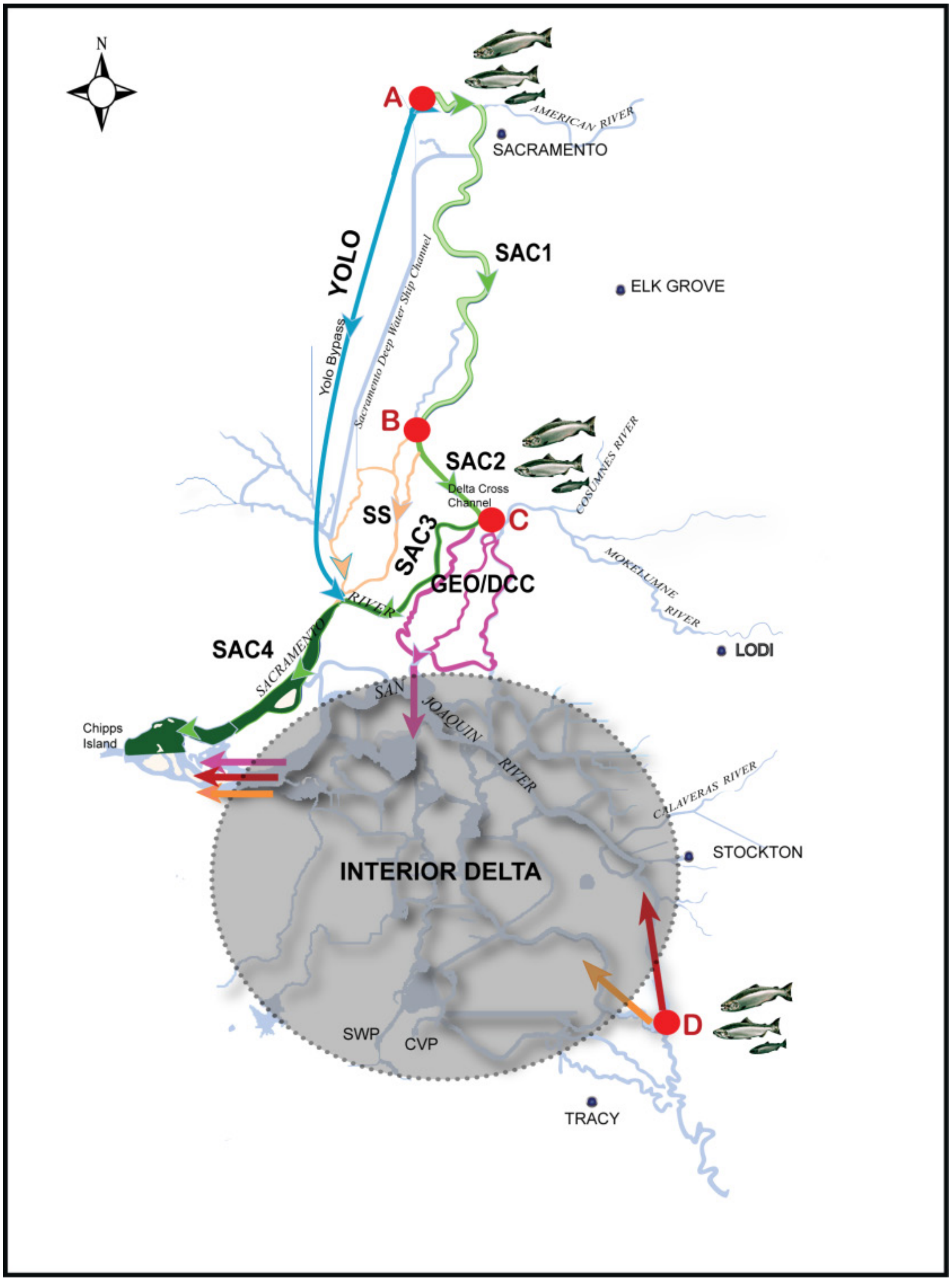


Figure 9H.1 IOS Model Reaches and Junctions in the Delta

Notes: Bold headings label modeled reaches and red circles indicate model junctions. Salmonid icons indicate locations where smolts enter the Delta in the IOS model.

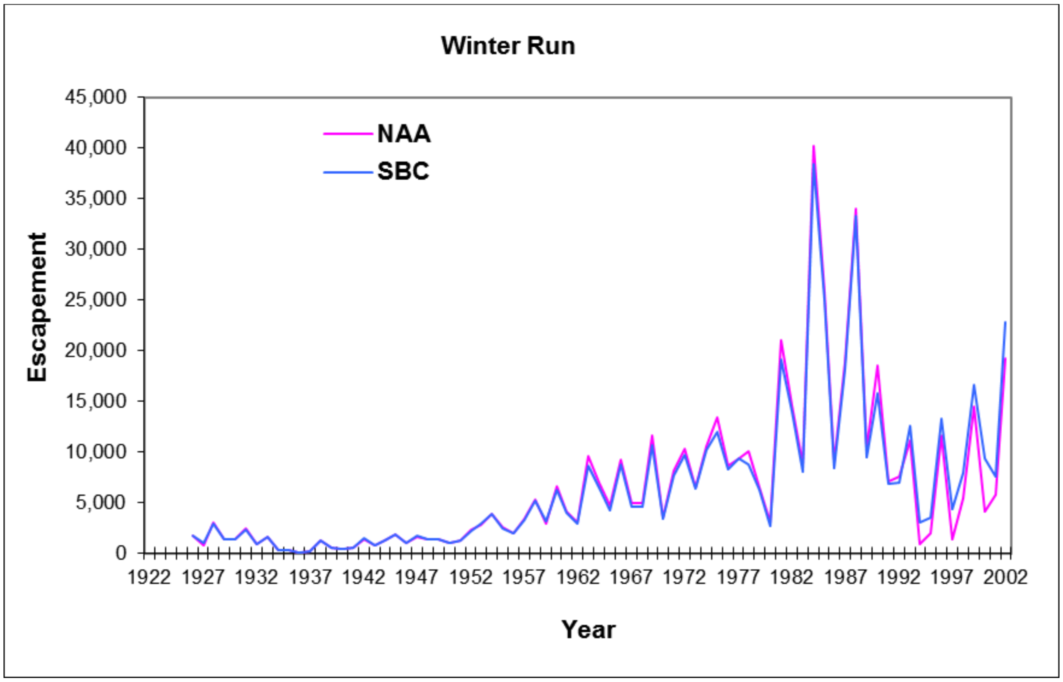


Figure 9H.2 Annual Adult Escapement for Winter-run Chinook Salmon under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC) over 81 Water Years Estimated by the IOS Model

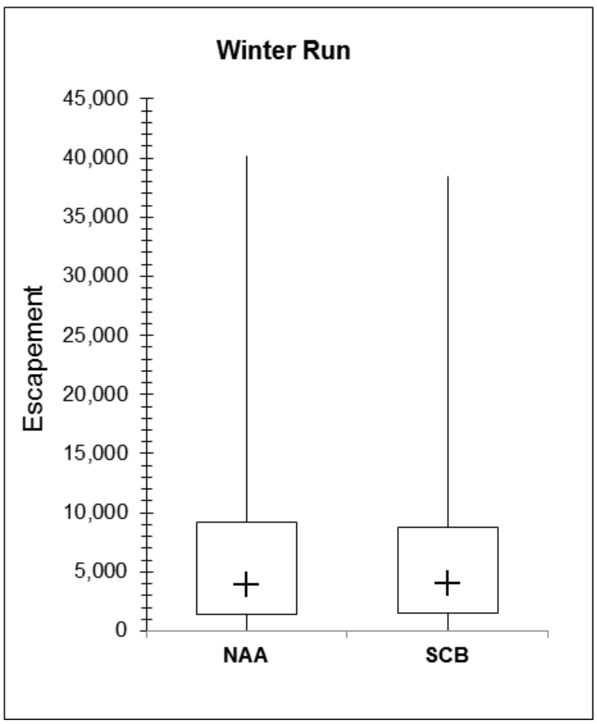


Figure 9H.3 Annual Adult Escapement for Winter-run Chinook Salmon under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

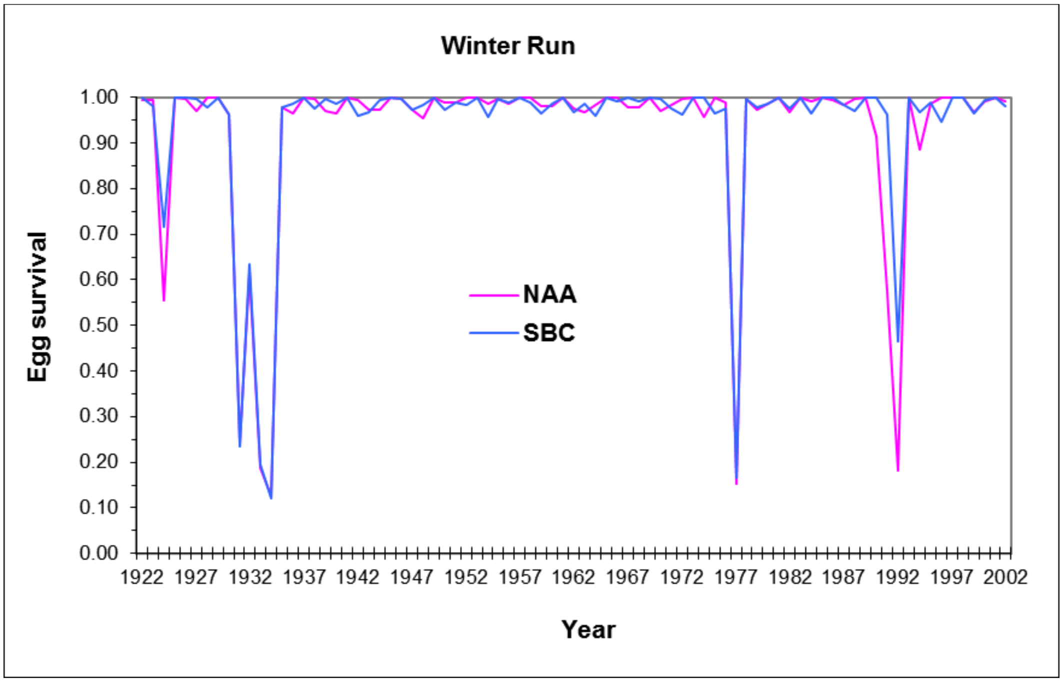


Figure 9H.4 Annual Egg Survival for Winter-run Chinook Salmon under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC) over 81 Water Years Estimated by the IOS Model

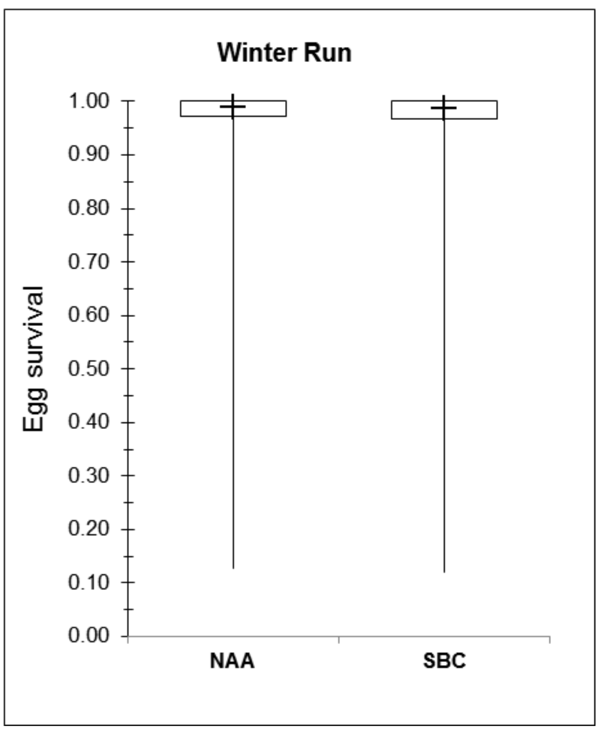
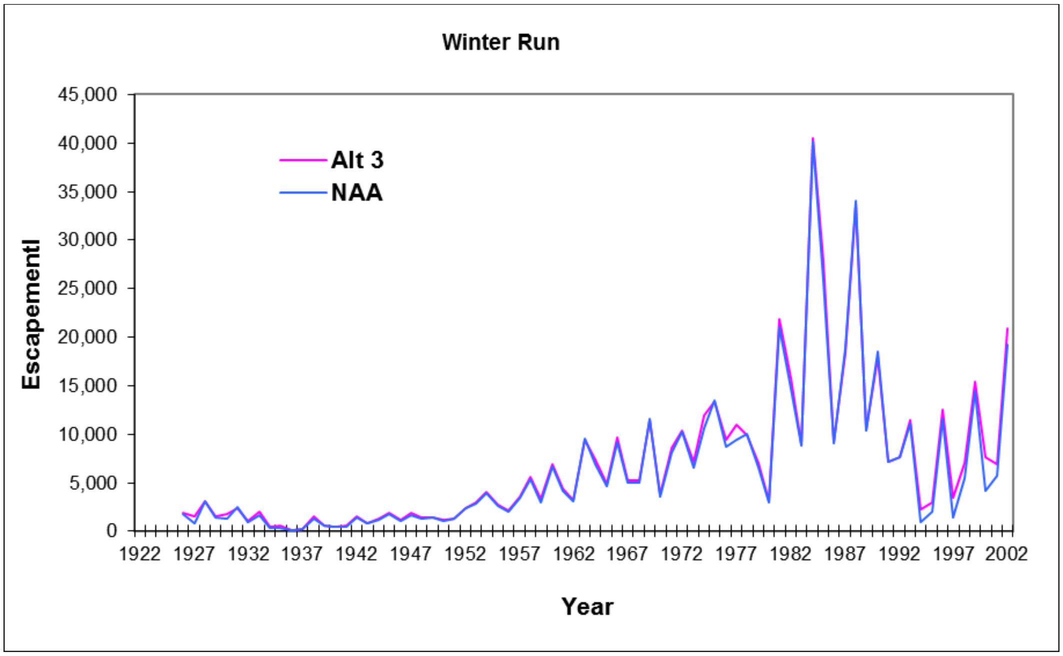
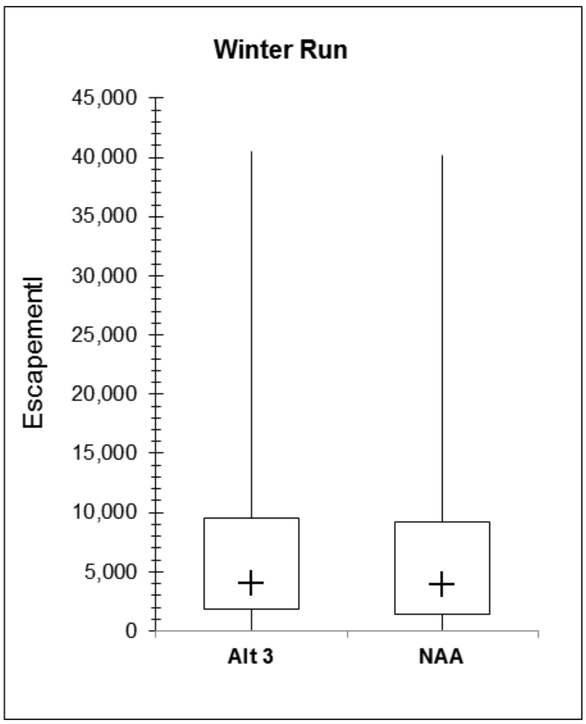


Figure 9H.5 Annual Egg Survival for Winter-run Chinook under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.



1 **Figure 9H.6 Annual Adult Escapement for Winter-run Chinook Salmon under**
2 **Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA) over 81 Water**
3 **Years Estimated by the IOS Model**



4 **Figure 9H.7 Annual Adult Escapement for Winter-run Chinook Salmon under**
5 **Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA) estimated by**
6 **the IOS Model**

7 Note: The plus symbol indicates median, box represents the interquartile range, and the
8 whiskers represent the minimum and maximum values.

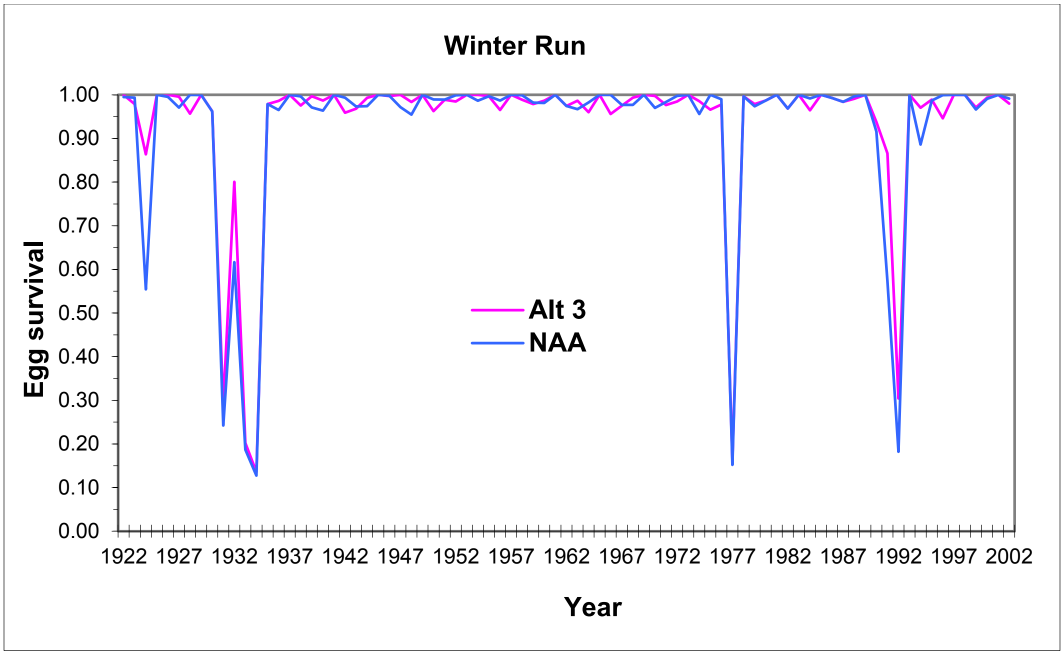


Figure 9H.8 Annual Egg Survival for Winter-run Chinook Salmon under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA) over 81 Water Years Estimated by the IOS Model

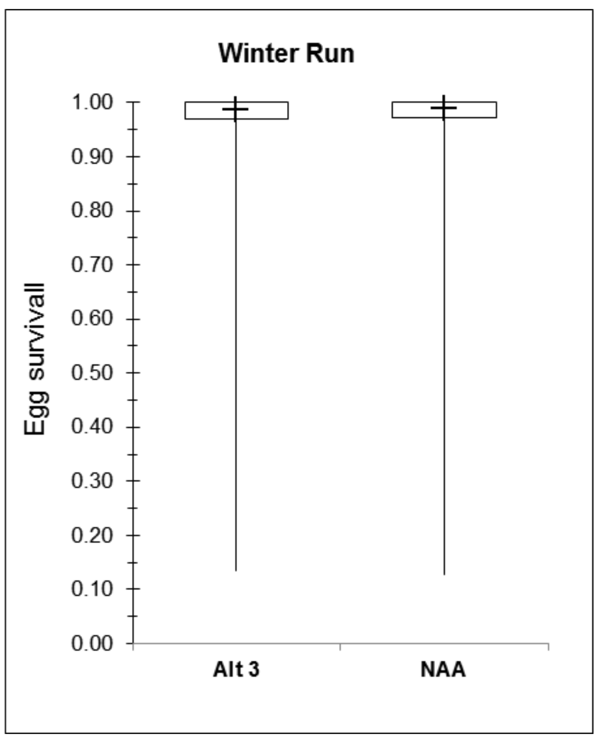


Figure 9H.9 Annual Egg Survival for Winter-run Chinook under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

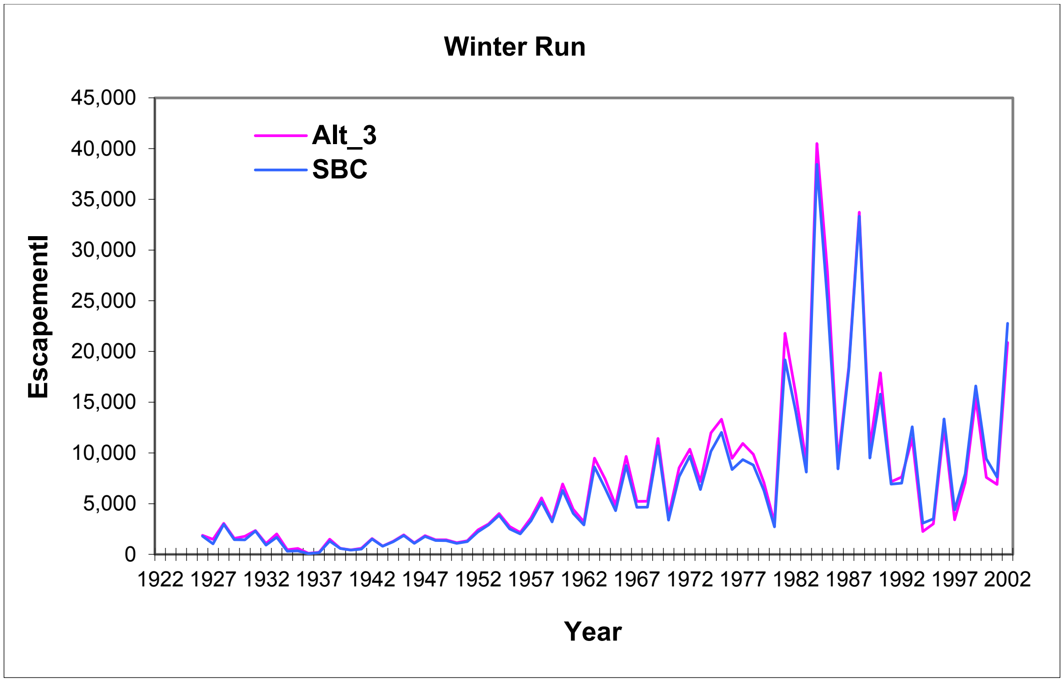


Figure 9H.10 Annual Adult Escapement for Winter-run Chinook Salmon under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison over 81 Water Years Estimated by the IOS Model

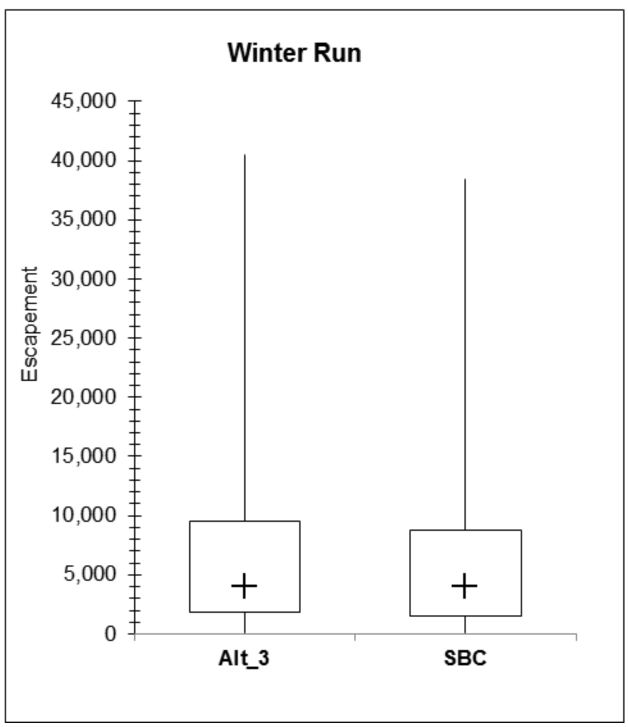


Figure 9H.11 Annual Adult Escapement for Winter-run Chinook Salmon under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

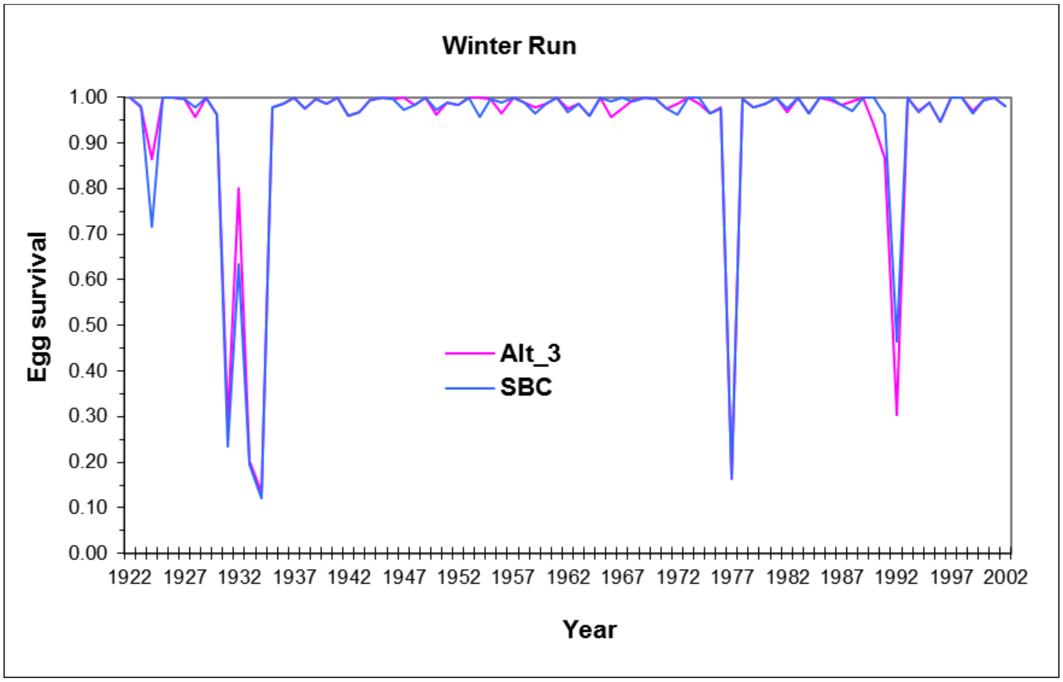


Figure 9H.12 Annual Egg Survival for Winter-run Chinook Salmon under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC) over 81 Water Years Estimated by the IOS Model

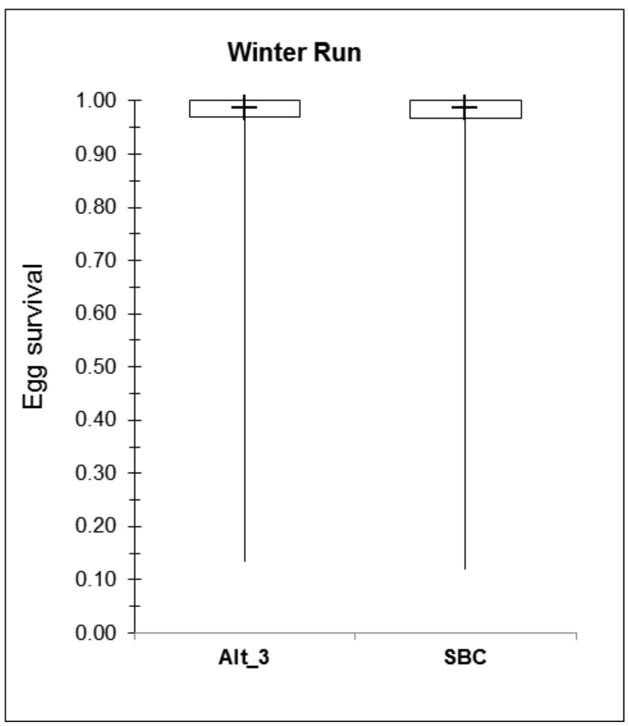


Figure 9H.13 Annual Egg Survival for Winter-run Chinook under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

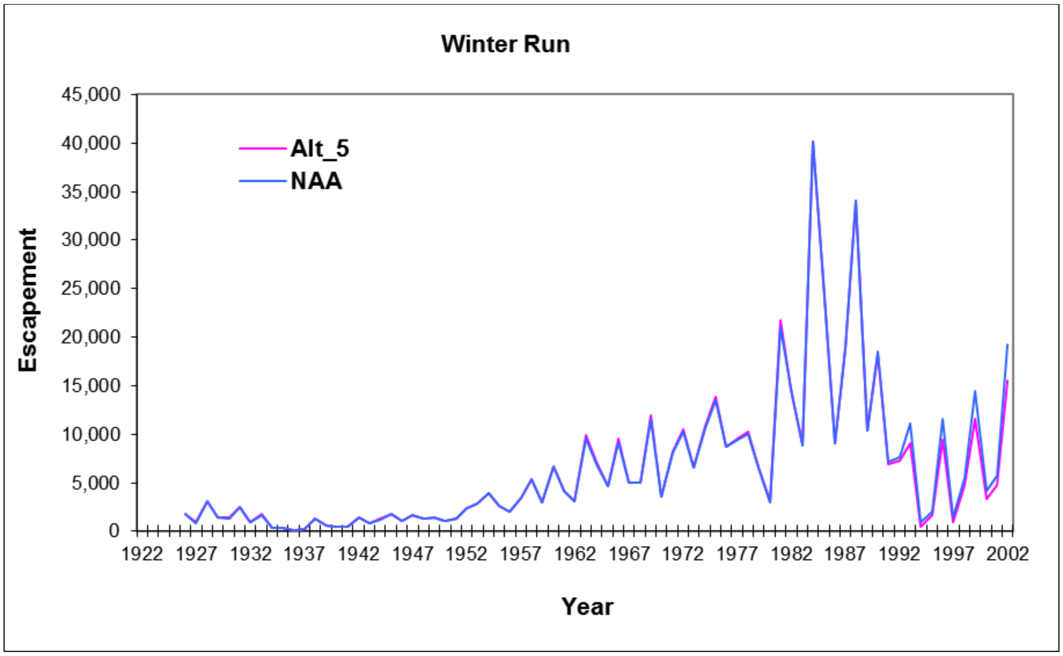


Figure 9H.14 Annual Adult Escapement for Winter-run Chinook Salmon under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA) over 81 Water Years Estimated by the IOS Model

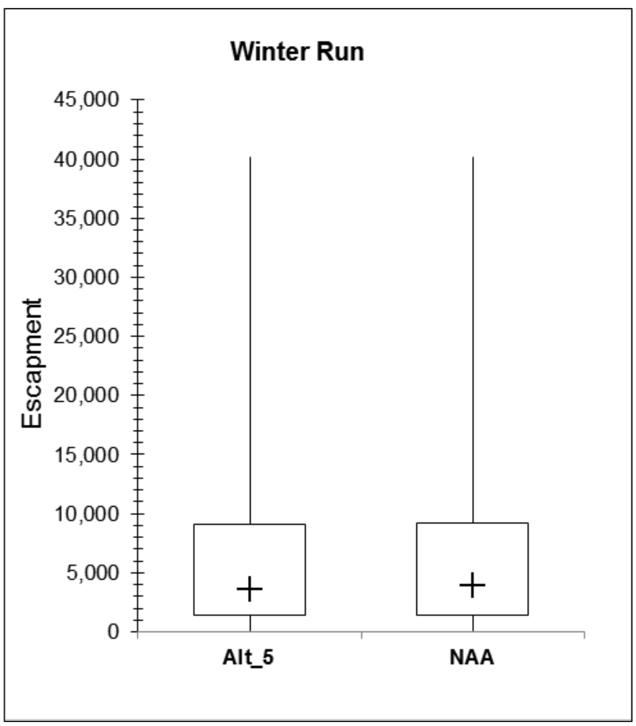


Figure 9H.15 Annual Adult Escapement for Winter-run Chinook Salmon under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

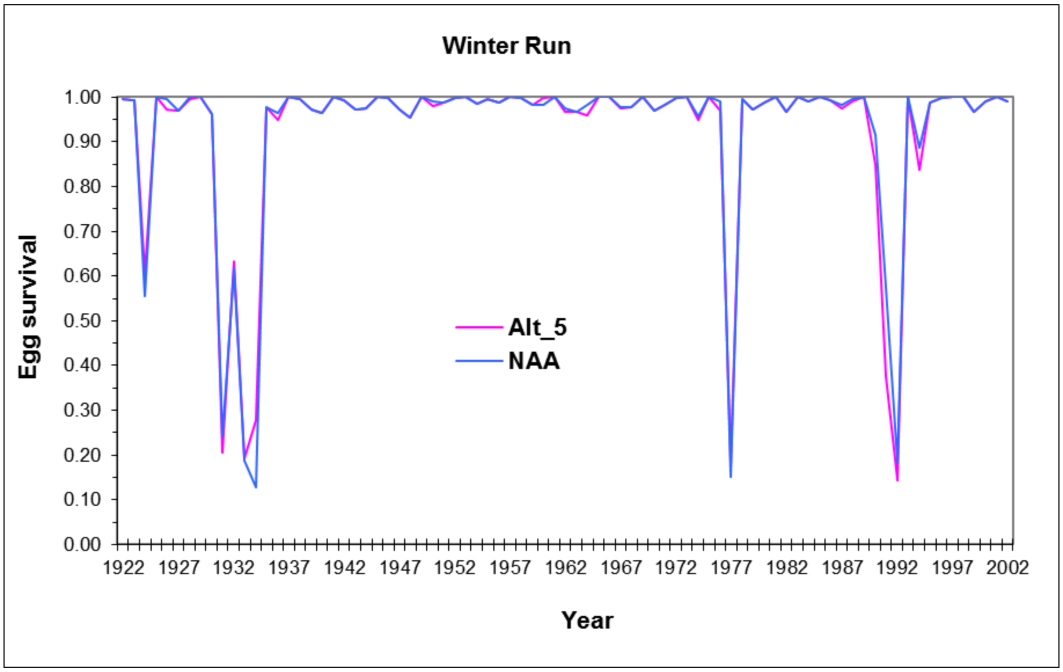


Figure 9H.16 Annual Egg Survival for Winter-run Chinook Salmon under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA) over 81 Water Years Estimated by the IOS Model

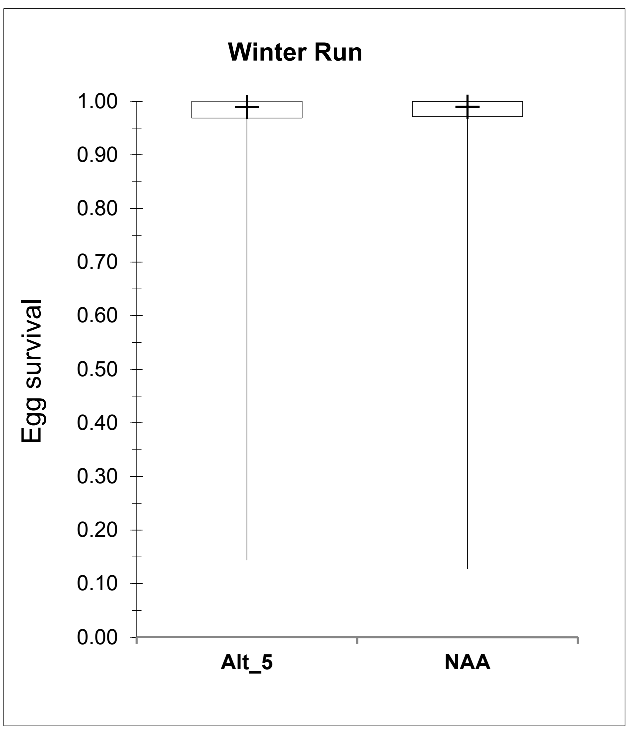


Figure 9H.17 Annual Egg Survival for Winter-run Chinook under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

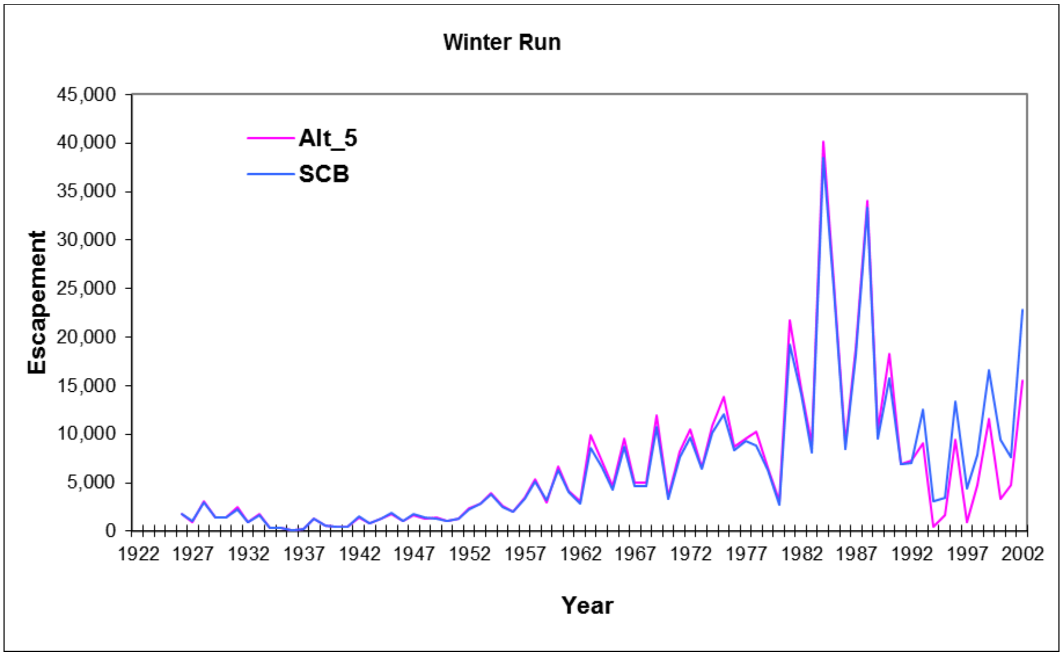


Figure 9H.18 Annual Adult Escapement for Winter-run Chinook Salmon under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison over 81 Water Years Estimated by the IOS Model

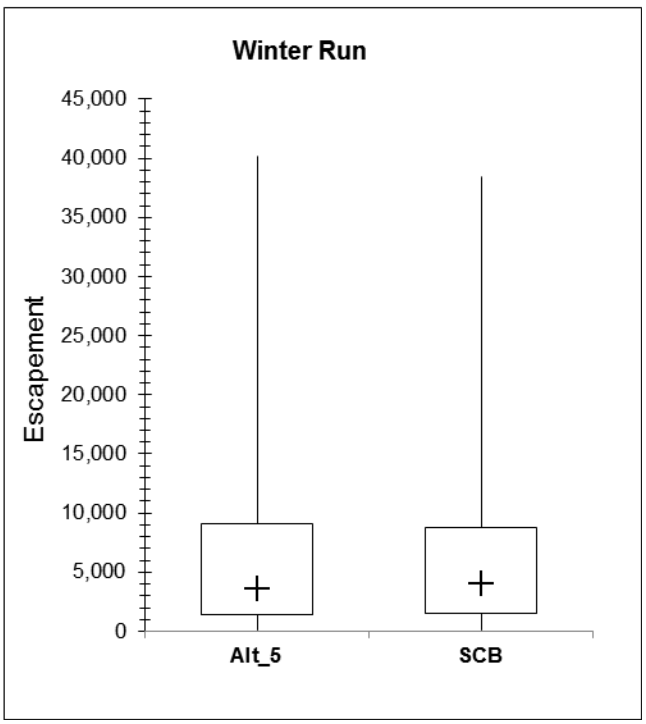


Figure 9H.19 Annual Adult Escapement for Winter-run Chinook Salmon under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

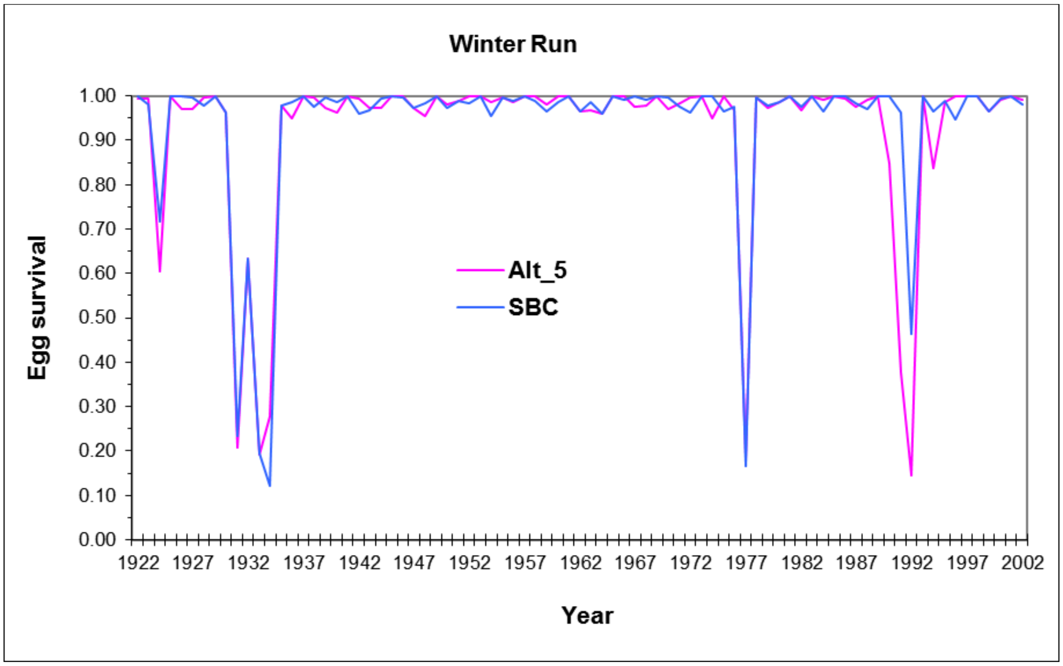


Figure 9H.20 Annual Egg Survival for Winter-run Chinook Salmon under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC) over 81 Water Years Estimated by the IOS Model

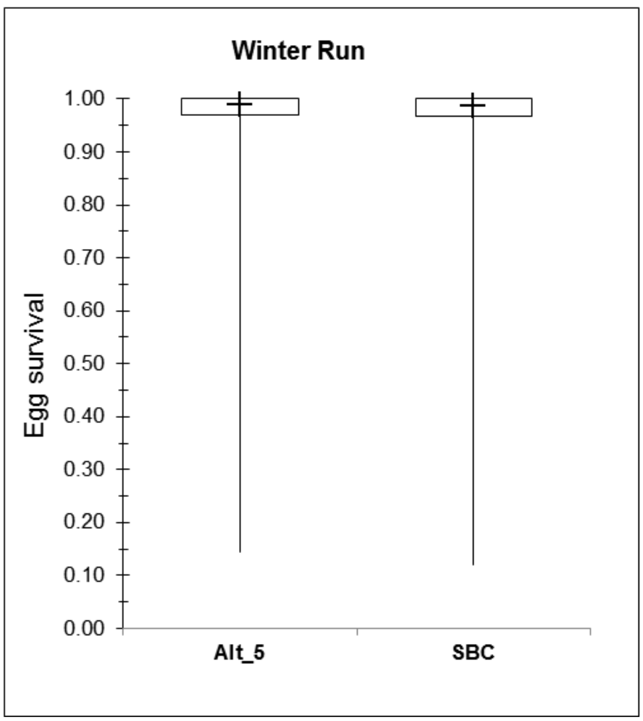


Figure 9H.21 Annual Egg Survival for Winter-run Chinook under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC) estimated by the IOS Model

Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.

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Appendix 9I

Oncorhynchus Bayesian Analysis (OBAN) Model Documentation

This appendix provides information about the methods and assumptions used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the Oncorhynhchus Bayesian Analysis (OBAN) model and pertinent results. This appendix is organized into two sections:

- Section 9I.1: Oncorhynchus Bayesian Analysis Model Methodology and Assumptions
  - The winter-run Chinook Salmon analysis uses the OBAN model (Hendrix et al. 2014) to quantify escapement of winter-run Chinook Salmon from the Sacramento River and overall survival, including ocean survival. This section briefly describes the analytical approach and assumptions of the OBAN model.
- Section 9I.2: Oncorhynchus Bayesian Analysis Model Results
  - This section presents the escapement and overall survival of winter-run Chinook Salmon from the Sacramento River. Results are presented in a series of figures for each comparison between alternatives.

9I.1 Oncorhynchus Bayesian Analysis Model Methodology and Assumptions

9I.1.1 Oncorhynchus Bayesian Analysis Model Methodology

Water operations in the Sacramento and San Joaquin Rivers and delta affect the hydrologic environment and therefore have the potential to affect the populations of fish that reside there. These effects may not be observed directly, however, and life-cycle models may be useful to evaluate the potential effects of water operations on fish population dynamics. To understand how anthropogenic factors in the freshwater and marine portions of the life history may affect winter-run Chinook Salmon (*Oncorhynchus tshawytscha*), the winter-run OBAN model was developed. A version of the OBAN model with updated parameter estimates in 2015 was used to evaluate the alternatives.

9I.1.1.1 OBAN Model Structure and Assumptions

- The OBAN model integrates sources of mortality across the life cycle (survival through the early life stages in the Sacramento River, survival through the delta, and survival in the ocean) to calculate escapement.

- For the evaluation of the scenarios, all sources of mortality after the delta (i.e., ocean) are assumed to be exactly the same so that the focus is on the river and delta portions of the life cycle that may be influenced by the alternatives.
- The OBAN model is sensitive to water temperature in the incubation stage (July –September) and minimum flows in the fry rearing stage (August – November).
- The OBAN model is less sensitive to Delta Cross Channel Gates (DCC) position, exports, and Yolo operations.

9I.1.2 Physical Data

Physical data including temperature, flows, and exports were supplied from CalSim II and the temperature model outputs for each of the scenarios in daily and monthly intervals, depending on the physical data. These data were compiled in the format appropriate for the covariates in the OBAN model. The years 1967 to 2002 were used in the analysis because this is the time period for which both escapement estimates and CalSim II output were available for model calibration. For example, daily temperature data from Bend Bridge were summarized into a monthly average from July through September to define alevin survival rates.

In general, the simulated physical parameters that were used in the OBAN model clustered into two groups. One group consisted of the No Action Alternative and Alternative 5 scenarios which had similar temperature (Figure 9I.1), flow (Figure 9I.2), exports (Figure 9I.3), and Delta Cross Channel configuration (Figure 9I.5). The physical parameters for the second group (the Second Basis of Comparison and Alternative 3 scenarios) were similar, but were different from the parameters used in the other group (Figures 9I.1, 9I.2, 9I.3, and 9I.5). In all four scenarios, the Yolo bypass flows were almost equivalent, with some slight differences over simulation years 1995 through 1998 (Figure 9I.4). Indicators of ocean productivity (Upwelling Index and Farallon Temperatures during spring; Figure 9I.6) and Age-3 harvest rates (Figure 9I.7) were constant across scenarios.

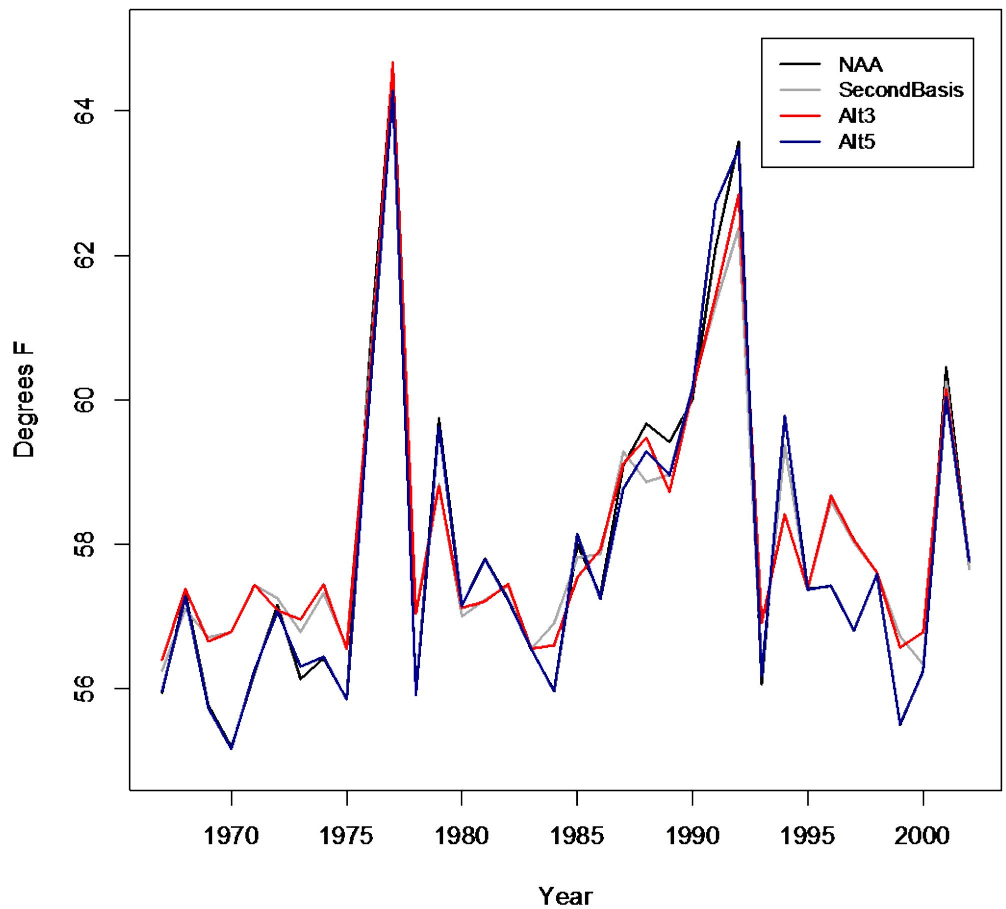

Figure 9I.1 Average Water Temperature from July through September at Bend Bridge for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

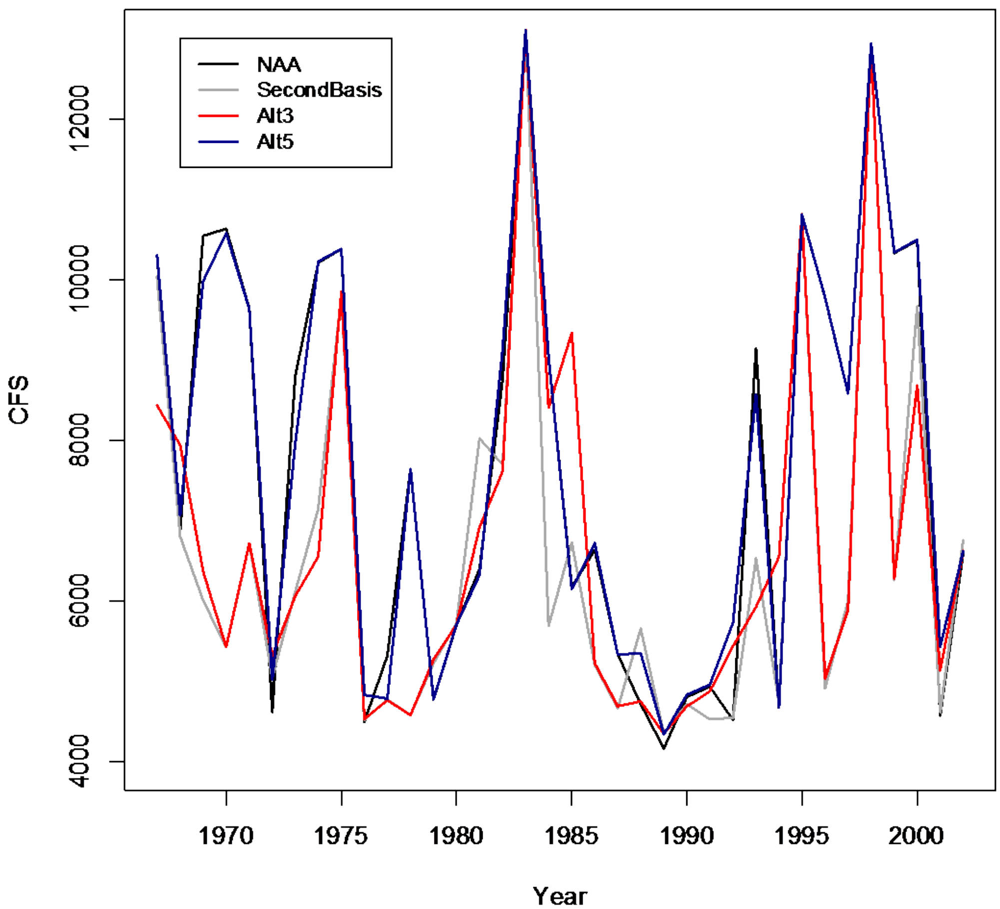

Figure 9I.2 Minimum of Monthly Average Flow from August through November at Bend Bridge for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

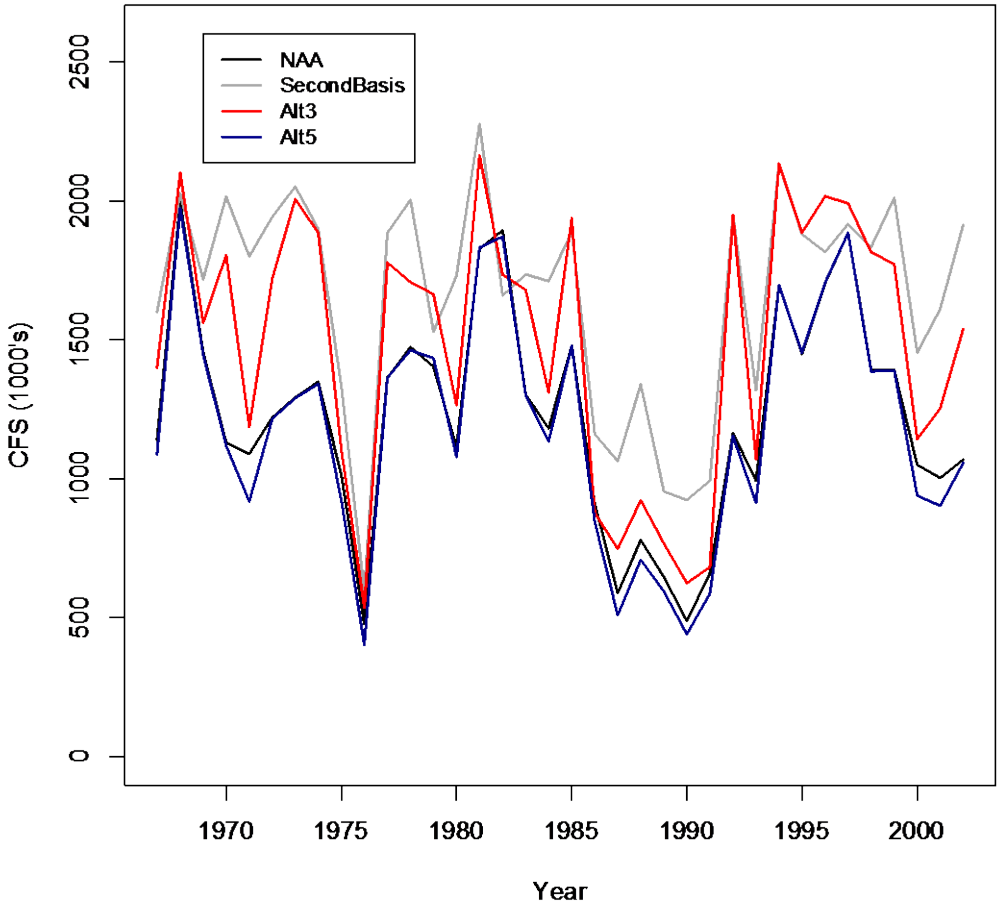

Figure 9I.3 Total Exports from December through June for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

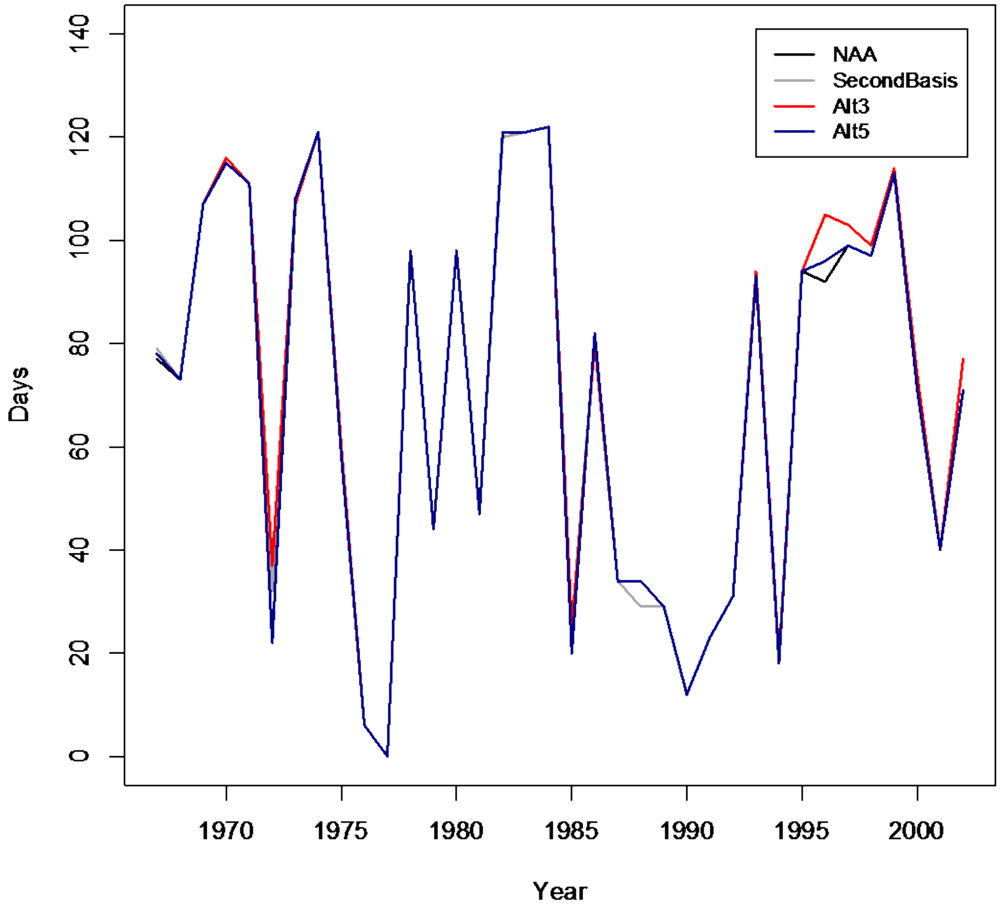

Figure 9I.4 Number of Days when Flow over the Fremont Weir is Greater than 100 Cubic Feet per Second from December through March for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

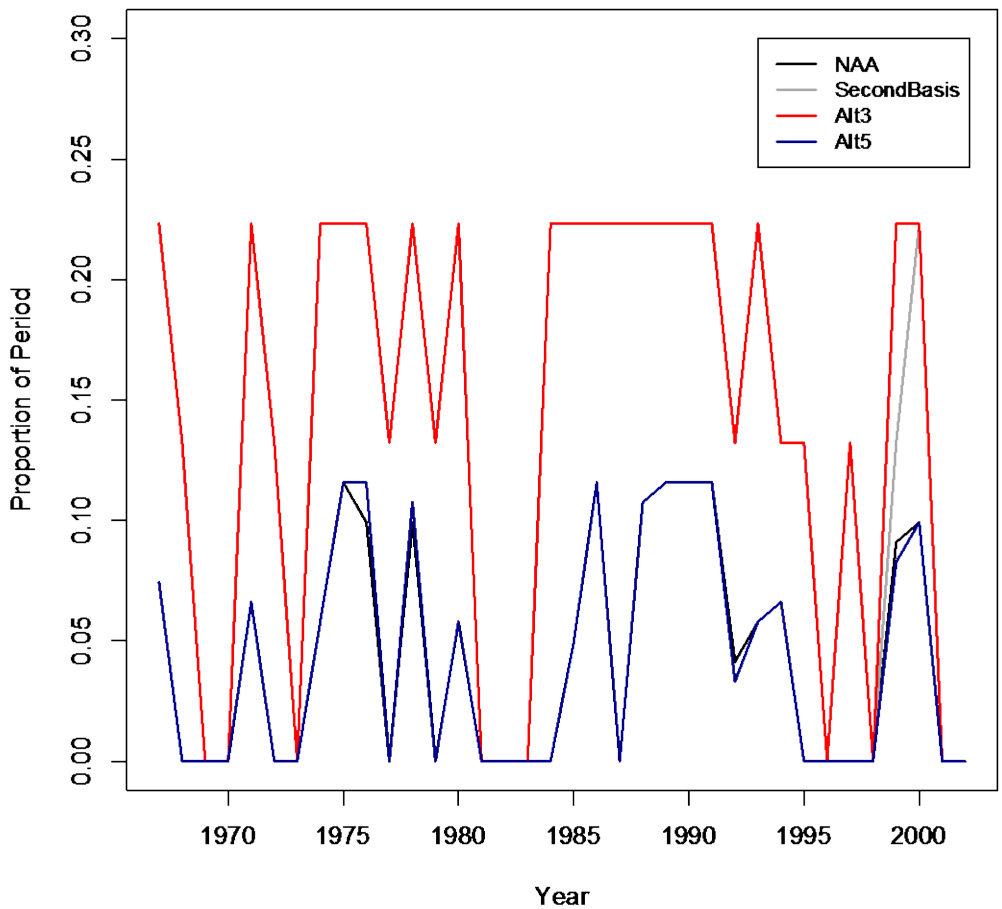

Figure 9I.5 Proportion of Period from December through March when Delta Cross Channel Gates are Open for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

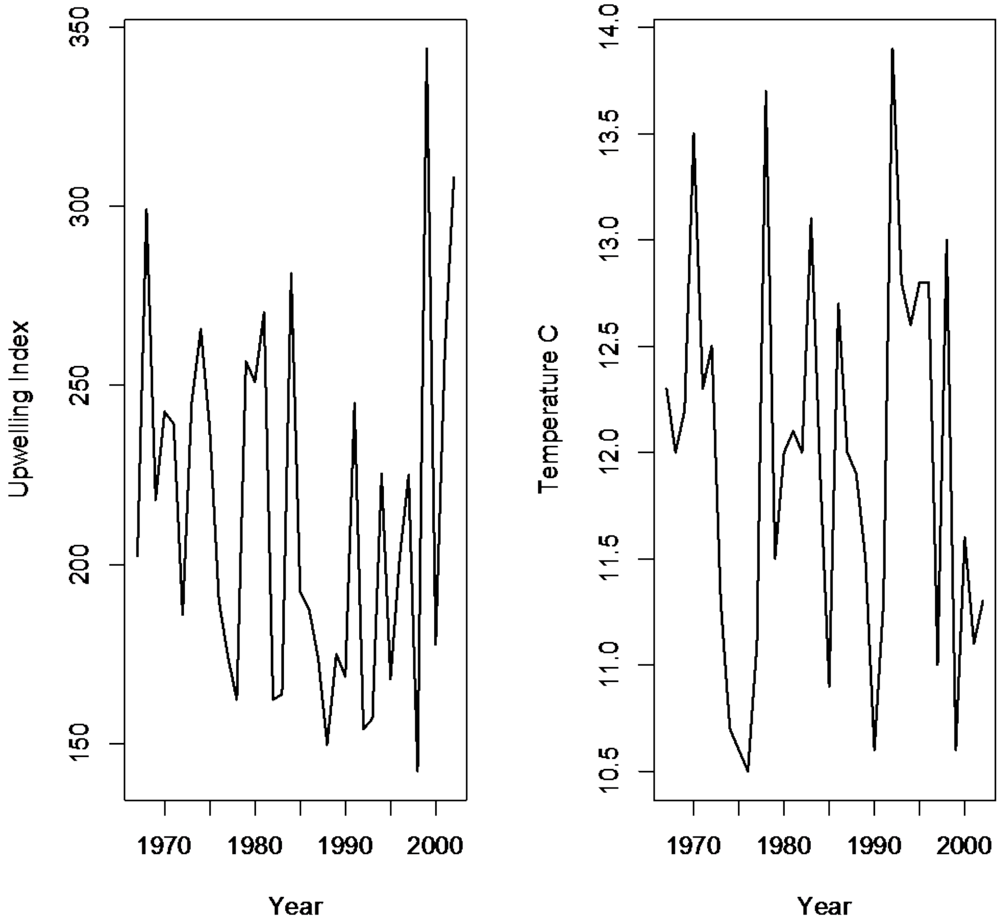

Figure 9I.6 [Indicators of Ocean Productivity including Upwelling Index during Spring (left) and Farallon Temperatures in Spring (right) for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5 (based on historical data).

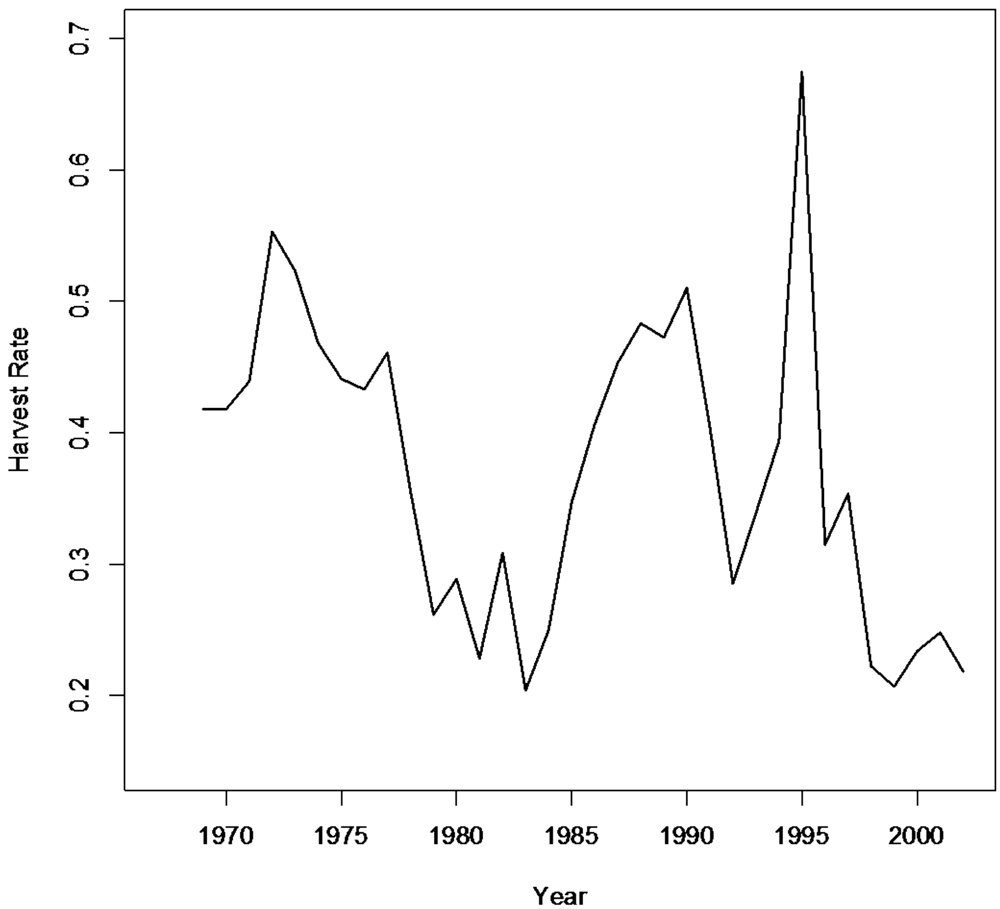

Figure 9I.7 Age 3 Harvest Rate for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5 (based on historical data).

9I.2 Oncorhynchus Bayesian Analysis Model Results

This section describes the OBAN model results for the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.

Results are provided separately for each of the following runs:

- No Action Alternative
- Second Basis of Comparison
- Alternative 3
- Alternative 5

The OBAN model, like many other forecasting models, provides inference for future conditions on a relative basis. That is, the forecasts are not accurate in an absolute sense, but do provide important information when evaluating scenarios relative to each other. The pairwise comparisons obtained from OBAN model runs were:

- Alternative 1 compared to No Action Alternative
- Alternative 3 compared to No Action Alternative
- Alternative 5 compared to No Action Alternative
- No Action Alternative compared to Second Basis of Comparison
- Alternative 1 compared to Second Basis of Comparison
- Alternative 3 compared to Second Basis of Comparison
- Alternative 5 compared to Second Basis of Comparison

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

For comparison of alternatives, the relative difference between two alternatives was calculated as:

*(proposal – base)/base * 100 percent*

The alternative listed first was the proposal and the alternative listed second was the base. The OBAN model produces forecasts of escapement and delta survival rates for simulation years 1967 to 2002, and incorporates parameter uncertainty in each of these outputs. As a result, the scenario comparisons also include uncertainty, and both median, 50 percent, and 90 percent probability intervals were calculated.

9I.2.1 OBAN Simulation Results

This section provides information on results from OBAN simulation for all alternatives without a comparison. Comparison of alternatives, which is used in Chapter 9 for impact analysis, is provided in section 9I.2.2.

The OBAN results indicated generally declining escapement levels until 1997, with a small recovery afterward (Figure 9I.1). Similar trends in median escapement between the No Action Alternative and Alternative 5 scenarios were forecast over the simulation period (Figure 9I.8). Similarly, the Alternative 3 and Second Basis model runs had similar escapement levels, with the Second Basis having slightly lower median escapement than the Alternative 3 scenario during some simulation years (for example, 1985 through 1990).

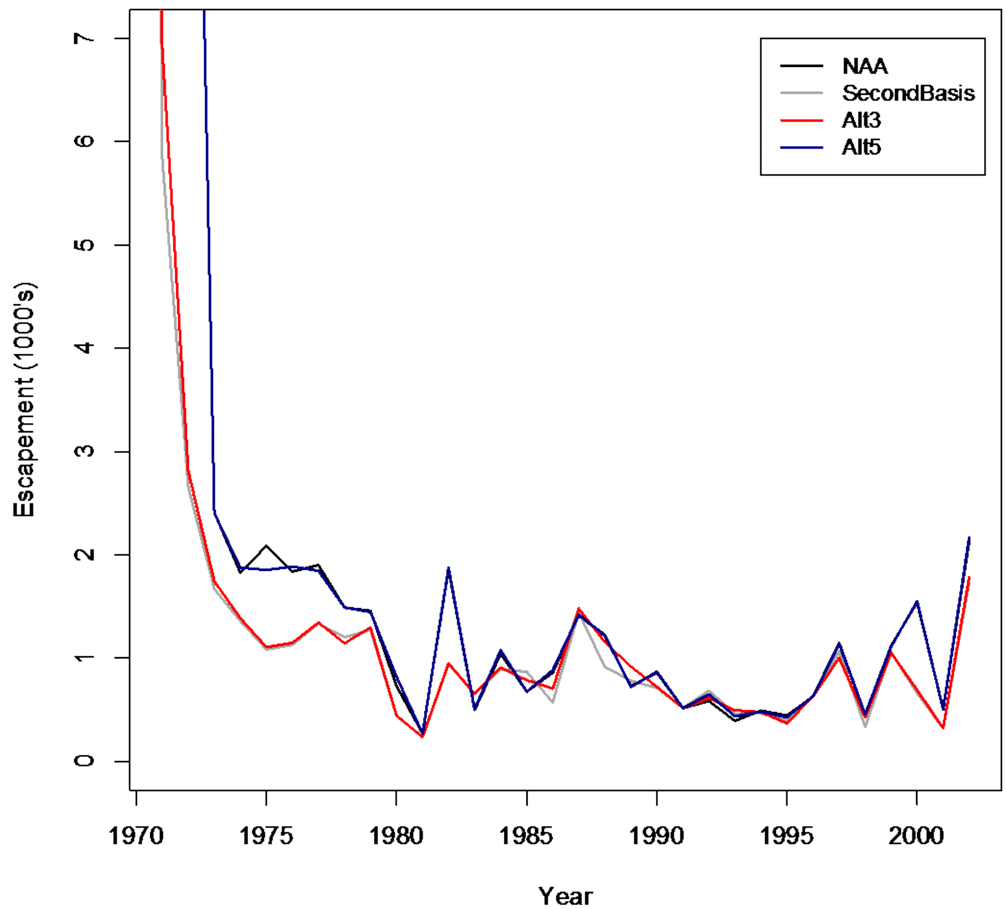

Figure 9I.8 Median Escapement under for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

Median Delta survival was generally higher under the Alternative 5 and the No Action Alternative scenarios and lower under the Alternative 3 and Second Basis of Comparison scenarios (Figure 9I.9).

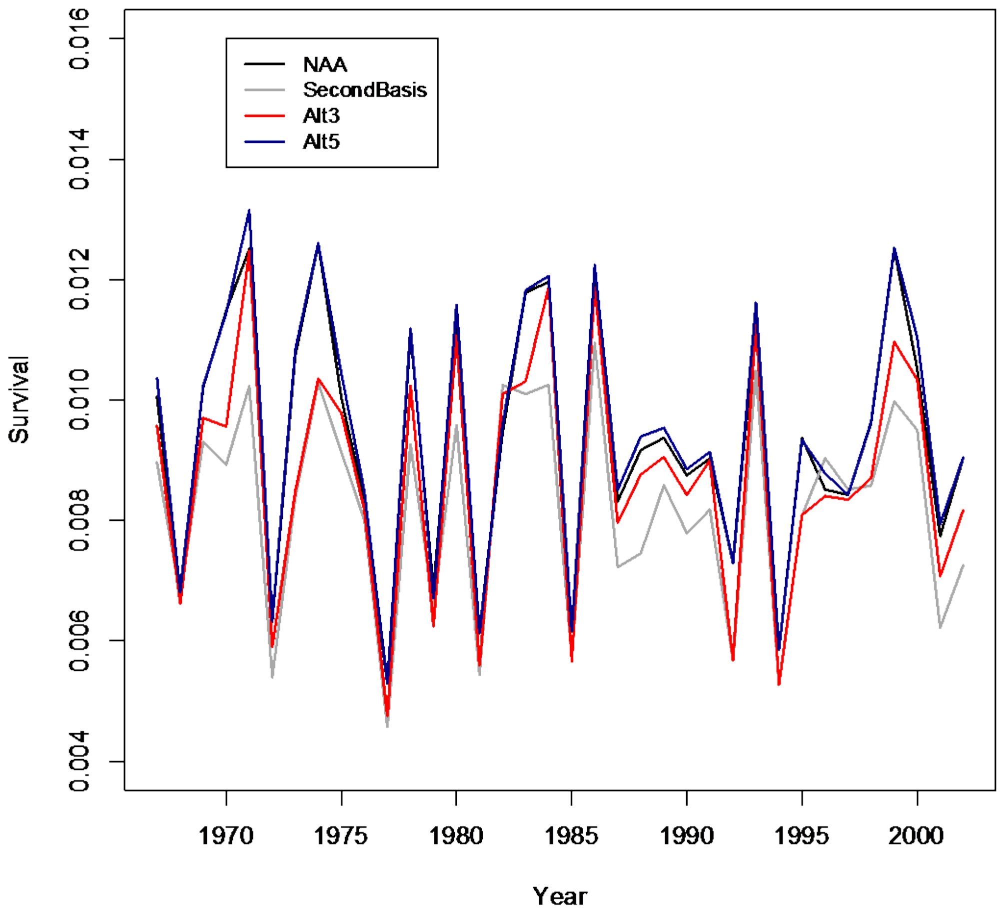

Figure 9I.9 Delta Survival under for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

The probability of exceeding a quasi-extinction threshold of 200 spawners was highest when the median escapement was at low levels (Figure 9I.10). The Alternative 3 and Second Basis scenarios typically had the highest probability of quasi-extinction among the scenarios evaluated.

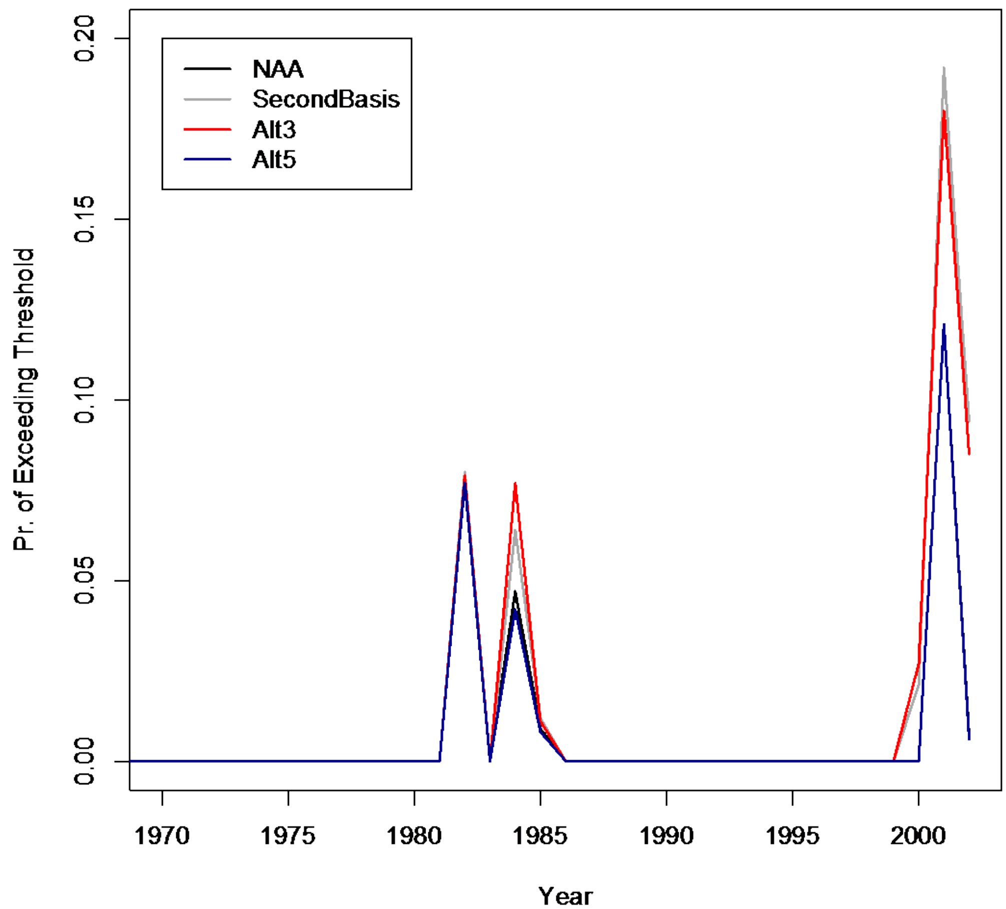

Figure 9I.10 Probability of Exceeding Quasi-Extinction Threshold of 200 Spawners under for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

The escapement estimates incorporating in simulation year 1985[1] indicated slightly higher median escapement of approximately 200 fish for the Second Basis and Alternative 3 scenarios relative to the No Action Alternative and Alternative 5 (Figure 9I.11). There was also a low probability (that is, probability of approximately 0.05) for higher median escapement under the Second Basis and Alternative 3 scenarios relative to the other scenarios in simulation year 1985 (Figure 9I.11)

[1] Years 1985 and 2002 were selected as an example to show a year earlier in the time series and a year later in the time series to look at the escapement levels. Because 2002 is the last year of simulation, it integrates the performance of each of the alternatives across the different water year types in the simulation period.

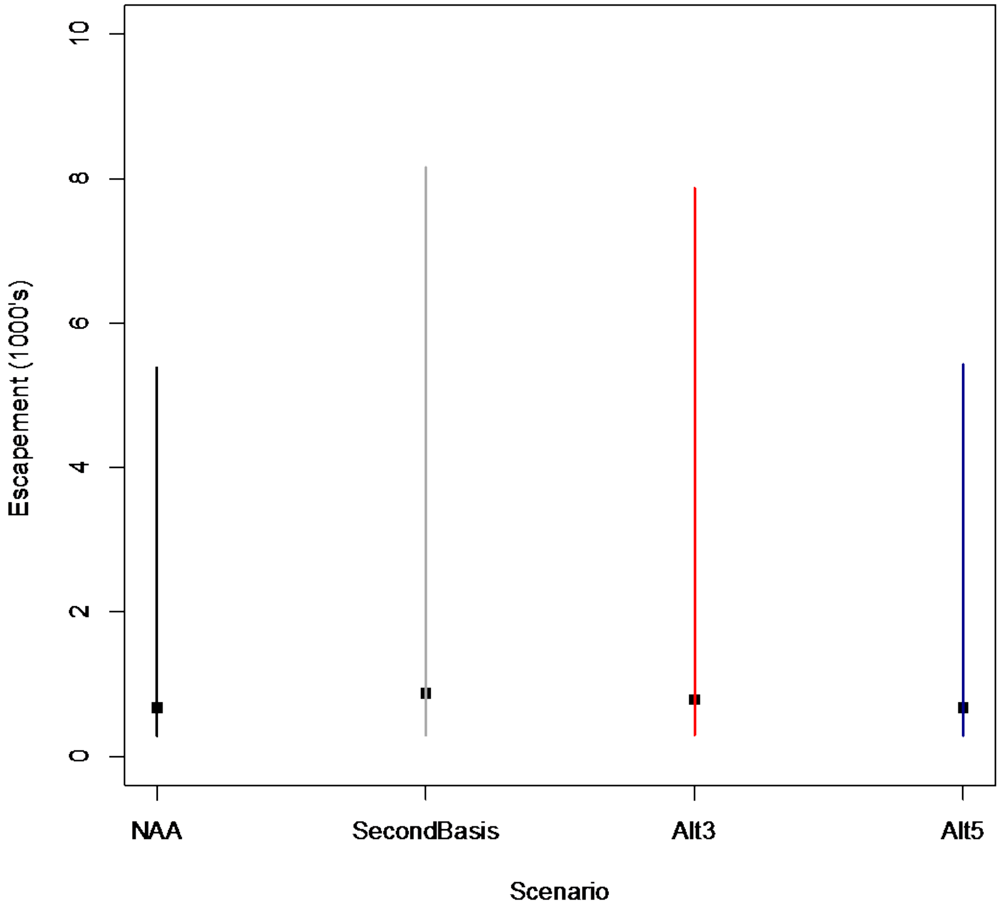

Figure 9I.11 Escapement in Simulation Year 1985 under for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

Note: Squares are median values and lines are 90 percent probability intervals

Comparison of escapement after recovery from the low escapement years of 1992 through 1996 (simulation year 2002) indicated slightly higher median escapement of approximately 300 fish under the No Action Alternative and Alternative 5 scenarios than for the Second Basis and Alternative 3 scenarios (Figure 9I.12).

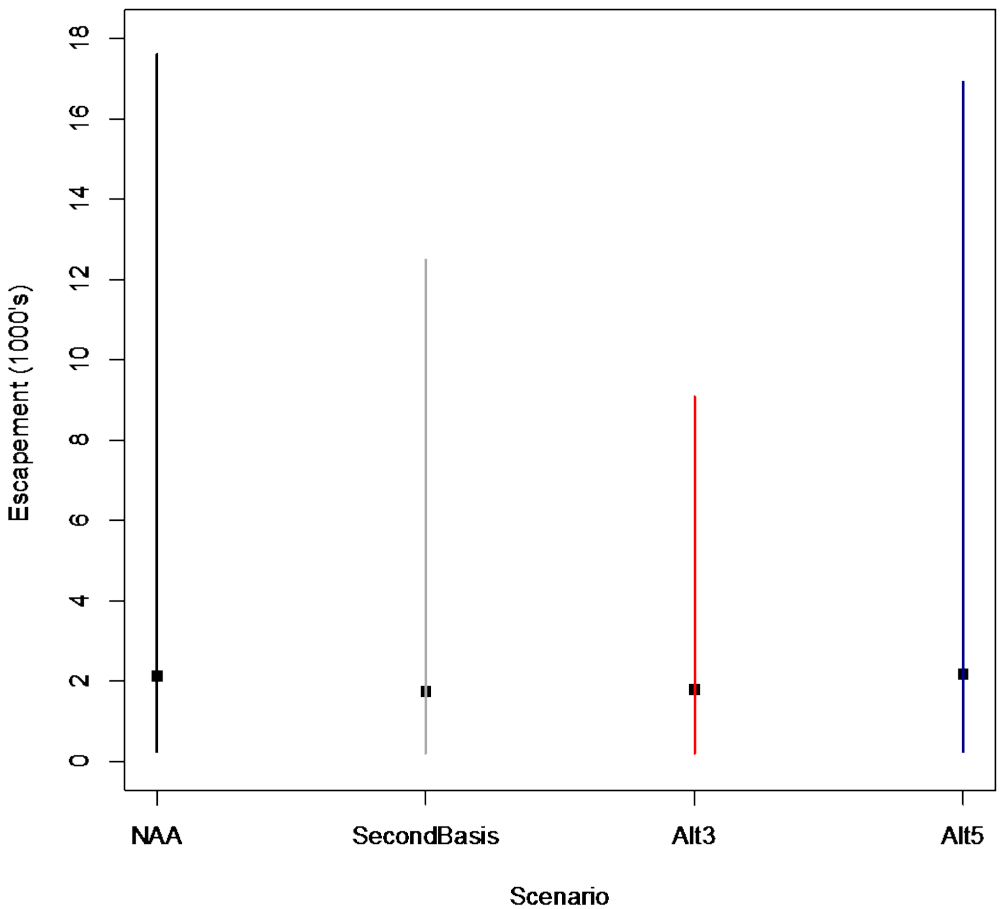

Figure 9I.12 Escapement in Simulation Year 2002 under for No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5

Note: Squares are median values and lines are 90 percent probability intervals

9I.2.2 OBAN Alternative Comparisons

This section provides comparisons of results between alternatives that are used in Chapter 9 for impact analysis. Percent differences provided in this section represent difference in model results between two alternatives (first alternative results minus the second alternative results) divided by the model results of the first alternative multiplied by 100 to present in percentages.

The EIS impact analysis starts with use of the monthly CalSim II model to project CVP and SWP water deliveries. Because this regional model uses monthly time steps to simulate requirements that change weekly or change through observations, it was determined that changes in the model of 5 percent or less were related to the uncertainties in the model processing. Therefore, reductions of 5 percent or less in this comparative analysis are considered to be not substantially different, or "similar."

9I.2.2.1 No Action Alternative Compared to the Second Basis of Comparison

Escapement was generally higher for the No Action Alternative than for the Second Basis, as indicated by the generally negative percent differences between the Second Basis of Comparison (SBC) and No Action Alternative (NAA) (Figure 9I.13). The median escapement under the Second Basis was higher in 6 of the 32 years of simulation (1971 through 2002), and within the 50 percent probability intervals, the Second Basis of Comparison values exceeded the No Action Alternative estimates in less than 25 percent of simulation years (that is, the dark gray area was below the dashed line in more than 75 percent of years).

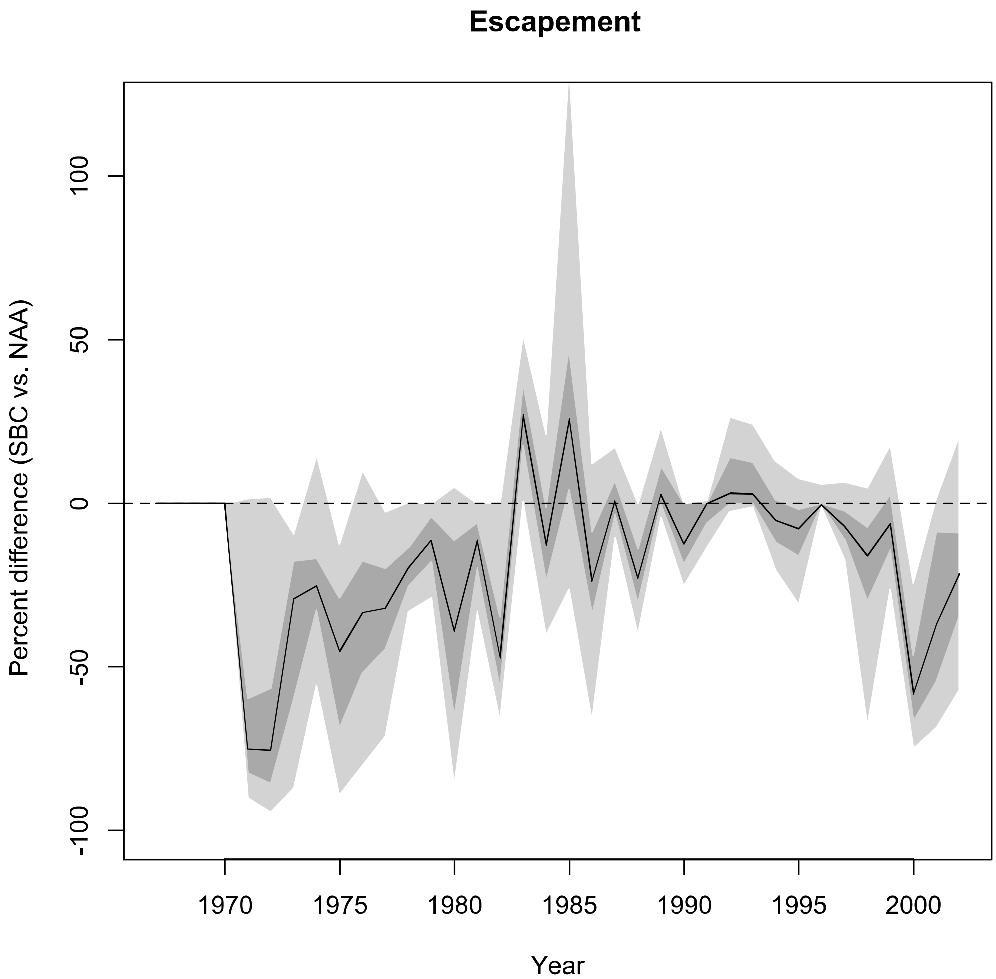

Figure 9I.13 Percent Difference in Escapement between the Second Basis of Comparison and the No Action Alternative

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed

Median delta survival (calculated as the average of the median values across all simulation years) was approximately 12 percent lower under the Second Basis than it was under the No Action Alternative (Figure 9I.14). However, the 50 percent probability intervals and the 90 percent probability intervals are both centered on the value of 0 (dashed line in Figure 9I.14), suggesting that no difference between alternatives is highly probable in most years.

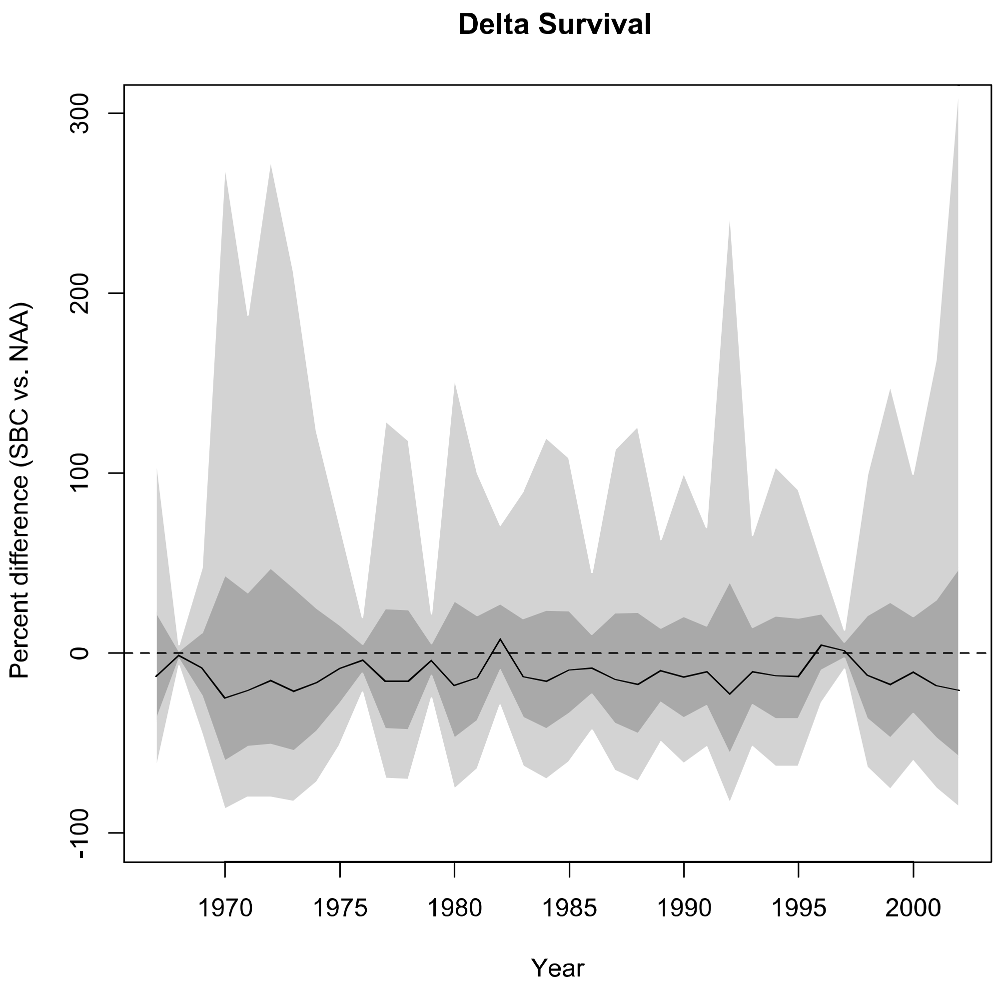

Figure 9I.14 Percent Difference in Delta Survival between the Second Basis of Comparison and the No Action Alternative

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed

9I.2.2.2 Comparison of Alternative 3 versus No Action Alternative

Alternative 3 generally had lower escapement values than the No Action Alternative scenario during the early and late portion of the time series, as indicated by the generally negative percent differences between Alternative 3 and No Action Alternative during those periods (Figure 9I.15). In general, the temporal pattern was similar to the percent differences between the Second Basis of Comparison and the No Action Alternative (Figure 9I.13).

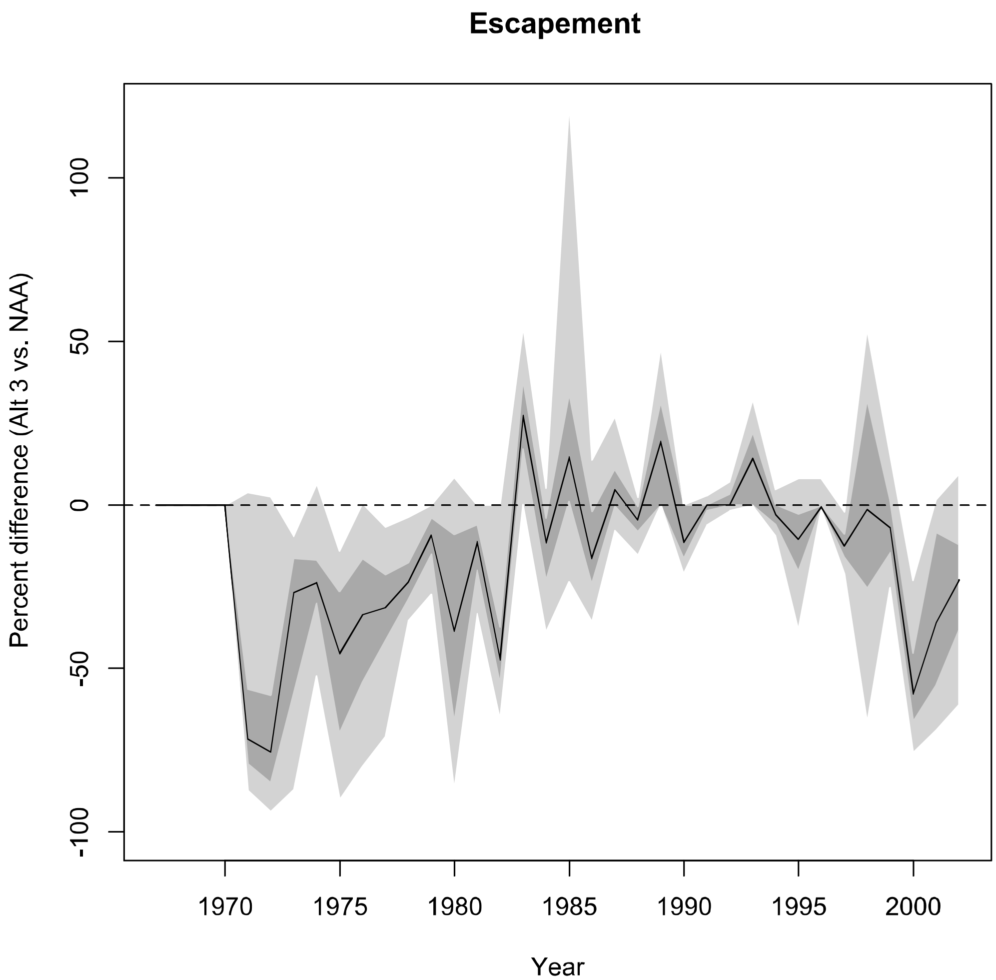

Figure 9I.15 Percent Difference in Escapement between Alternative 3 and the No Action Alternative

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed

With the exception of one year, median delta survival rates were consistently lower (-7 percent) under Alternative 3 than under the No Action Alternative. However, the 50 percent probability intervals and the 90 percent probability intervals are both centered on the value of 0 (dashed line in Figure 9I.16), suggesting that no difference between alternatives is highly probable in most years.

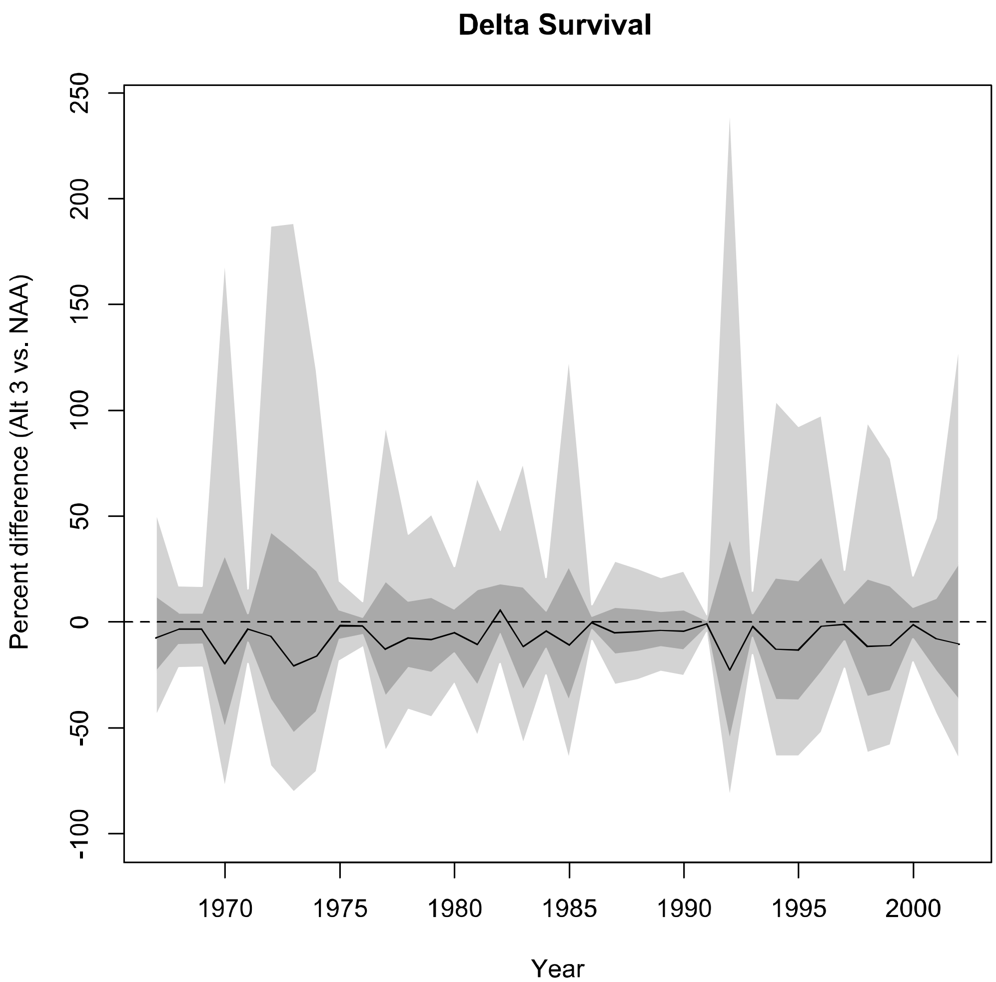

Figure 9I.16 Percent Difference in Delta Survival between Alternative 3 and the No Action Alternative

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line displayed

9I.2.2.3 Comparison of Alternative 3 versus Second Basis of Comparison

Differences in escapement between Alternative 3 and the Second Basis scenarios are presented in Figure 9I.17. Escapement was generally greater for Alternative 3 than for the Second Basis. However, the 50 percent probability intervals and the 90 percent probability intervals are both centered on the value of 0 (dashed line in Figure 9I.17), suggesting that no difference between alternatives is highly probable in most years.

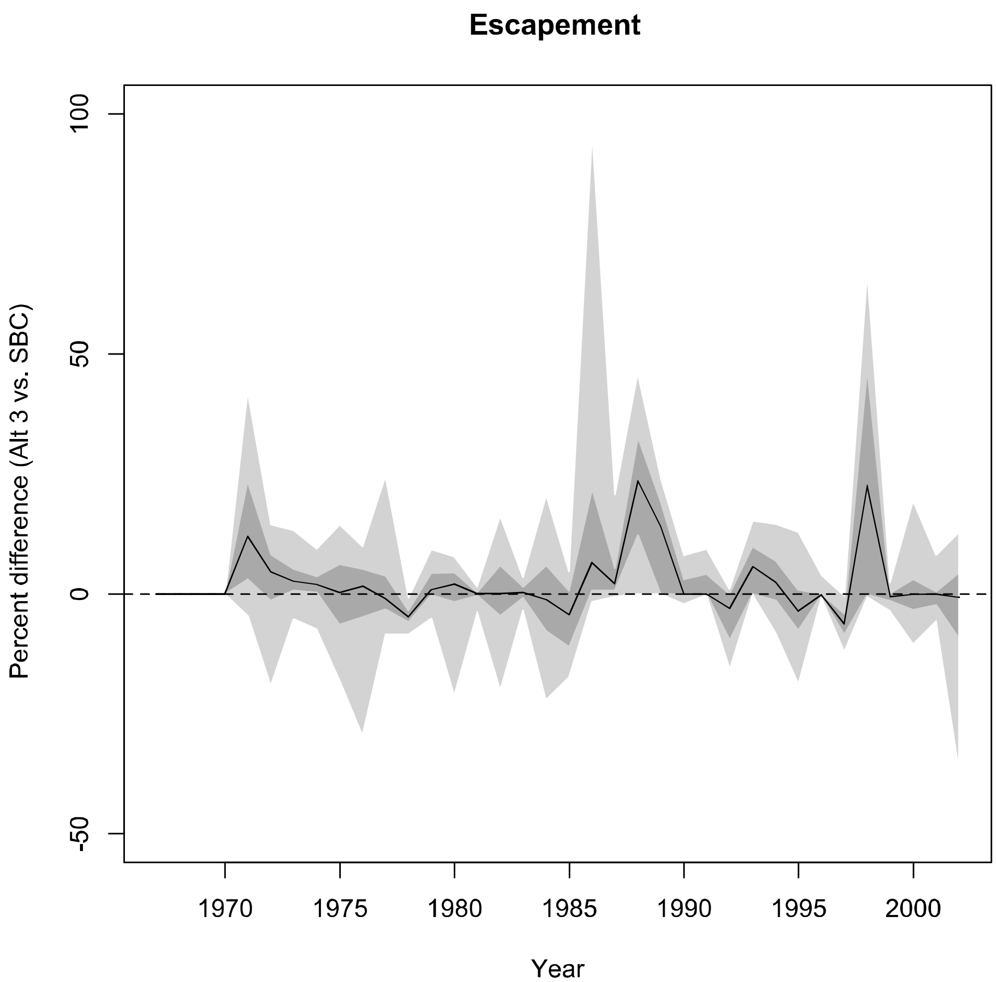

Figure 9I.17 Percent Difference in Escapement between Alternative 3 and the Second Basis of Comparison

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed

The median delta survival was slightly higher for Alternative 3 than it was for the Second Basis scenario (6 percent), although the probability of no difference between alternatives was generally high throughout the simulation time period (50 percent probability intervals and the 90 percent probability intervals are both centered on the value of 0) (Figure 9I.18).

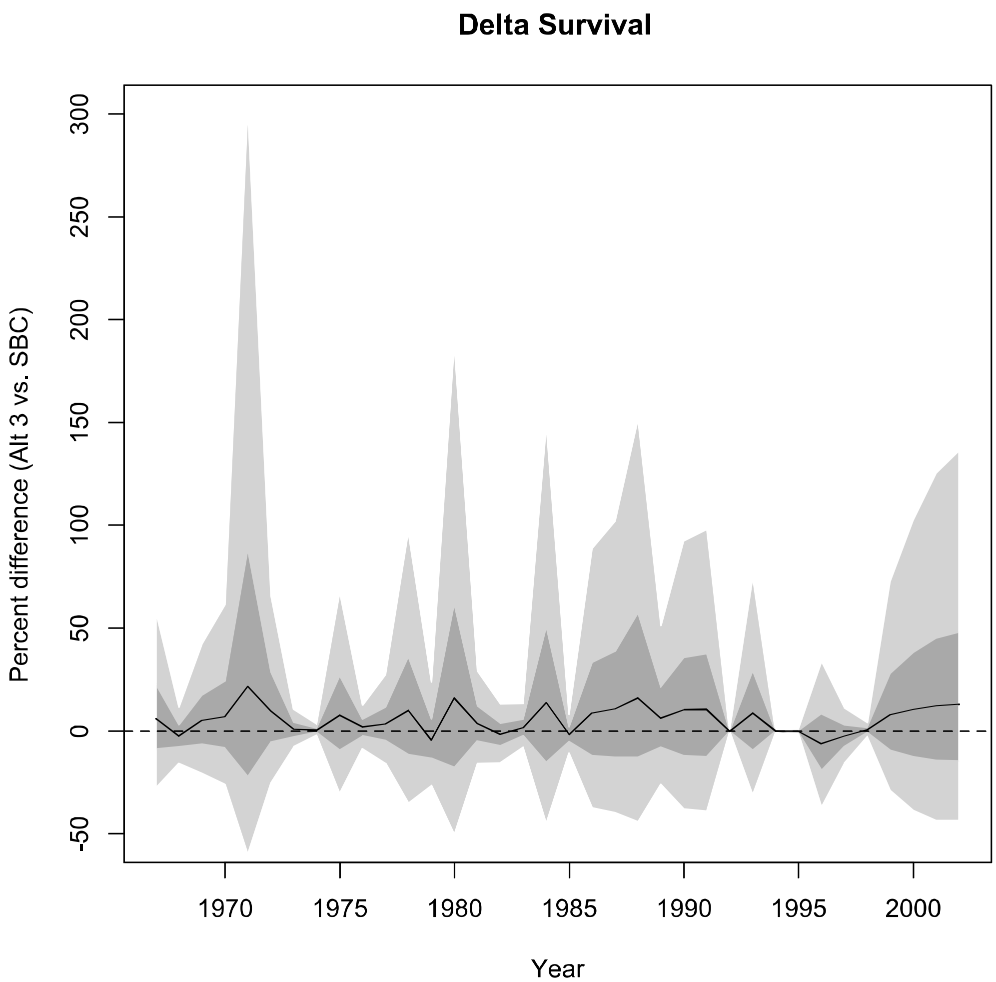

Figure 9I.18 Percent Difference in Delta Survival between Alternative 3 and the Second Basis of Comparison

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed

9I.2.2.4 Comparison of Alternative 5 versus No Action Alternative

Little difference in escapement estimates was evident between the Alternative 5 and No Action Alternative scenarios (Figure 9I.19). The scale of each figure has been altered to incorporate the 90 percent probability intervals, and the intervals in this comparison are smaller than other similar figures (for example, Figures 9I.17 and 9I.13).

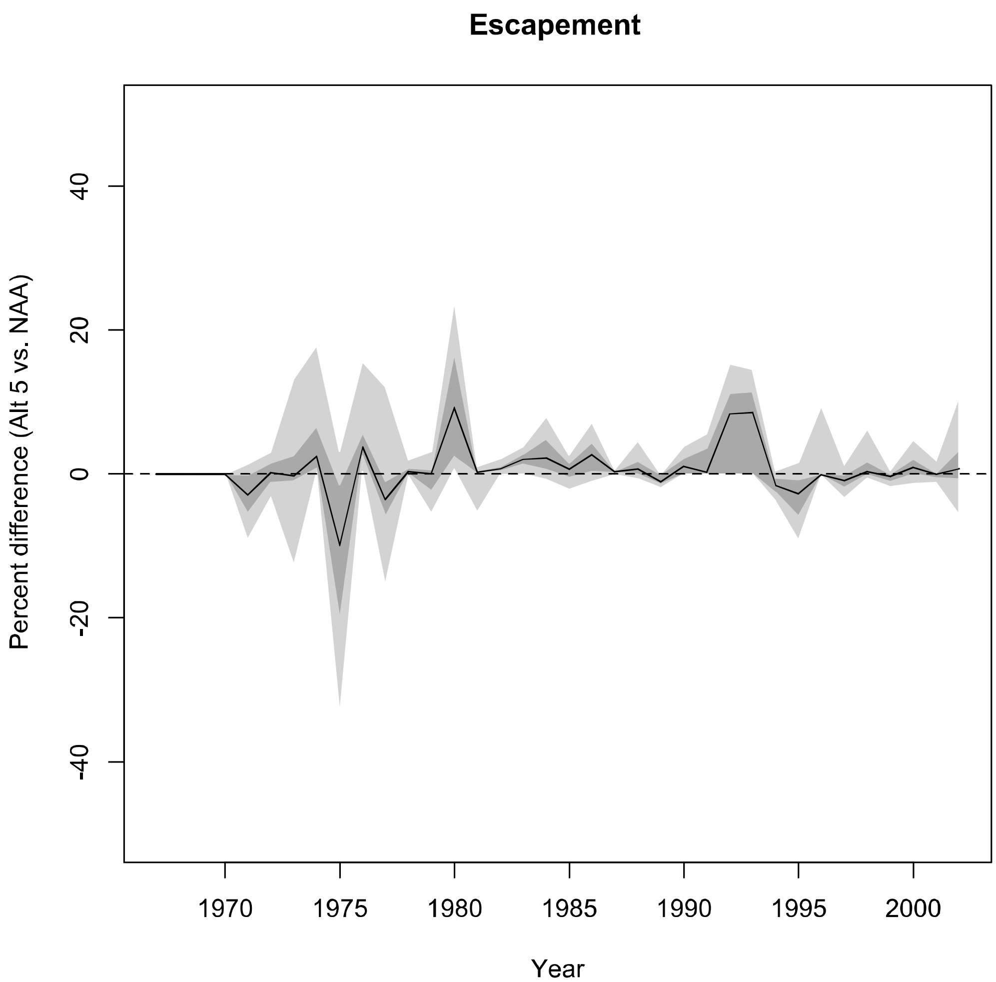

Figure 9I.19 Percent Difference in Escapement between Alternative 5 and the No Action Alternative

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed. Also, the scale of this figure has been altered to incorporate the 90 percent probability intervals, and the intervals in this comparison are smaller than other escapement estimate figures (for example, Figures 9I.13 and 9I.17).

Median Delta survival was similar between the No Action Alternative and Alternative 5 scenarios, with a slight improvement in median values of delta survival (1 percent) under Alternative 5 compared to the No Action Alternative. The 50 percent probability intervals and the 90 percent probability intervals are both centered on the value of 0 (dashed line in Figure 9I.20), suggesting that no difference between alternatives is highly probable in most years.

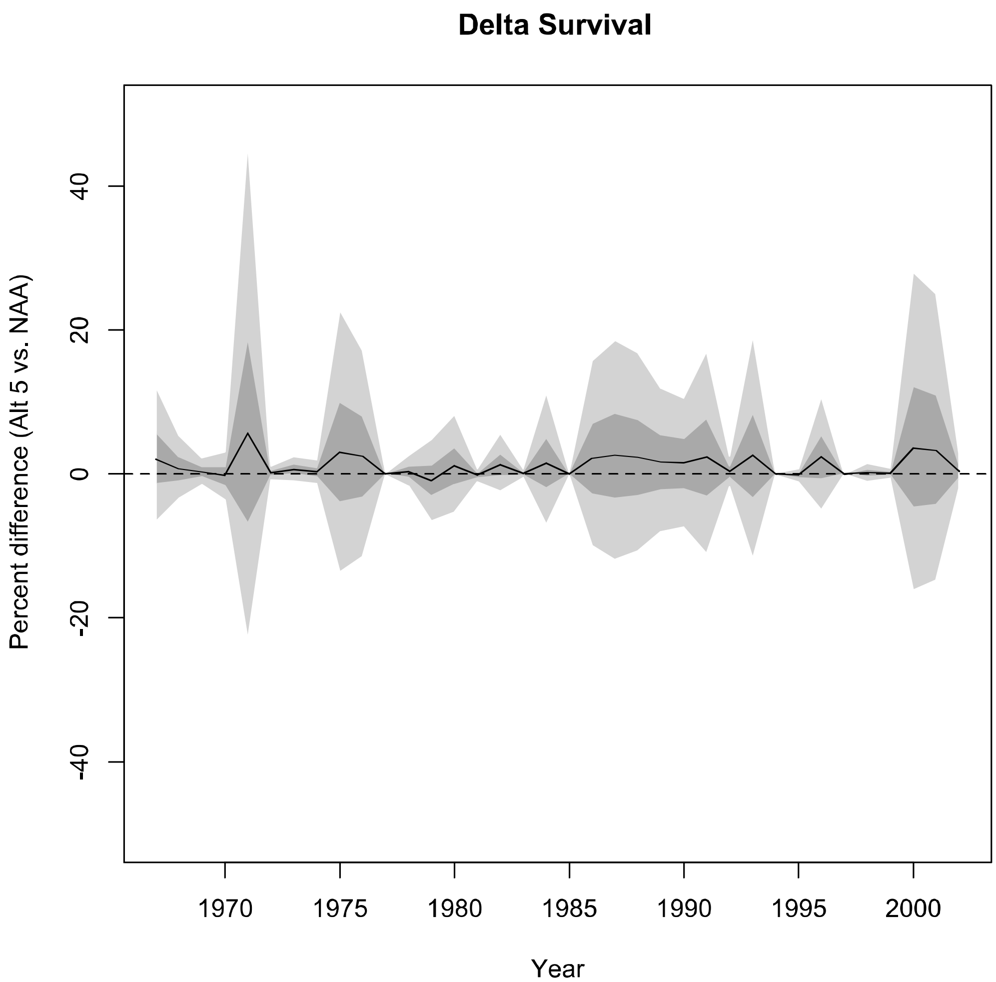

Figure 9I.20 Percent Difference in Delta Survival between Alternative 5 and the No Action Alternative

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed. Also, the scale of this figure has been altered to incorporate the 90 percent probability intervals, and the intervals in this comparison are smaller than other escapement estimate figures (for example, Figures 9I.14 and 9I.18).

9I.2.2.5 Comparison of Alternative 5 versus Second Basis

Differences between Alternative 5 and the Second Basis were moderate (Figure 9I.21). In years prior to 1983 and after 1995, the median escapement values were higher under the Alternative 5 scenario than it was under the Second Basis scenario. In many of the simulation years, the central 50 percent probability interval did not include 0, and in a few years the central 90 percent interval did not include 0, suggesting consistently higher escapement under Alternative 5 than under the Second Basis scenario, despite uncertainty in model parameter values.

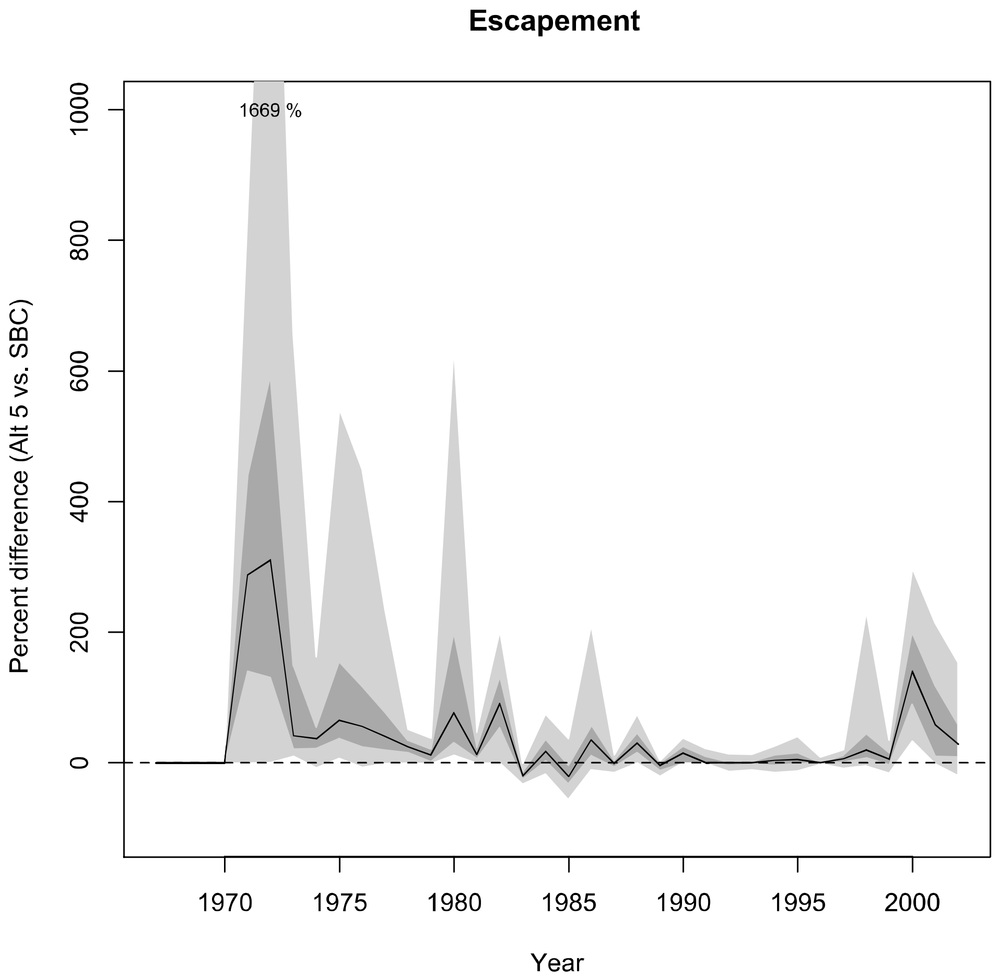

Figure 9I.21 Percent Difference in Escapement between Alternative 5 and the Second Basis of Comparison

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed). Also, the scale of this figure has been altered to incorporate the 90 percent probability intervals, and the intervals in this comparison are larger than other escapement estimate figures (for example, Figures 9I.14 and 9I.18).

Delta survival was generally higher under Alternative 5 (Figure 9I.22) than it was under the Second Basis scenario (15 percent). All years, however, the 50 percent probability intervals and the 90 percent probability intervals are both centered on the value of 0 (dashed line in Figure 9I.22), suggesting that no difference between alternatives is highly probable in most years.

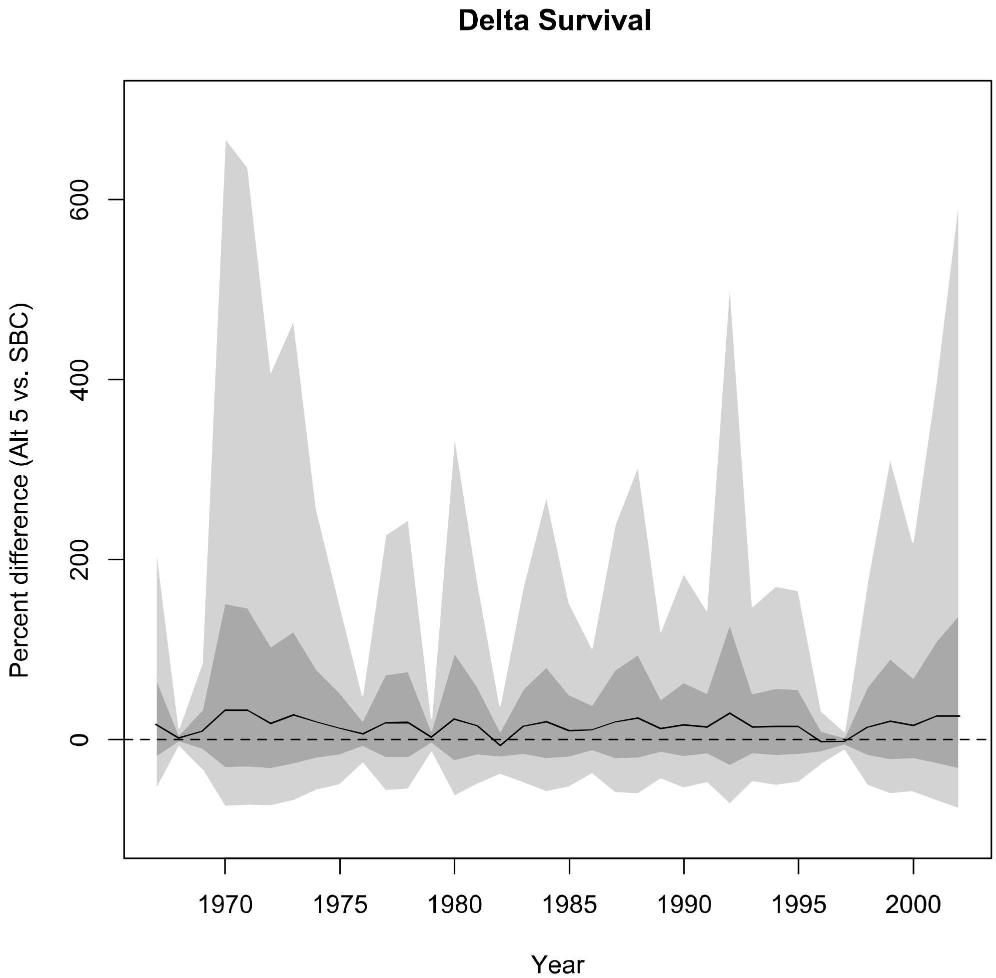

Figure 9I.22 Percent Difference in Delta Survival between Alternative 5 and the Second Basis of Comparison

Note: Median difference (solid line) with 50 percent probability intervals (dark gray) and 90 percent probability intervals (light gray) and reference line of no difference (dashed line) displayed. Also, the scale of this figure has been altered to incorporate the 90 percent probability intervals, and the intervals in this comparison are smaller than other survival estimate figures.

9I.3 References

Hendrix, N., A. Criss, E. Danner, C. M. Greene, H. Imaki, A. Pike, and S. T. Lindley. 2014. Life cycle modeling framework for Sacramento River winter-run Chinook salmon. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC 530.

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Appendix 9J

Delta Passage Model Documentation

Information about the methods and assumptions used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the Delta Passage Model (DPM) model is provided in this appendix. The appendix comprises two main sections as follows:

- Section 9J.1: DPM Methodology and Assumptions
  - The DPM model analysis is used to quantify survival within the Delta of winter-run, fall-run, and late fall-run Chinook Salmon. The approach and assumptions for the DPM analysis are described in this section.
- Section 9J.2: DPM model Analysis Results
  - The results of the DPM analysis are presented in this section in a series of figures for each alternative comparison.

9J.1 DPM Model Methodology and Assumptions

9J.1.1 DPM Model Methodology

The DPM is based on a detailed accounting of migratory pathways and reach-specific mortality as Chinook Salmon smolts travel through a simplified network of reaches and junctions (Figure 1). The biological functionality of the DPM is based upon the foundation provided by Perry et al. (2010) as well as other acoustic tagging based studies (Michel 2010) and coded wire tag (CWT)-based studies (Newman and Brandes 2010; Newman 2008). Uncertainty is explicitly modeled in the DPM by incorporating environmental stochasticity and estimation error whenever available.

The major model functions in the DPM are: 1) Delta Entry Timing, that models the temporal distribution of smolts entering the Delta for each race of Chinook Salmon, 2) Fish Behavior at Junctions, that models fish movement as they approach river junctions, 3) Migration Speed, that models reach-specific smolt migration speed and travel time, 4) Reach-specific Survival, that models reach-specific survival, 5) Flow-dependent Survival, that models reach-specific survival response to flow, 6) Export-dependent Survival, that models survival response to water export levels in the Interior Delta reach, and 7) North Delta Intake Predation, that models the mortality associated with predation at a North Delta Intake water diversion (not applicable in this EIS).

The DPM operates on a daily time step using simulated daily average flows and Delta exports as model inputs. The DPM does not attempt to represent sub-daily flows or diel salmon smolt behavior in response to the interaction of tides, flows, and specific channel features. The DPM is intended to represent the net outcome of migration and mortality occurring over days, not three dimensional movements occurring over minutes or hours.

The DPM is composed of eight reaches and four junctions (Figure 9J.1; Table 9J.1) selected to represent primary salmonid migration corridors where high quality fish and hydrodynamic data were available. For simplification, Sutter Slough and Steamboat Slough are combined as the reach "SS," and the forks of the Mokelumne River and Georgiana Slough are combined as "Geo/DCC." The Geo/DCC reach can be entered by Mokelumne River fall-run at the head of the South and North Forks of the Mokelumne River or by Sacramento runs through the combined junction of Georgiana Slough and Delta Cross Channel (DCC) (Junction C). The Interior Delta reach can be entered from three different pathways: 1) Geo/DCC, 2) San Joaquin River via Old River Junction (Junction D), or 3) Old River via Junction D. Due to lack of data informing specific routes through the Interior Delta, or tributary-specific survival, we treat the entire Interior Delta region as a single model reach. The four distributary junctions depicted in the Delta portion of the model are: A) Sacramento River at Freemont Weir (head of Yolo Bypass), B) Sacramento River at head of Sutter and Steamboat Sloughs, C) Sacramento River at the combined junction with Georgiana Slough and DCC, and D) San Joaquin River at the head of Old River (Figure 9J.1; Table 9J.1). Due to lack of data informing specific routes through the Interior Delta, or tributary-specific survival, we treat the entire Interior Delta region as a single model reach.

The DPM model uses scenario-specific daily simulation model (DSM2) and CalSim II data as model input. Daily DSM2 data informs fish migration speed, reach-specific survival, and routing at Delta junctions. Daily export data from CalSim II is used to inform export-dependent survival of salmon smolts that enter the Interior Delta from the Geo/DCC reach.

For reaches where acoustic tagging data supported migration speed responses to flow (Sac1, Sac2, and Geo/DCC), daily migration speed is influenced by mean daily flow. Migration speed is modeled as a logarithmic function of reach-specific flow occurring on the first day smolts entered a particular reach.

Reach-specific survival through a given reach is calculated and applied the first day smolts enter the reach. For reaches where literature or available tagging data showed support for reach-level responses to environmental variables, survival is influenced by flow (Sac1, Sac2, Sac3, Sac4, SS, Interior Delta via San Joaquin River, and Interior Delta via Old River) or water exports (Interior Delta via Geo/DCC). For these reaches, daily flow (DSM2 data) or exports (CalSim II data) occurring the day of reach-entry is used to predict reach survival through the entire reach. For all other reaches (Geo/DCC and Yolo), reach survival is uninfluenced by Delta conditions and is informed by means and standard deviations of survival from acoustic tagging studies.

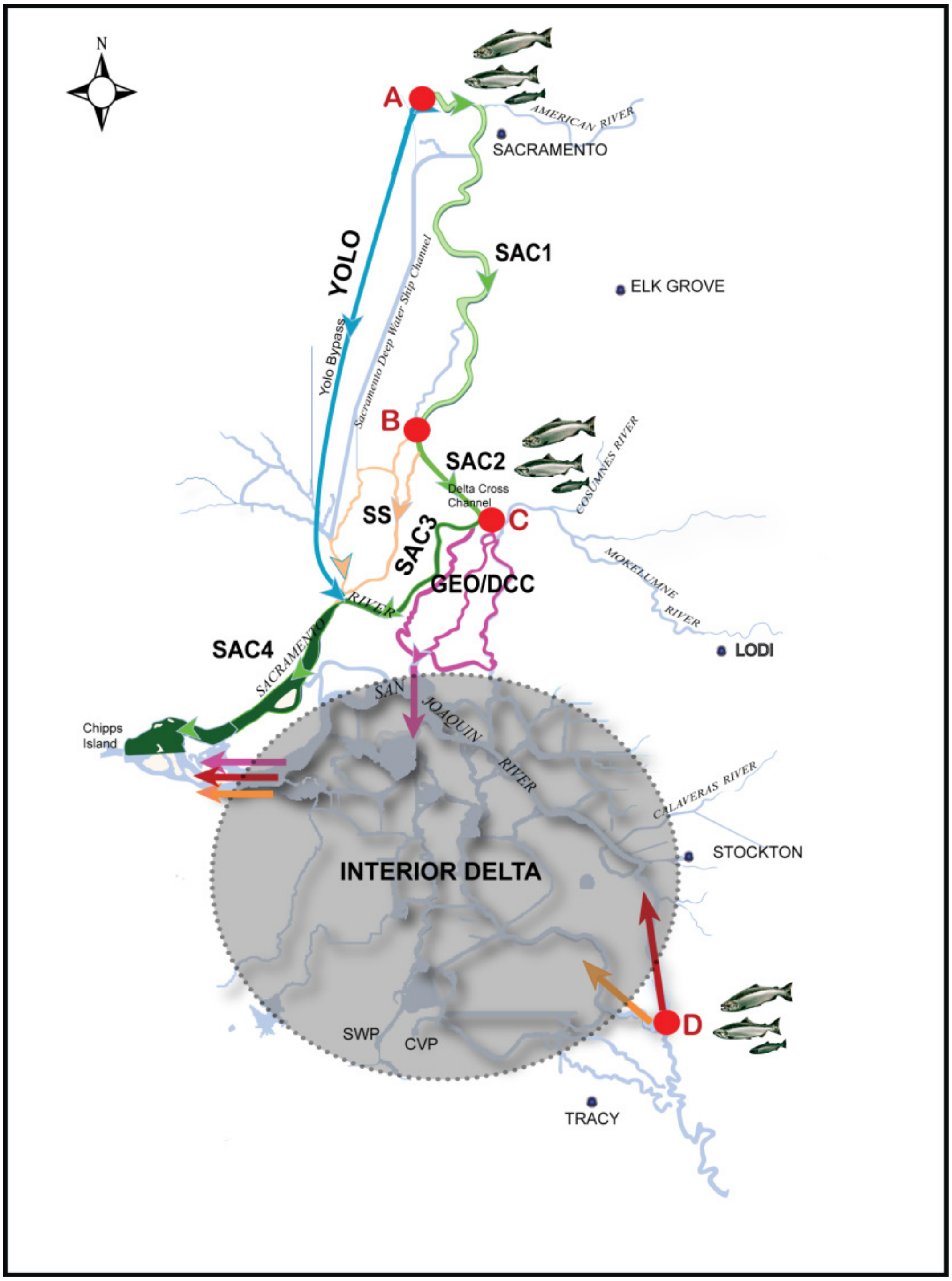

Figure 9J.1 DPM model Reaches and Junctions in the Delta (Notes: Bold headings label modeled reaches and red circles indicate model junctions. Salmonid icons indicate locations where smolts enter the Delta in the DPM model.)

Table 9J.1 Description of Modeled Delta Reaches and Junctions in the DPM Model

Reach/Junction	Description	Reach Length (kilometers)
Sac1	Sacramento River from Freeport to junction with Sutter Slough	41.04
Sac2	Sacramento River from Sutter Slough junction to junction with DCC)	10.78
Sac3	Sacramento River from DCC to Rio Vista	22.37
Sac4	Sacramento River from Rio Vista to Chipps Island	23.98
Yolo	Yolo Bypass from entrance at Fremont Weir to Rio Vista	– [a]
SS	Combined reach of Sutter Slough and Steamboat Slough ending at Rio Vista	26.72
Geo/DCC	Combined reach of Georgiana Slough, DCC, and Sough and North forks of the Mokelumne River ending at confluence with San Joaquin River	25.59
Interior Delta	Begins at end of reach Geo/DCC, San Joaquin River via Junction D, or Old River via Junction D, and ends at Chipps Island	– [b]
A	Junction of Yolo Bypass and Sacramento River	Not applicable
B	Combined junction of Sutter Slough and Steamboat Slough with Sacramento River	Not applicable
C	Combined junction of DCC and Georgiana Slough with Sacramento River	Not applicable
D	Junction of Old River with San Joaquin River	Not applicable

Notes:

a. Reach length for Yolo Bypass is currently undefined because reach length is not currently used to calculate Yolo Bypass speed and ultimate travel time.

b. Reach length for the Interior Delta is undefined due to the multiple pathways salmon can take. Timing through the Interior Delta does not affect Delta survival because there are no Delta reaches located downstream of the Interior Delta.

At each junction in the model, smolts move in relation to the proportional movement of flow entering each route. Daily DSM2 flow data entering each route is used to inform the proportion of smolts entering each route at a junction. Smolts move in direct proportion to flow at all junctions except Junction C, where a non-proportional relationship is applied as defined by acoustic tagging study data.

9J.1.2 Model Analysis Scenario Assumptions

A major assumption of the DPM model is that surrogate fish data can be used to inform many model relationships. Simulation model relationships can often be informed by field data from outside the study region, laboratory studies in controlled experimental settings, or artificially raised (hatchery) surrogates. For example, many of our model relationships rely on data from tagged hatchery surrogates because experimental studies often rely on easily accessible hatchery-origin fish and assume that fish responses are at least similar among individuals of different natal origins. In addition to limited data on wild fish, many of the model relationships are informed by data from a single Chinook Salmon race, thereby making the assumption that all races move, grow, and survive according to the same rules.

9J.2 Model Analysis Results

DPM model results are organized by each Chinook Salmon run (spring-run, winter-run, fall-run, and late-fall-run). Differences in Delta survival of juvenile Chinook Salmon between scenarios are displayed as time histories across all 81 water years (1922-2002), and box plots of median survival across all years. The following scenario comparisons are presented in Figures 9J.2 through 9J.41.

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 3 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the No Action Alternative
- Alternative 5 compared to the Second Basis of Comparison

9J.3 References

Michel, C. 2010. “River and estuarine survival and migration of yearling Sacramento River Chinook salmon (Oncorhynchus tshawytscha) smolts and the influence of environment.” Masters Thesis, University of California Santa Cruz, Santa Cruz, CA.

Newman, K. B. 2008. *An evaluation of four Sacramento-San Joaquin River Delta juvenile salmon survival studies*. Project number SCI-06-G06-299. U.S. Fish and Wildlife Service. November.

Newman, K.B. 2010. "Analyses of Salmon CWT releases into the San Joaquin system." Handout to the VAMP review panel. March 2nd 2010.

Newman, K.B. & Brandes, P.L. 2010. "Hierarchical modeling of juvenile Chinook salmon survival as a function of Sacramento-San Joaquin Delta water exports." *North American Journal of Fisheries Management* 30:157-169.

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

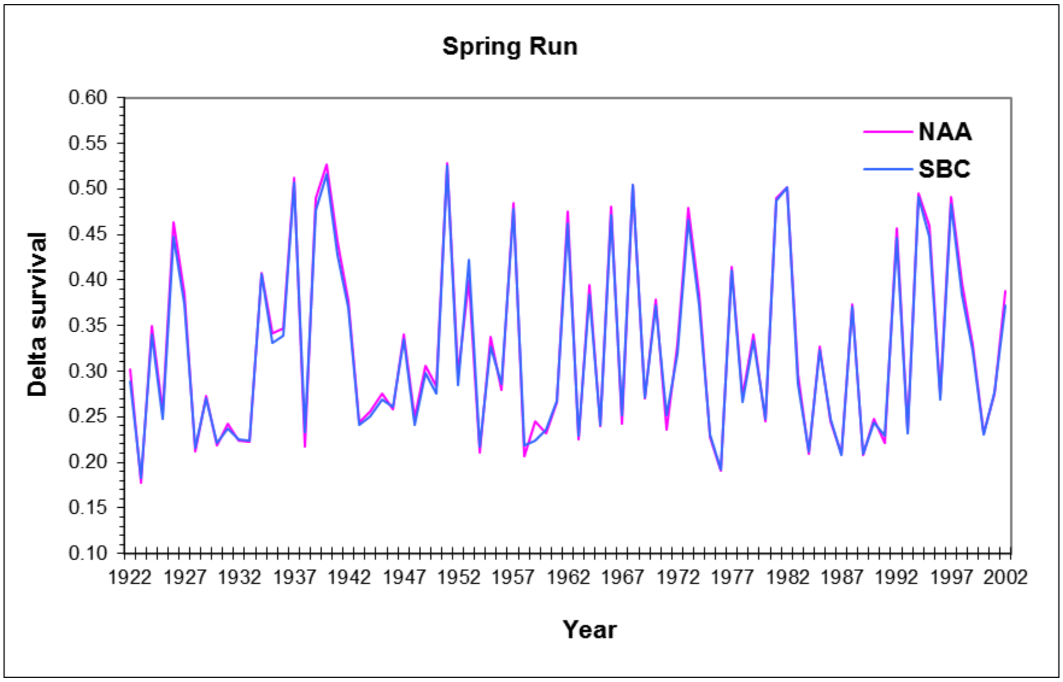

Figure 9J.2 Annual Delta Survival for Spring-run Chinook Salmon under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC) over 81 water years estimated by the DPM model

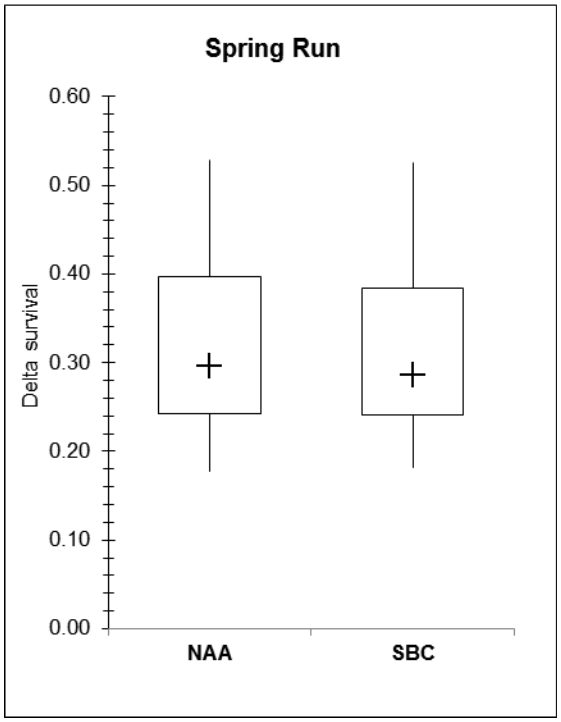

Figure 9J.3 Annual Delta Survival for Spring-run Chinook Salmon under the NAA compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

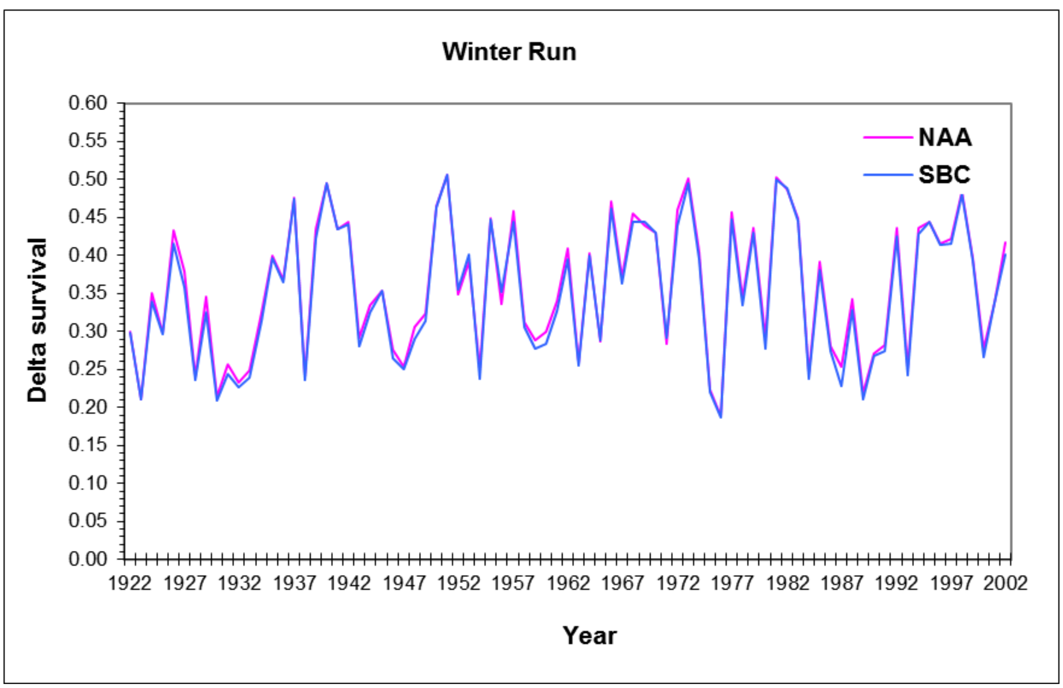

Figure 9J.4 Annual Delta Survival for Winter-run Chinook Salmon under the NAA compared to the SBC over 81 water years estimated by the DPM model

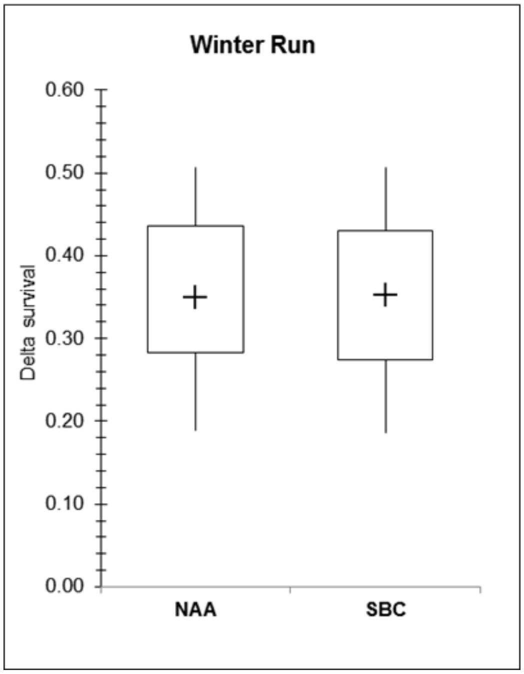

Figure 9J.5 Annual Delta Survival for Winter-run Chinook Salmon under the NAA compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

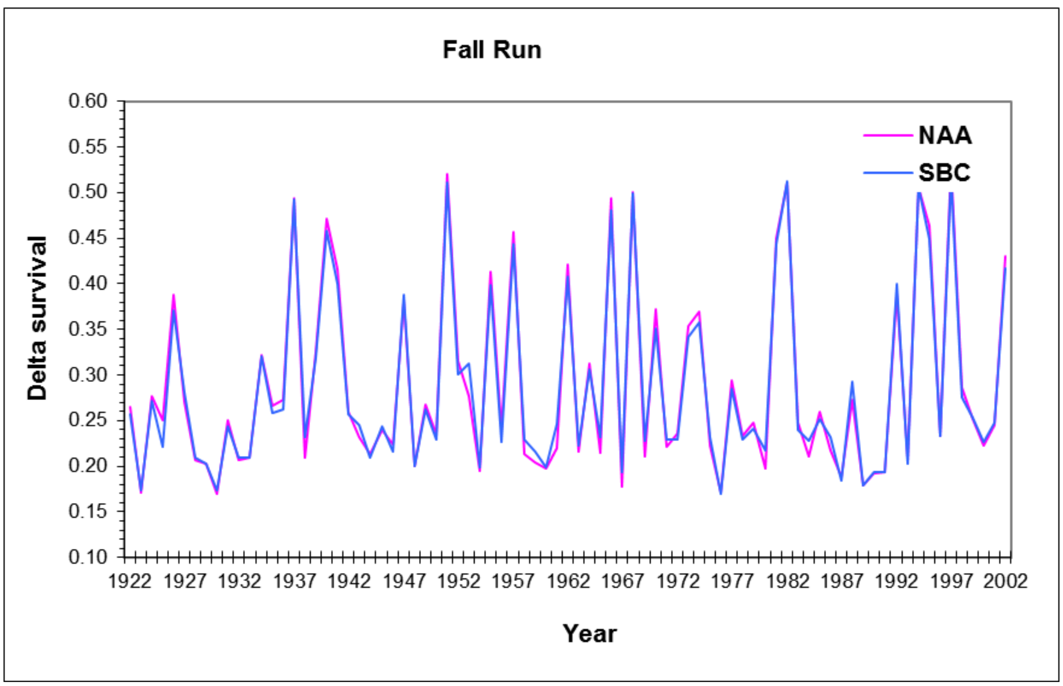

Figure 9J.6 Annual Delta Survival for Fall-run Chinook Salmon under the NAA compared to the SBC over 81 water years estimated by the DPM model

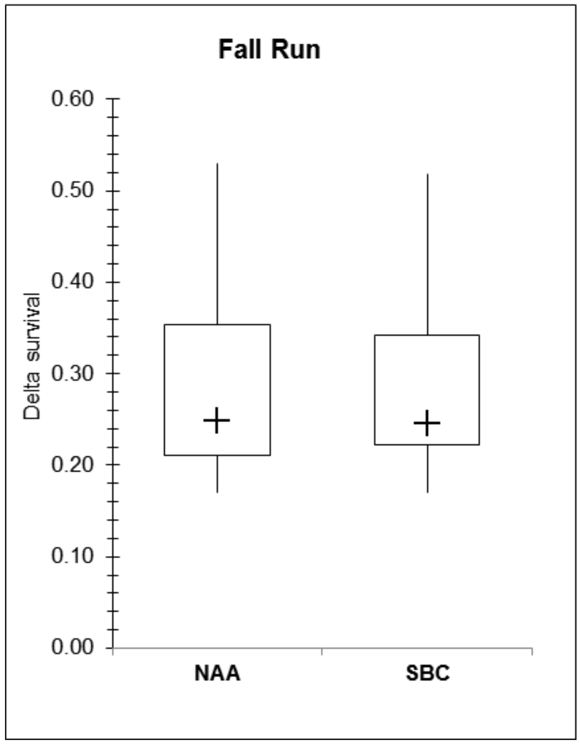

Figure 9J.7 Annual Delta Survival for Fall-run Chinook Salmon under the NAA compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

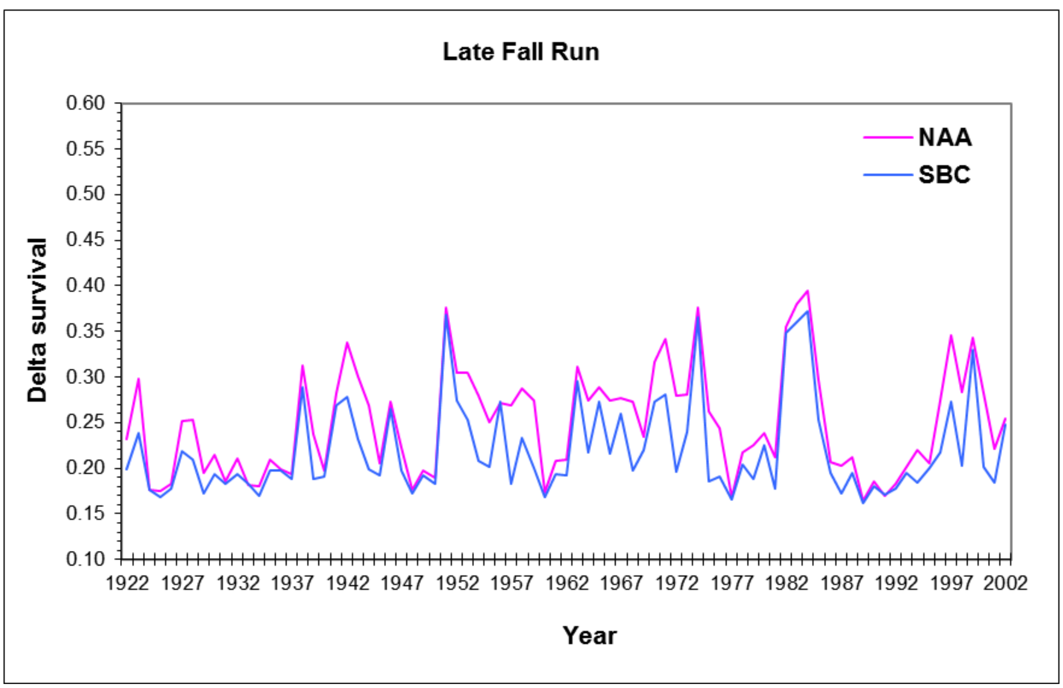

Figure 9J.8 Annual Delta Survival for Late Fall-run Chinook Salmon under the NAA compared to the SBC over 81 water years estimated by the DPM model

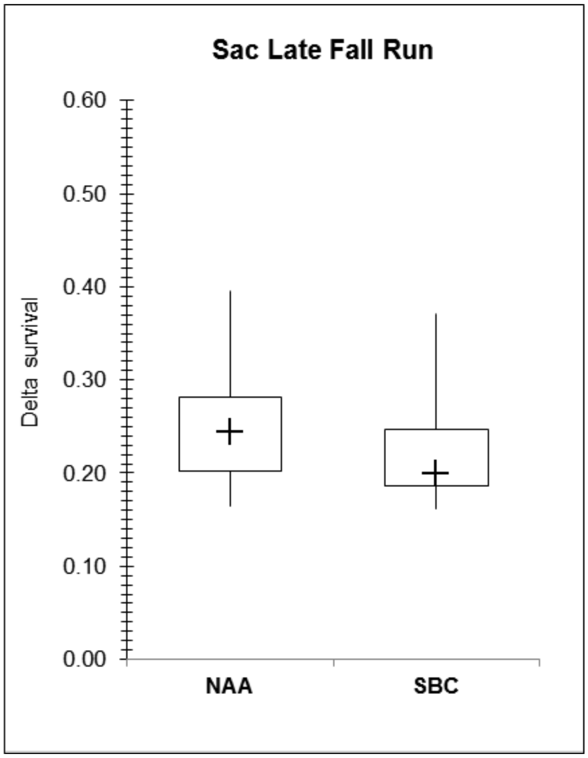

Figure 9J.9 Annual Delta Survival for Late Fall-run Chinook Salmon under the NAA compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

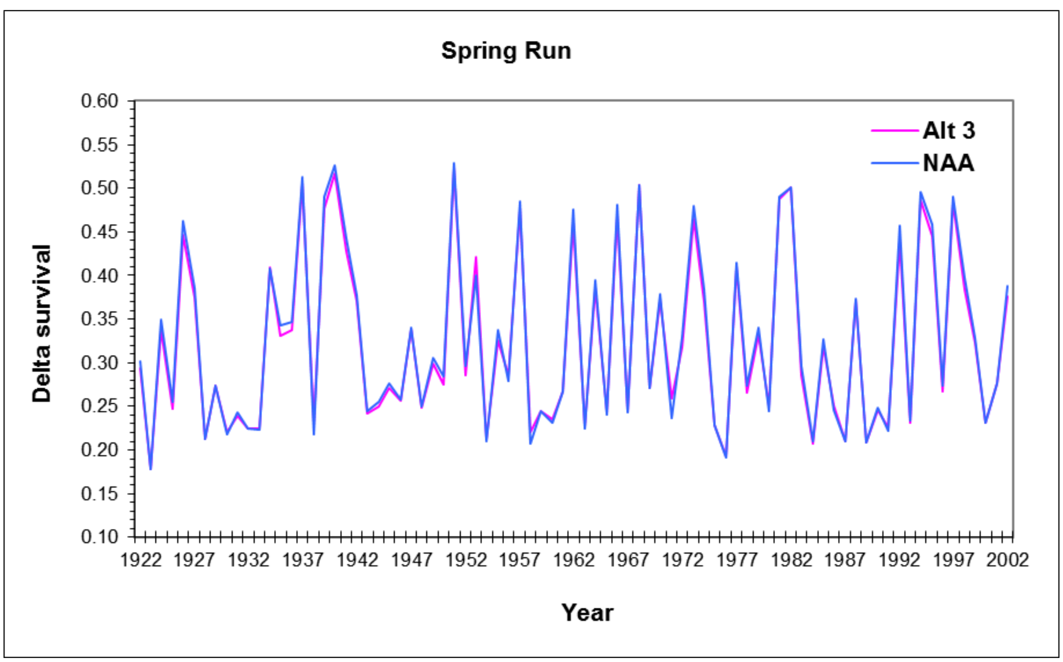

Figure 9J.10 Annual Delta Survival for Spring-run Chinook Salmon under Alternative 3 (Alt 3) as compared to the NAA over 81 water years estimated by the DPM model

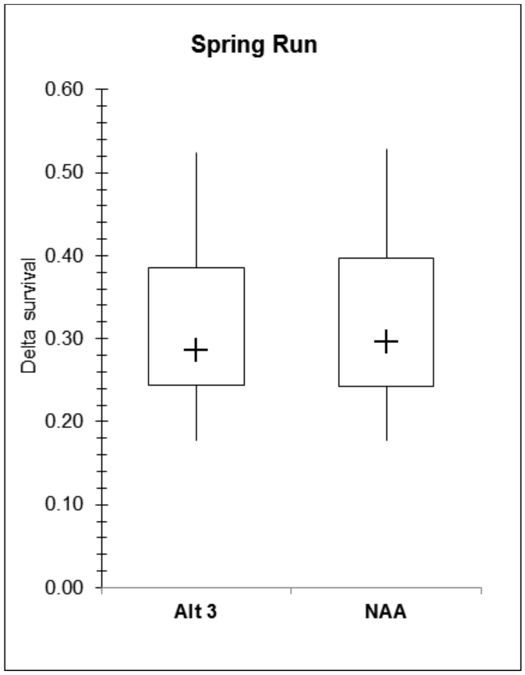

Figure 9J.11 Annual Delta Survival for Spring-run chinook under Alternative 3 (Alt 3) as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

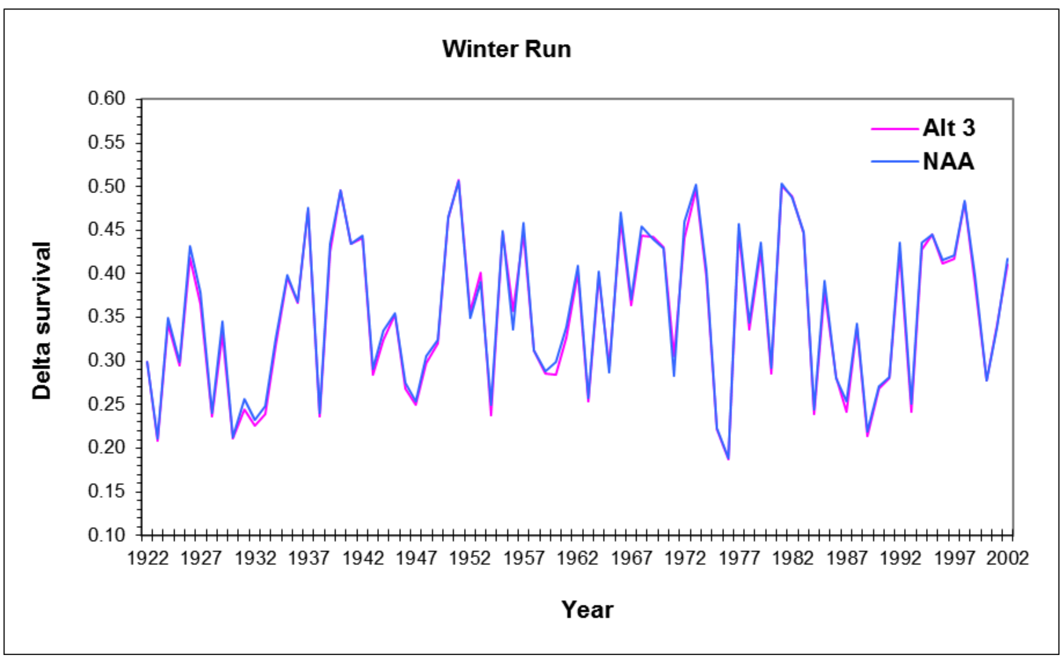

Figure 9J.12 Annual Delta Survival for Winter-run Chinook Salmon under Alt 3 as compared to the NAA over 81 water years estimated by the DPM model

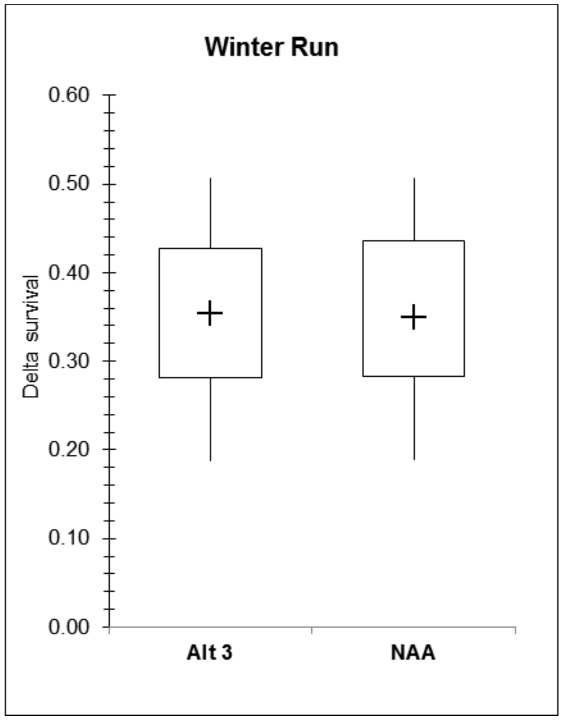

Figure 9J.13 Annual Delta Survival for Winter-run Chinook under Alternative 3 (Alt 3) as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

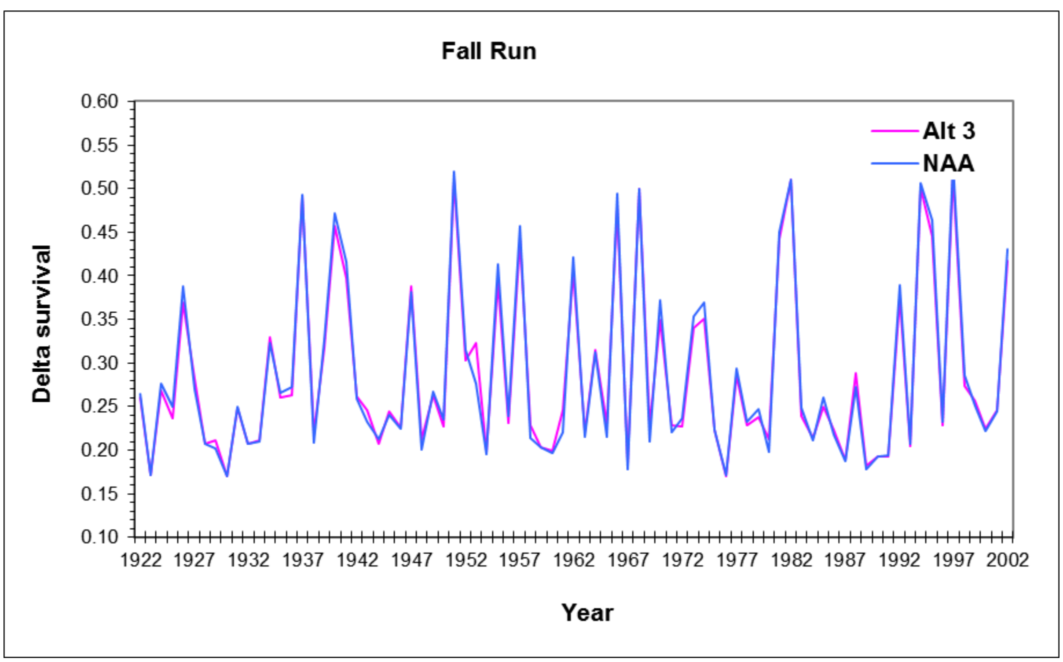

Figure 9J.14 Annual Delta Survival for Fall-run Chinook Salmon under Alt 3 as compared to the NAA over 81 water years estimated by the DPM model

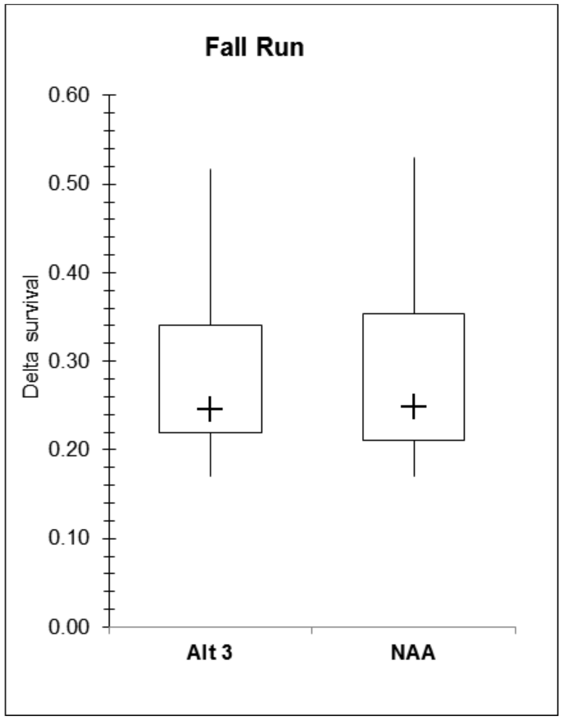

Figure 9J.15 Annual Delta Survival for Fall-run Chinook under Alt 3 as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

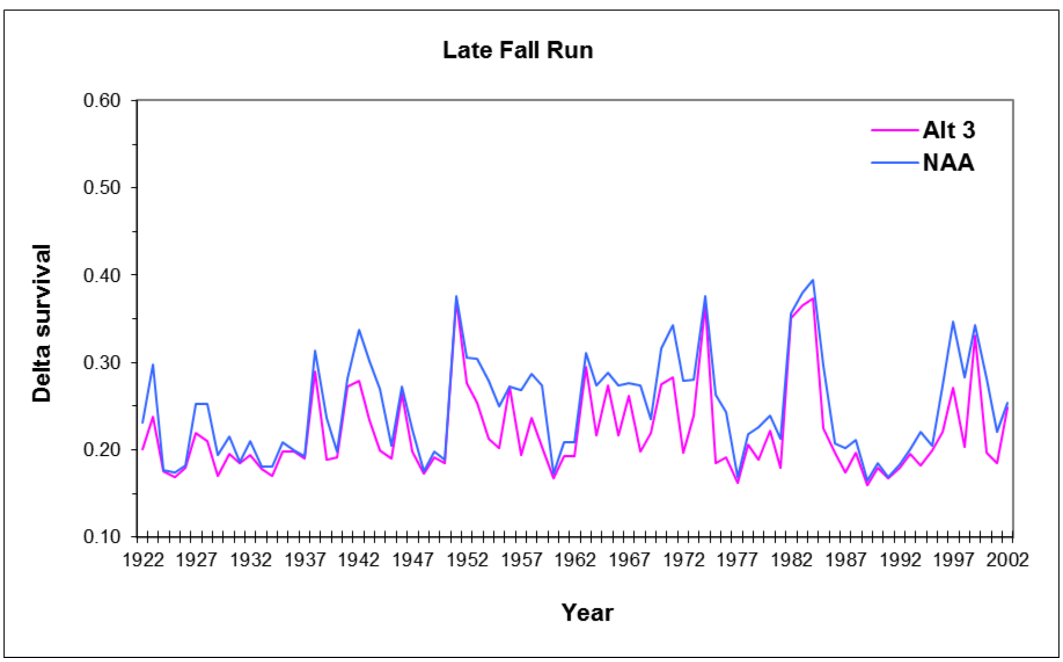

Figure 9J.16 Annual Delta Survival for Late Fall-run Chinook Salmon under Alt 3 as compared to the NAA over 81 water years estimated by the DPM model

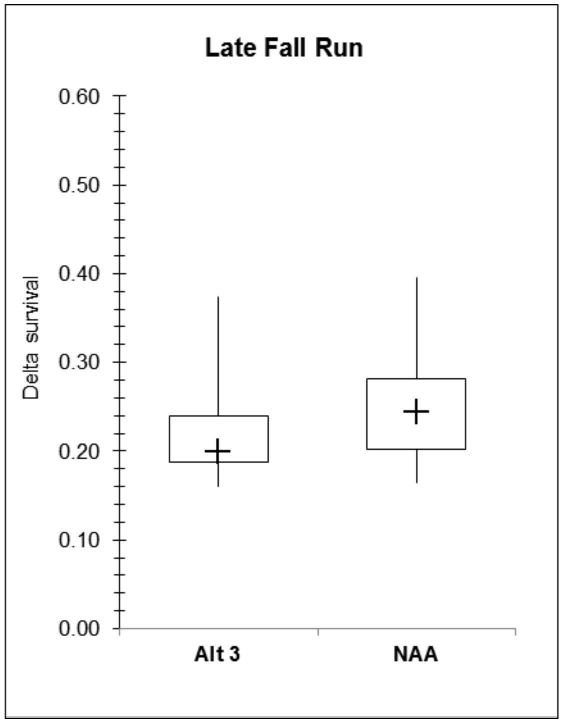

Figure 9J.17 Annual Delta Survival for Late Fall-run Chinook under Alt 3 as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

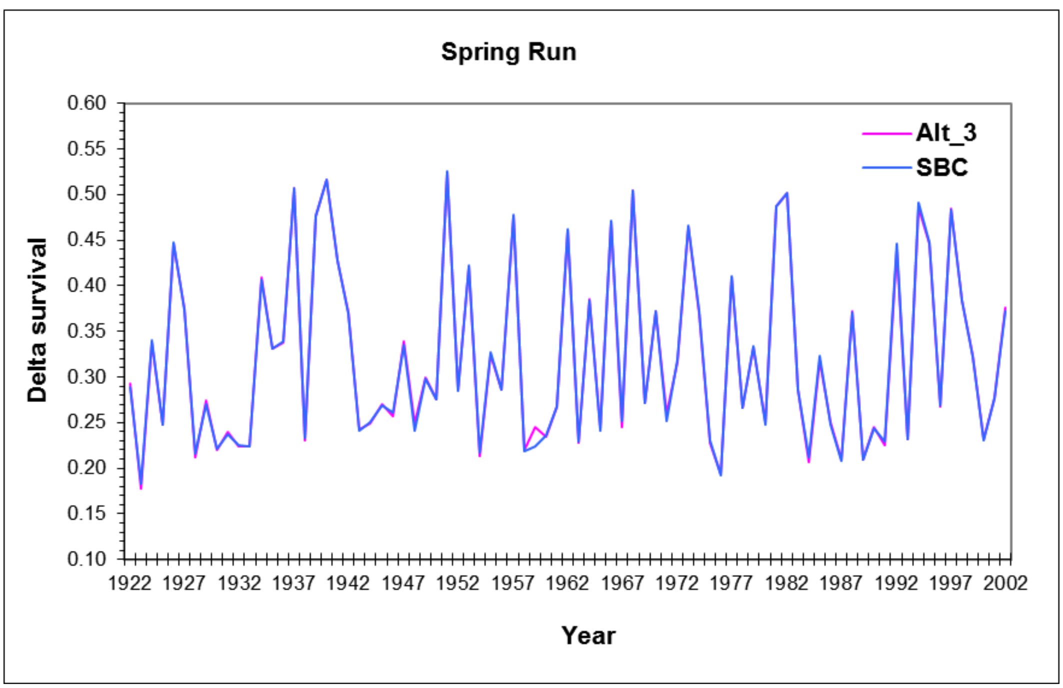

Figure 9J.18 Annual Delta Survival for Spring-run Chinook Salmon under Alt 3 as compared to the SBC over 81 water years estimated by the DPM model

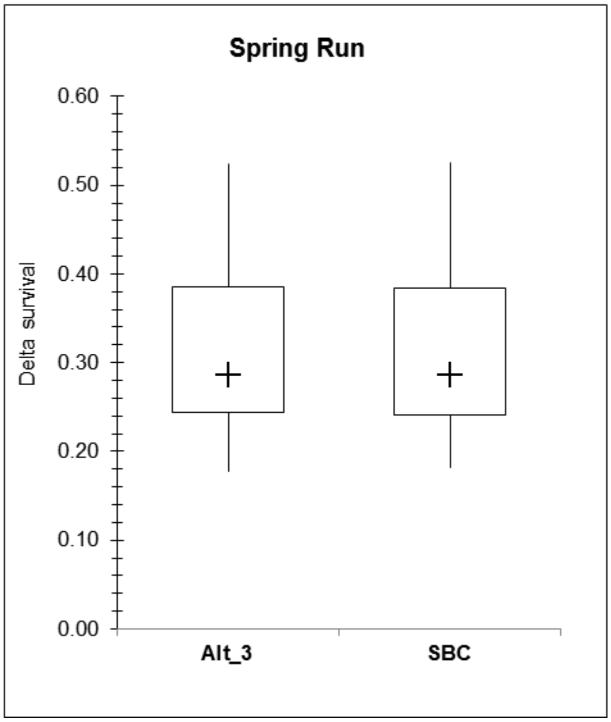

Figure 9J.19 Annual Delta Survival for Spring-run Chinook Salmon under Alt 3 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

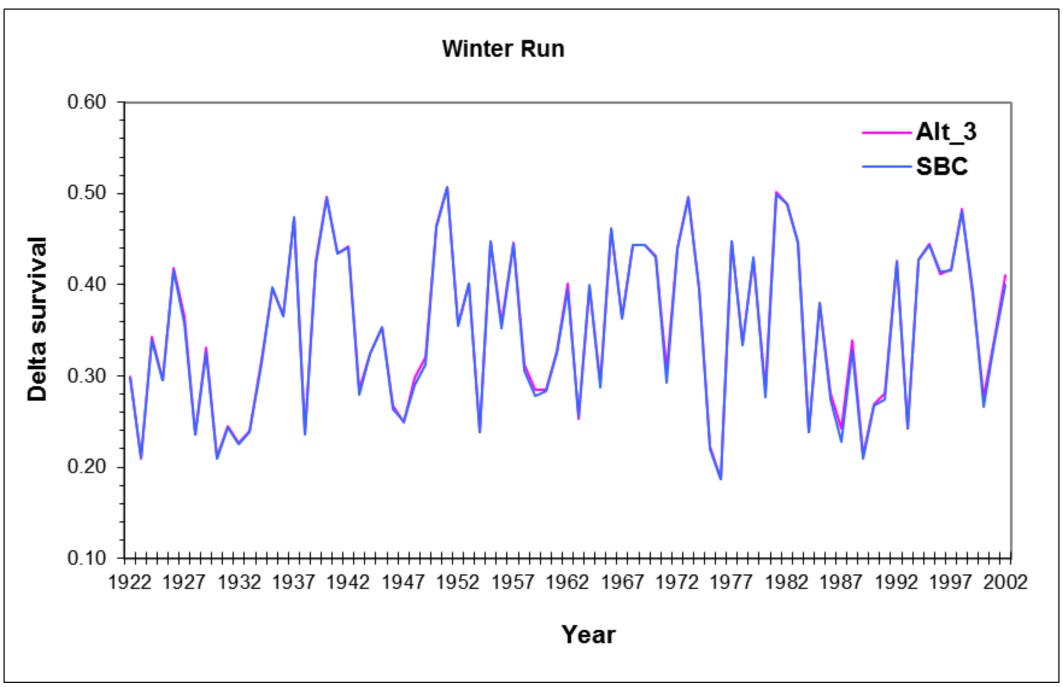

Figure 9J.20 Annual Delta Survival for Winter-run Chinook Salmon under Alt 3 as compared to the SBC over 81 water years estimated by the DPM model

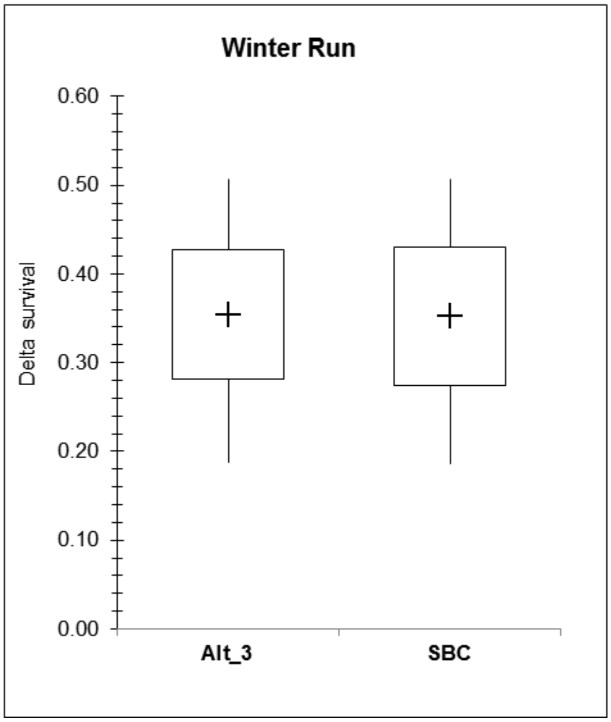

Figure 9J.21 Annual Delta Survival for Winter-run Chinook under Alt 3 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

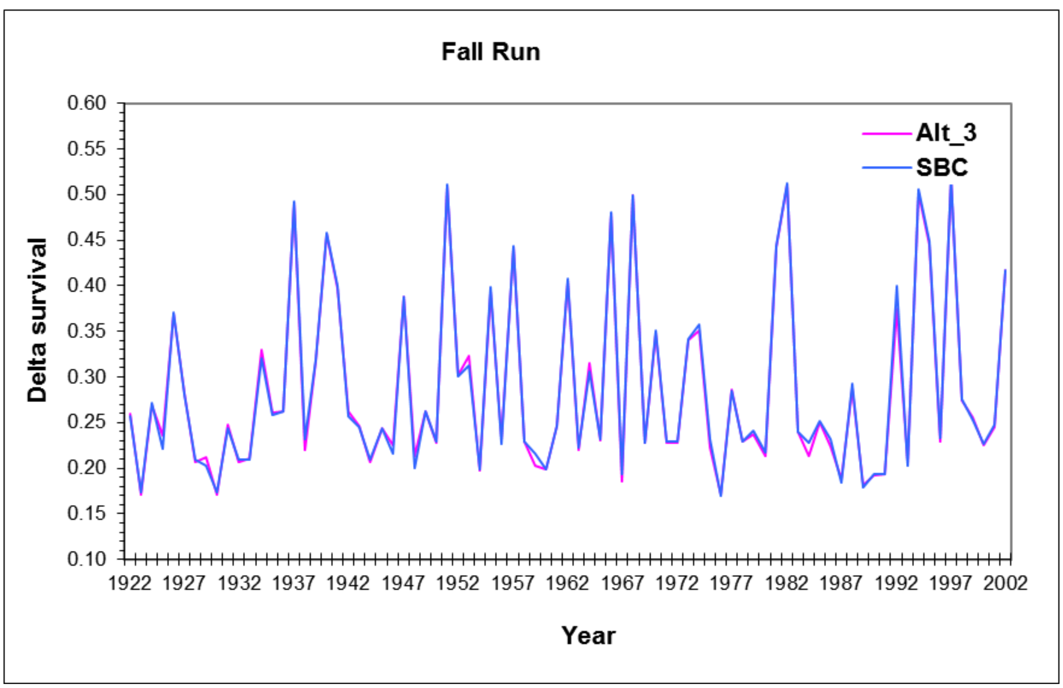

Figure 9J.22 Annual Delta Survival for Fall-run Chinook Salmon under Alt 3 as compared to the SBC over 81 water years estimated by the DPM model

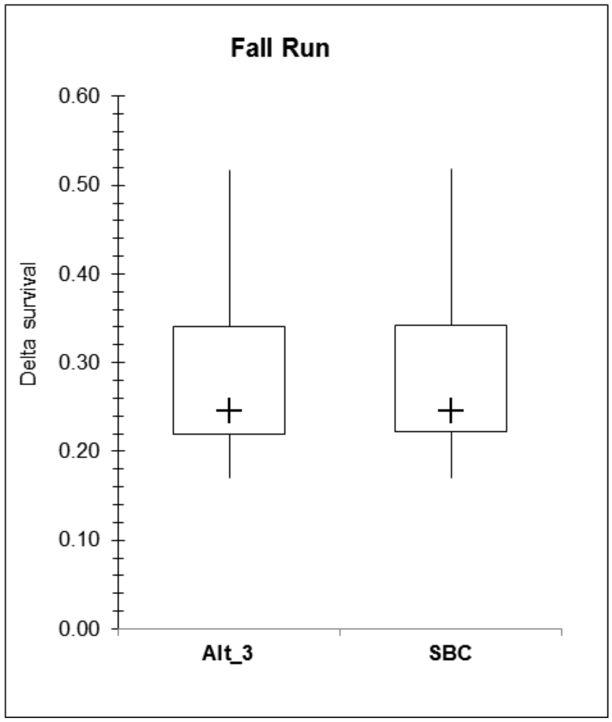

Figure 9J.23 Annual Delta Survival for Fall-run Chinook under Alt 3 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

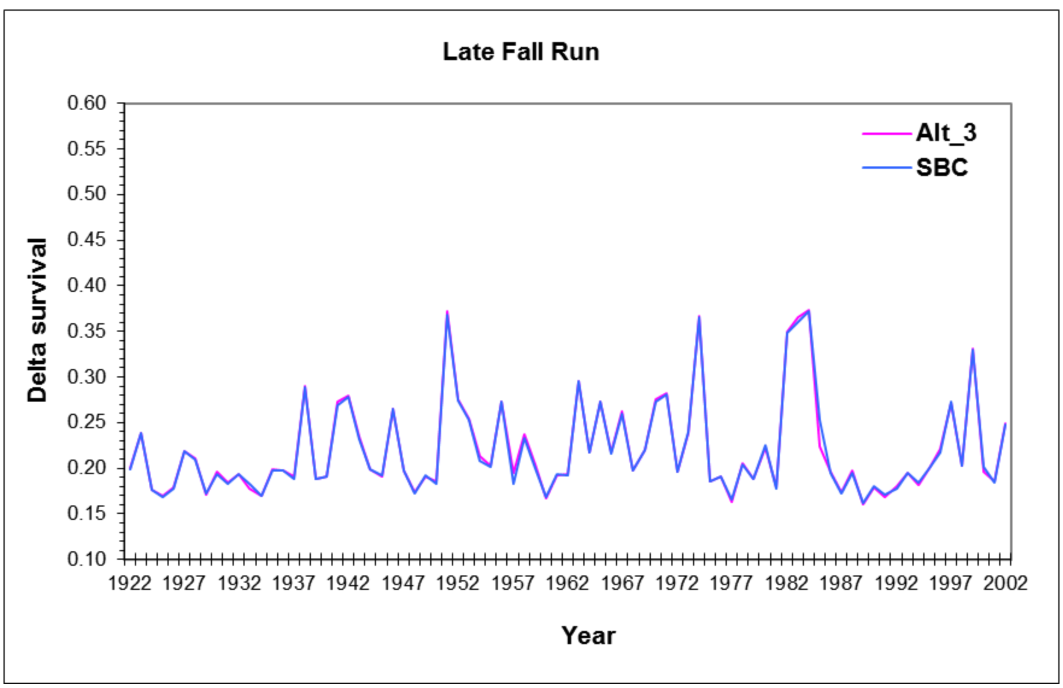

Figure 9J.24 Annual Delta Survival for Late Fall-run Chinook Salmon under Alt 3 as compared to the SBC over 81 water years estimated by the DPM model

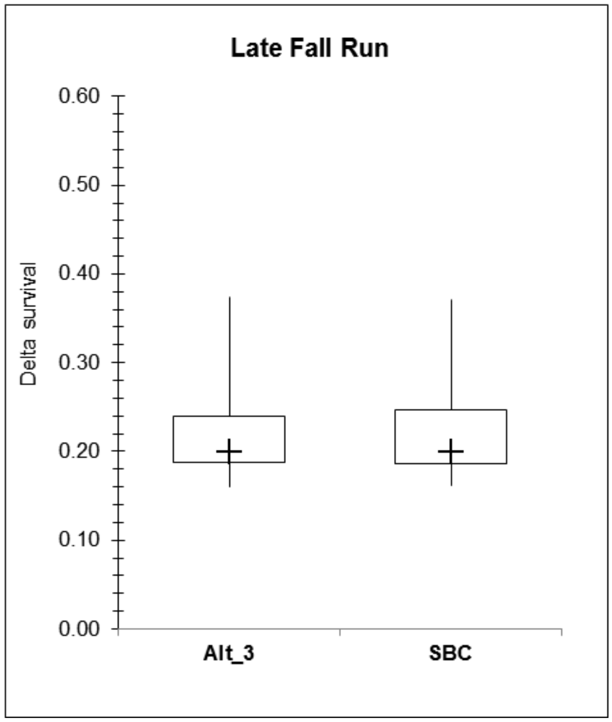

Figure 9J.25 Annual Delta Survival for Late Fall-run Chinook under Alt 3 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

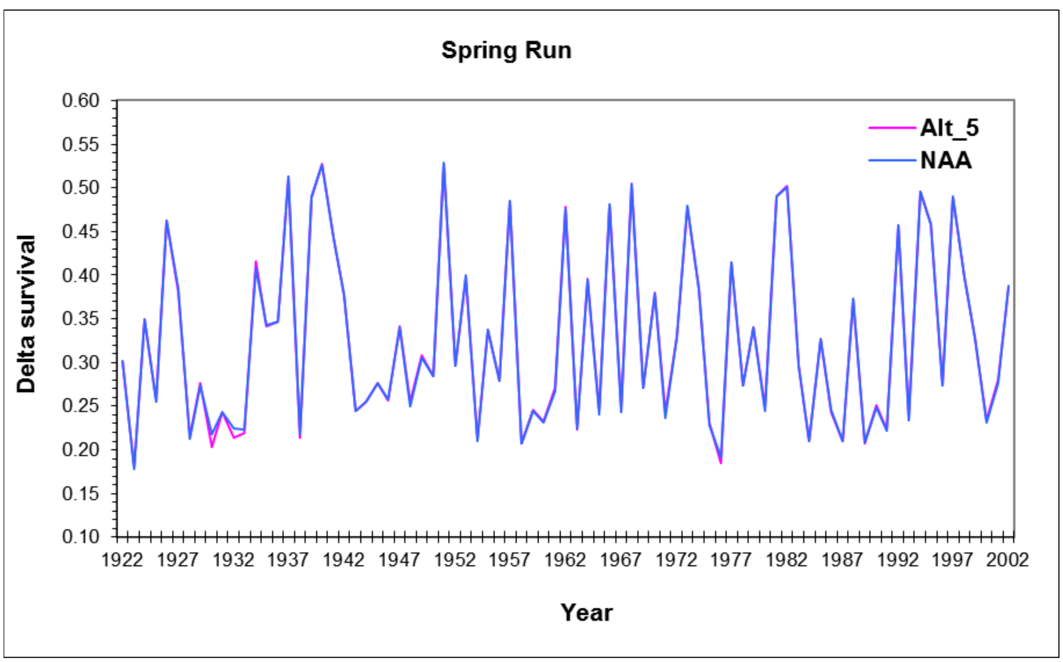

Figure 9J.26 Annual Delta Survival for Spring-run Chinook Salmon under Alternative 5 (Alt 5) as compared to the NAA over 81 water years estimated by the DPM model

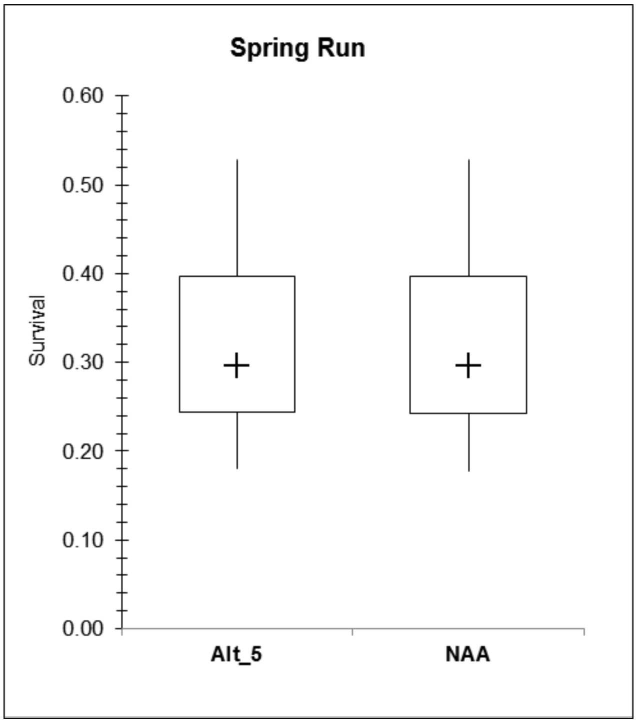

Figure 9J.27 Annual Delta Survival for Spring-run Chinook Salmon under Alt 5 as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

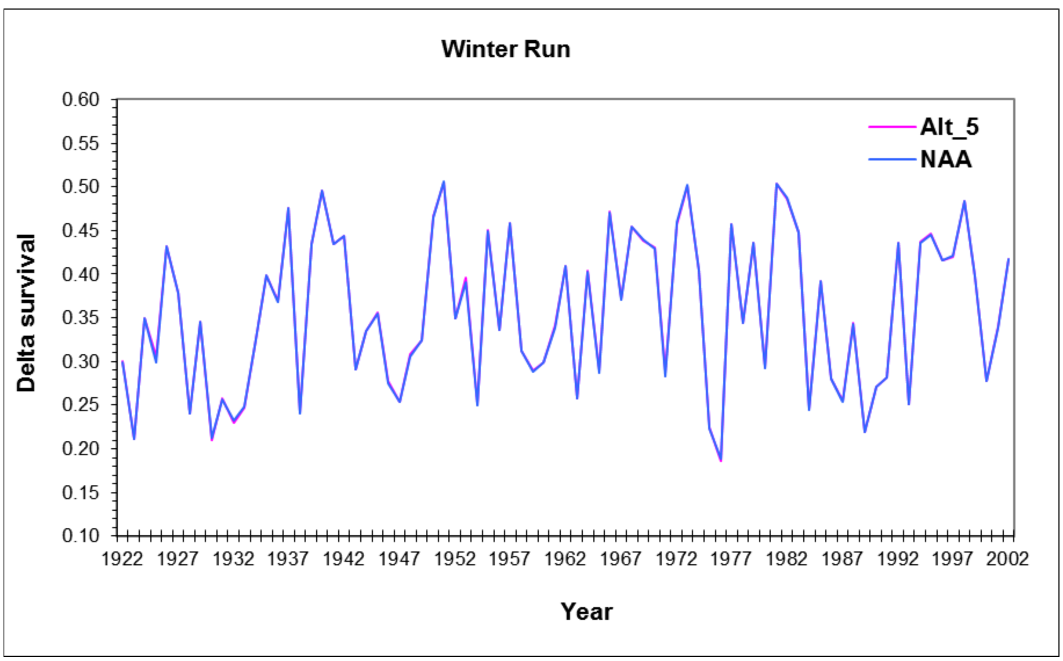

Figure 9J.28 Annual Delta Survival for Winter-run Chinook Salmon under Alt 5 as compared to the NAA over 81 water years estimated by the DPM model

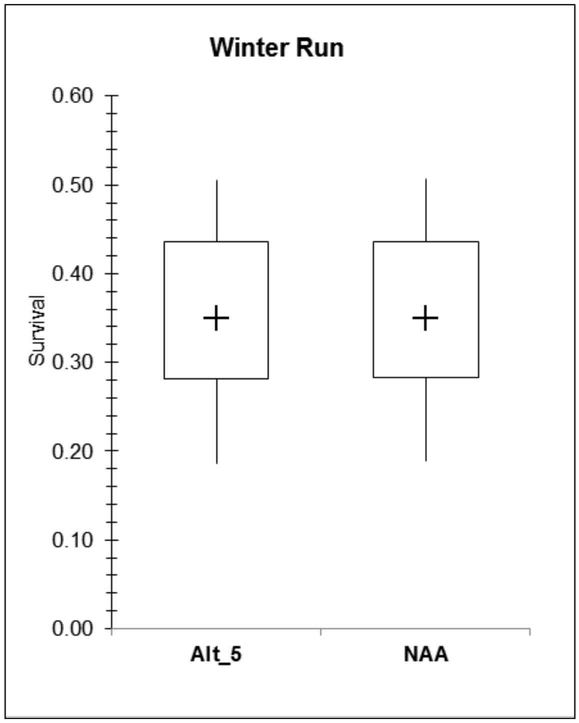

Figure 9J.29 Annual Delta Survival for Winter-run Chinook under Alt 5 as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

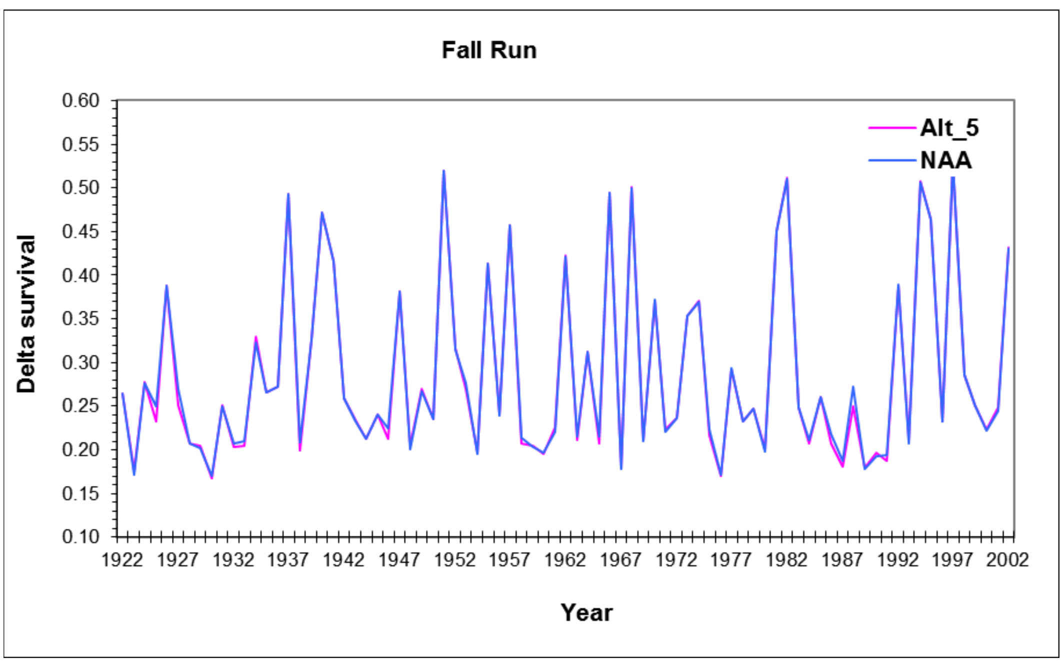

Figure 9J.30 Annual Delta Survival for Fall-run Chinook Salmon under (Alt 5) as compared to the NAA over 81 water years estimated by the DPM model

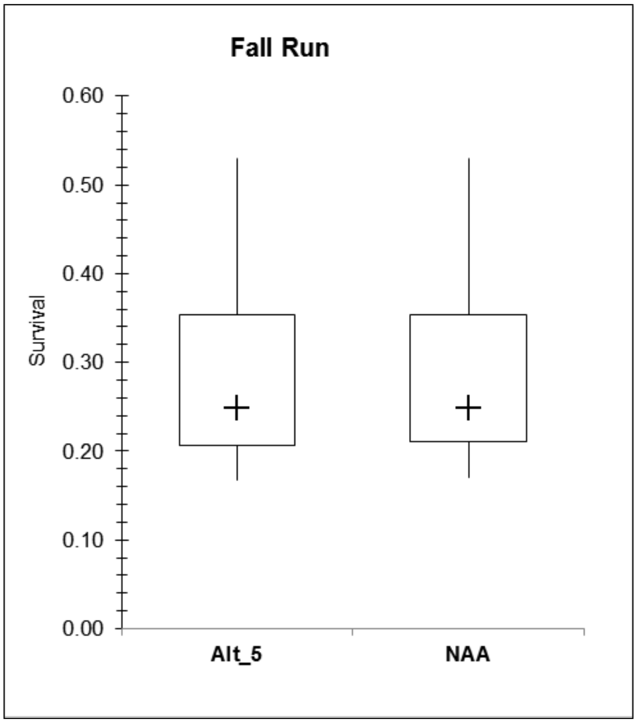

Figure 9J.31 Annual Delta Survival for Fall-run Chinook under Alt 5 as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

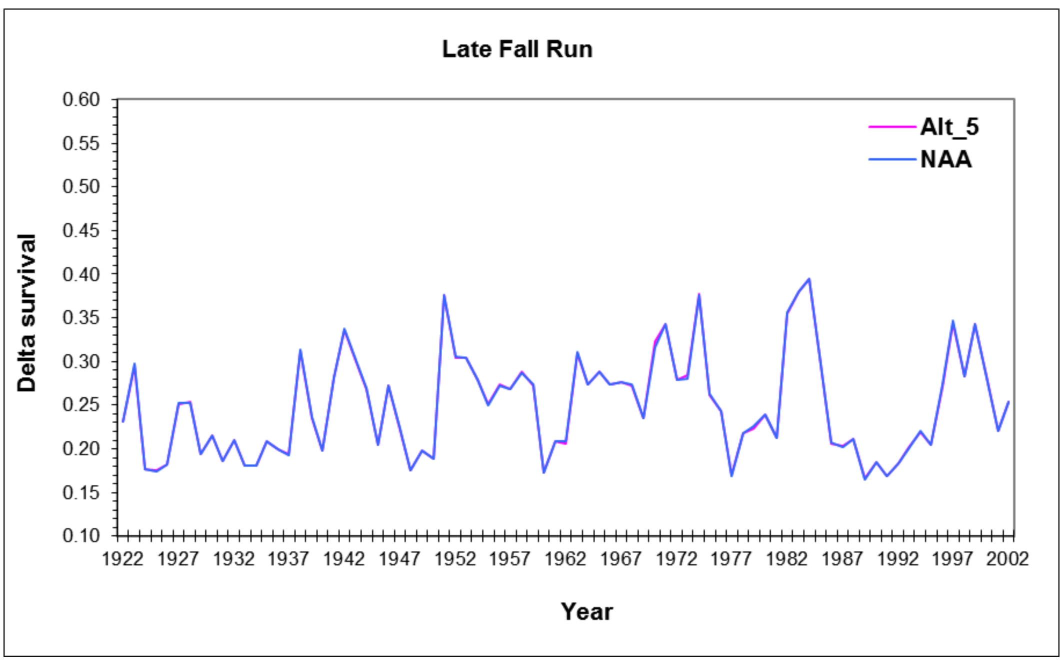

Figure 9J.32 Annual Delta Survival for Late Fall-run Chinook Salmon under Alt 5 as compared to the NAA over 81 water years estimated by the DPM model

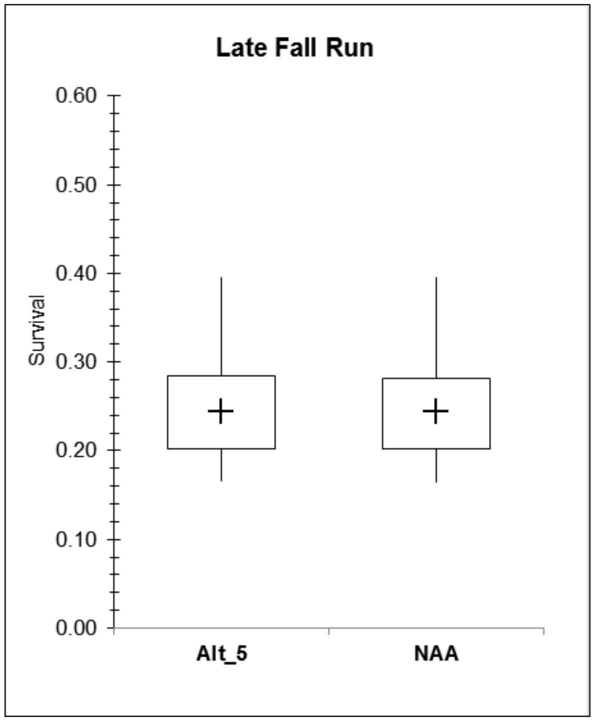

Figure 9J.33 Annual Delta Survival for Late Fall-run Chinook Salmond under Alt 5 as compared to the NAA estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

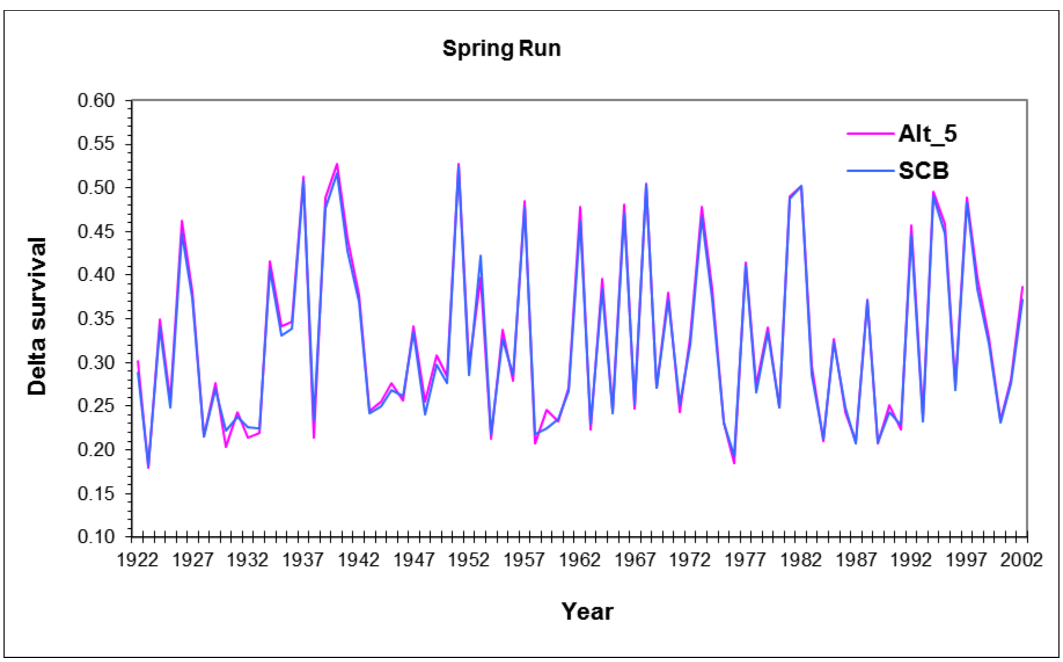

Figure 9J.34 Annual Delta Survival for Spring-run Chinook Salmon under Alt 5 as compared to the SBC over 81 water years estimated by the DPM model

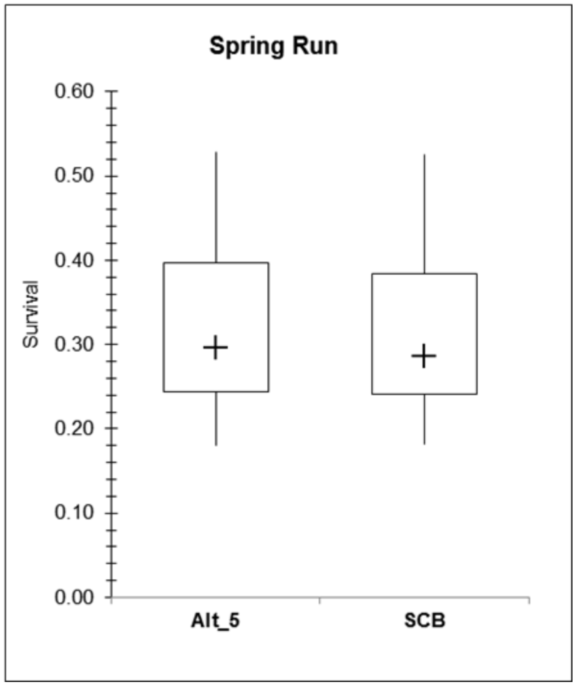

Figure 9J.35 Annual Delta Survival for Spring-run Chinook Salmon under Alt 5 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

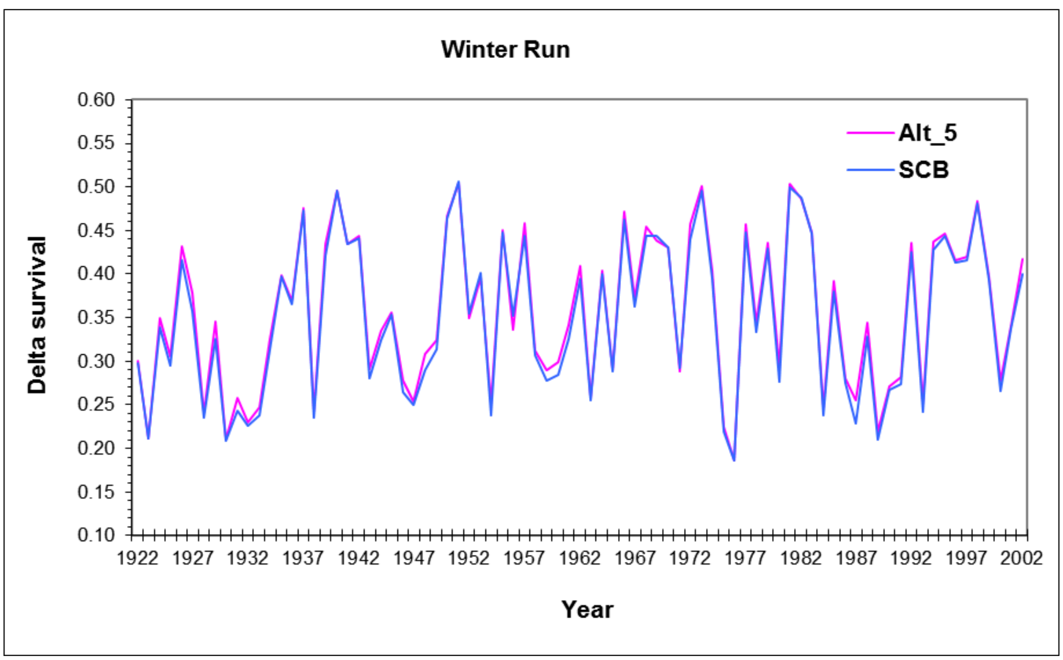

Figure 9J.36 Annual Delta Survival for Winter-run Chinook Salmon under Alt 3 as compared to the SBC over 81 water years estimated by the DPM model

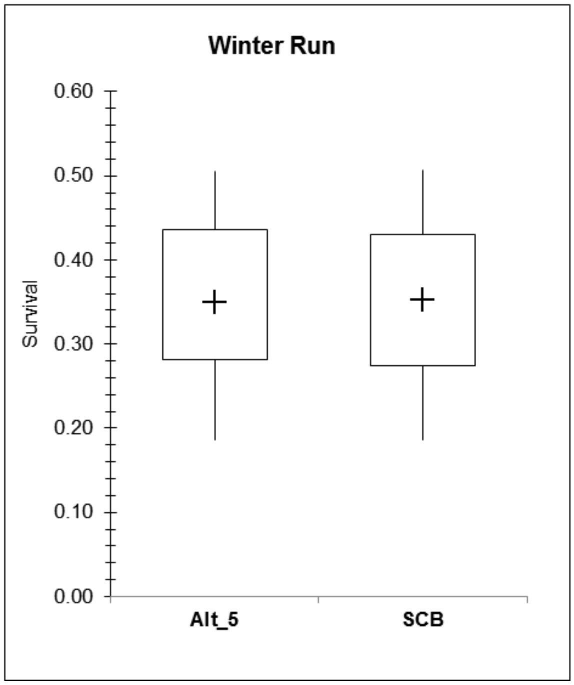

Figure 9J.37 Annual Delta Survival for Winter-run Chinook under Alt 5 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

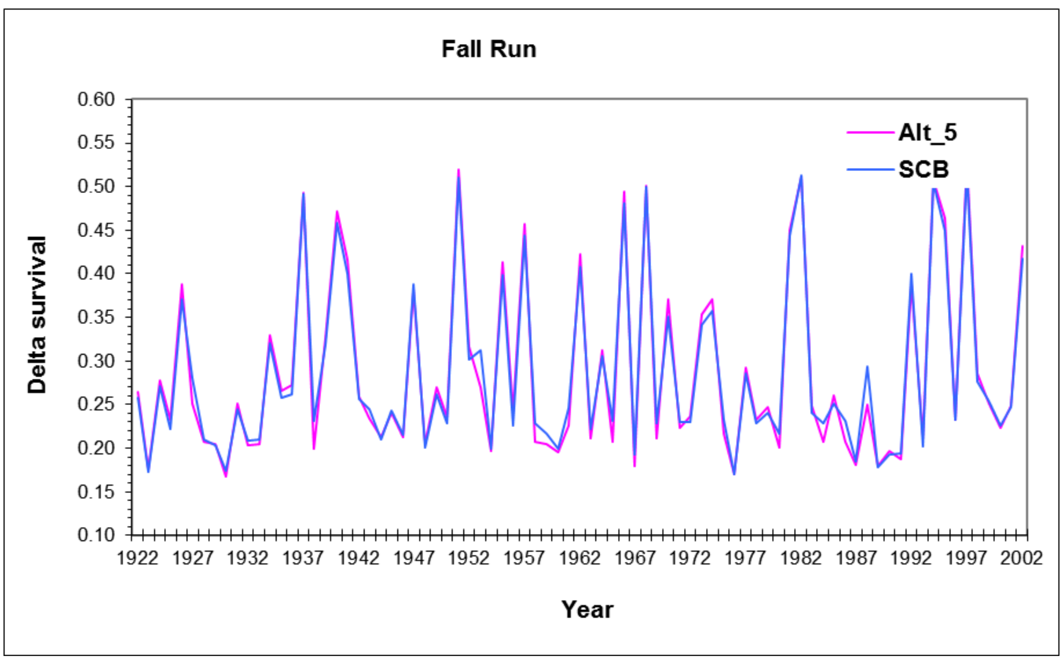

Figure 9J.38 Annual Delta Survival for Fall-run Chinook Salmon under Alt 3 as compared to the SBC over 81 water years estimated by the DPM model

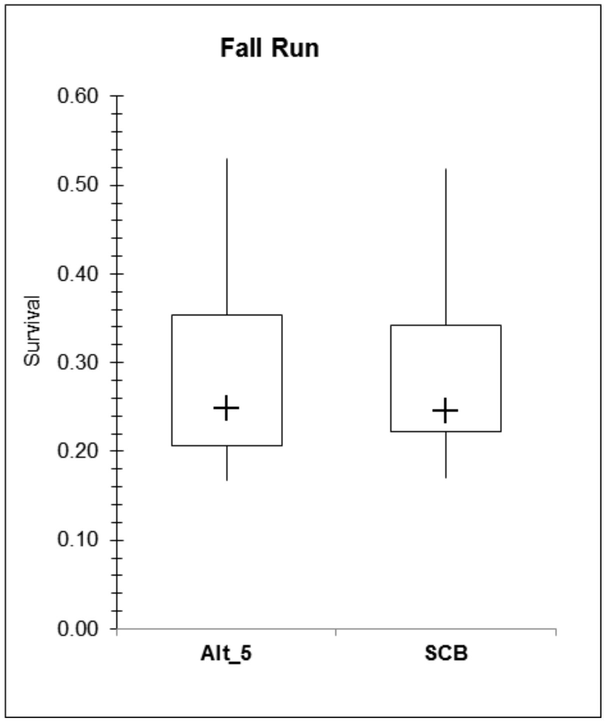

Figure 9J.39 Annual Delta Survival for Fall-run Chinook under Alt 5 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

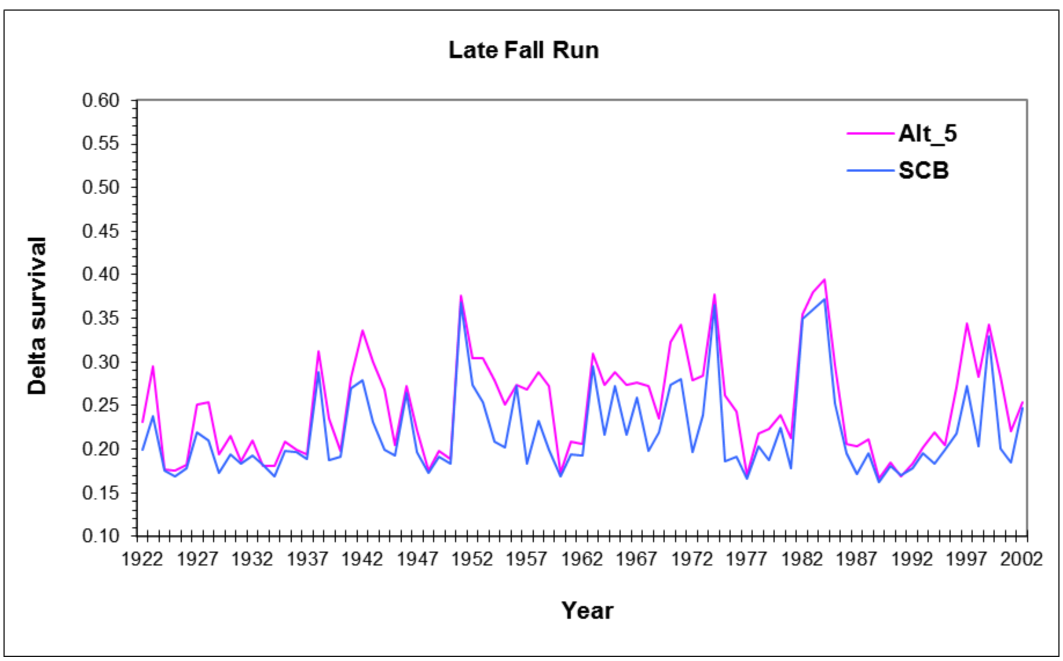

Figure 9J.40 Annual Delta Survival for Late Fall-run Chinook Salmon under Alt 3 as compared to the SBC over 81 water years estimated by the DPM model

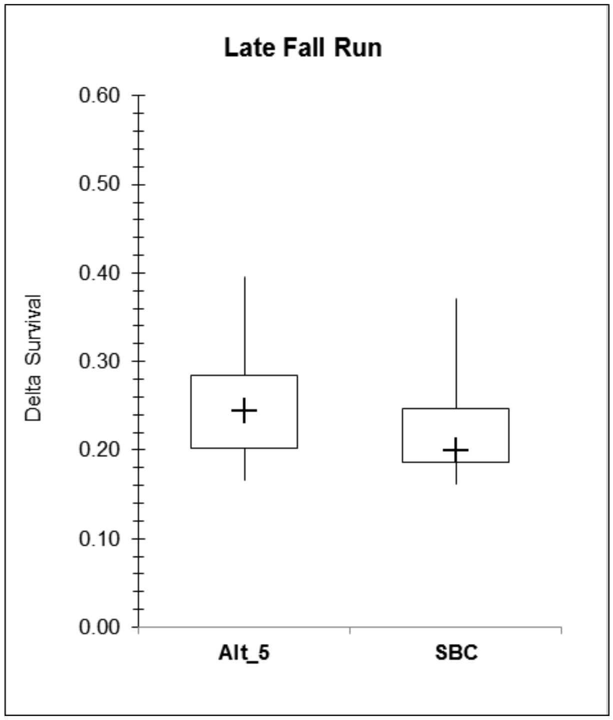

Figure 9J.41 Annual Delta Survival for Late Fall-run Chinook under Alt 5 as compared to the SBC estimated by the DPM model (Note: The plus symbol indicates median, box represents the interquartile range, and the whiskers represent the minimum and maximum values.)

Appendix 9K

Delta Hydrodynamic Analysis Documentation

This appendix provides information about the methods and assumptions used for the Coordinated Long Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the Delta Hydrodynamic analysis. This appendix is organized into the following sections:

- Section 9K.1: Delta Hydrodynamic Analysis Methodology and Assumptions
  - The Delta Hydrodynamic analysis summarizes 15-minute velocity output from DSM2 over the 82-year simulation period (1922 to 2003). This section briefly describes the approach and assumptions for the Delta Hydrodynamic analysis.
- Section 9K.2: Delta Hydrodynamic Analysis Results
  - This section presents the results of the Delta Hydrodynamic analysis. Results are presented in a series of figures showing the proportion positive velocity for each alternative comparison for five DSM2 Hydro channels.

9K.1 Delta Hydrodynamic Analysis Methodology and Assumptions

9K.1.1 Delta Hydrodynamic Analysis Methodology

For this analysis, 15-minute DSM2 Hydro output (velocity) was summarized over the 82-year simulation period (1922 to 2003) at the midpoint of five DSM2 channels, as follows:

- San Joaquin River mainstem downstream of the Head of Old River (DSM2 channel 21)
- Old River downstream of the facilities (DSM2 channel 212)
- Old River upstream of the facilities (DSM2 channel 94)
- Sacramento River near Georgiana Slough (DSM2 channel 421)
- San Joaquin River mainstem near the confluence with the Mokelumne River (DSM2 channel 45)

DSM2 output is summarized as the proportion of 15-minute observations with a value greater than 0 feet/second (proportion positive velocity). The proportion positive velocity is selected as the hydrodynamic metric because there is evidence that juvenile anadromous fish selectively migrate with the tides (Forward and Tankersly 2001). Thus, in a tidally-influenced system, a metric that measures the frequency and directionality of the velocity (proportion positive velocity) is arguably more relevant for anadromous fish migration than a metric that measures the magnitude of the velocity (e.g., mean velocity).

The 15-minute observations were summarized for every combination of scenario (No Action Alternative, Second Basis of Comparison, Alternative 3, and Alternative 5) for 81 water years (1922 to 2003); DSM2 channels (21, 45, 94, 212, 421); and January through June to provide a total of 9,840 observations (4 * 82 * 5 * 6).

9K.1.2 Delta Hydrodynamic Analysis Scenario Assumptions

The key assumption in the Delta Hydrodynamic analysis is that the proportion positive velocity of a channel, measured at a monthly time step, is an indicator of the likelihood that juvenile anadromous fish will successfully migrate through that channel towards the ocean.

9K.2 Delta Hydrodynamic Analysis Results

The results are provided as box-whiskers plots[1] summarizing the proportion of positive velocities in each month at various locations over the 82-year CalSim II simulation period for following runs:

- No Action Alternative
- Second Basis of Comparison (same as Alternative 1)
- Alternative 3
- Alternative 5

The following scenario comparisons are presented in Figures 9K.1 through 9K.25:

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 3 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the No Action Alternative
- Alternative 5 compared to the Second Basis of Comparison

9K.3 Reference

Forward, Jr. R.B. & R.A. Tankersley. 2001. "Selective Tidal-stream Transport of Marine Animals." *Oceanogr. Mar. Biol. Ann. Rev.* 39: 305-353.

[1] The box represents 25th and 75th percentiles, the line represents the median, and whiskers extend to the data point to 1.5 times the length of the box away from the box. Outliers are represented in points.

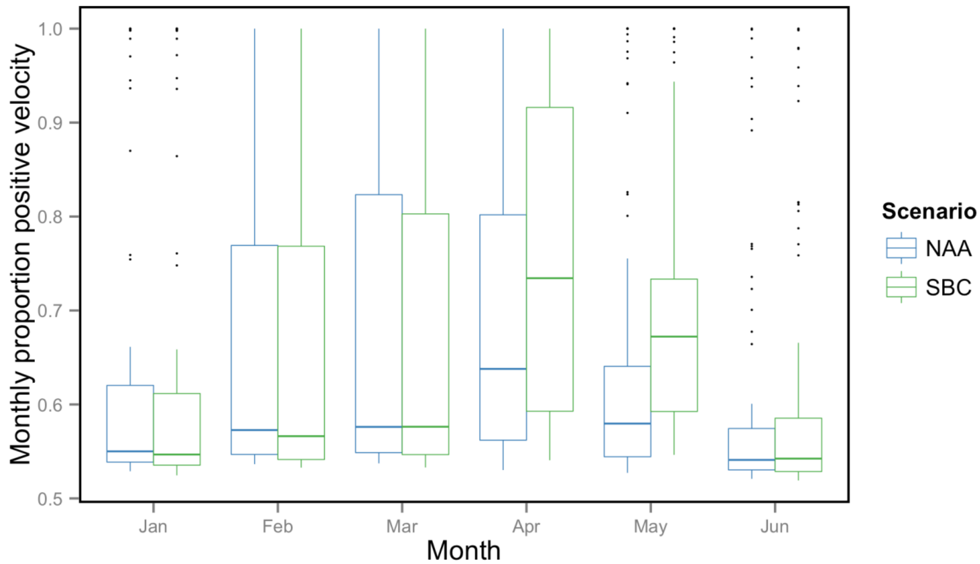

Figure 9K.1 Proportion of Monthly Positive Velocities in the San Joaquin River Downstream of the Head of Old River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

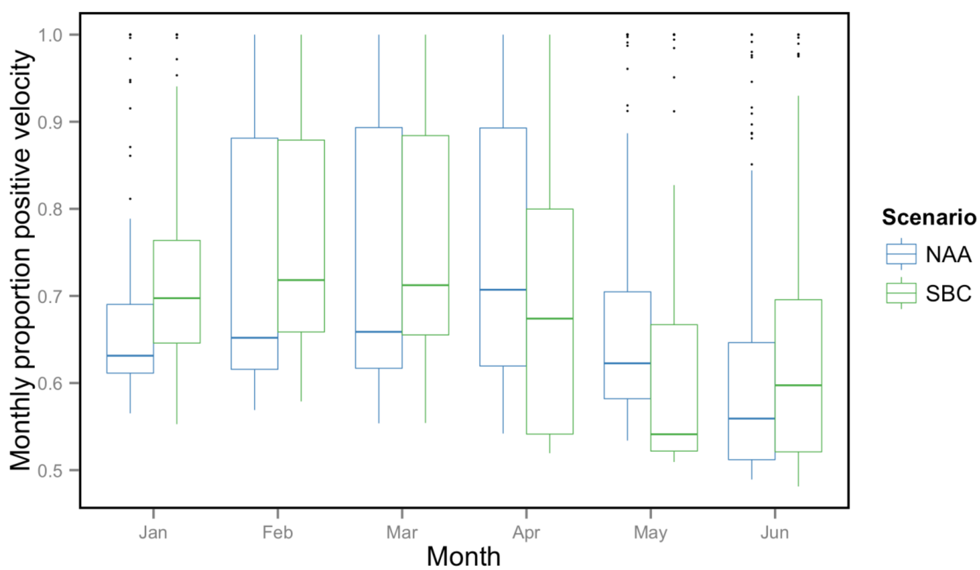

Figure 9K.2 Proportion of Monthly Positive Velocities in Old River Upstream of the Facilities under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

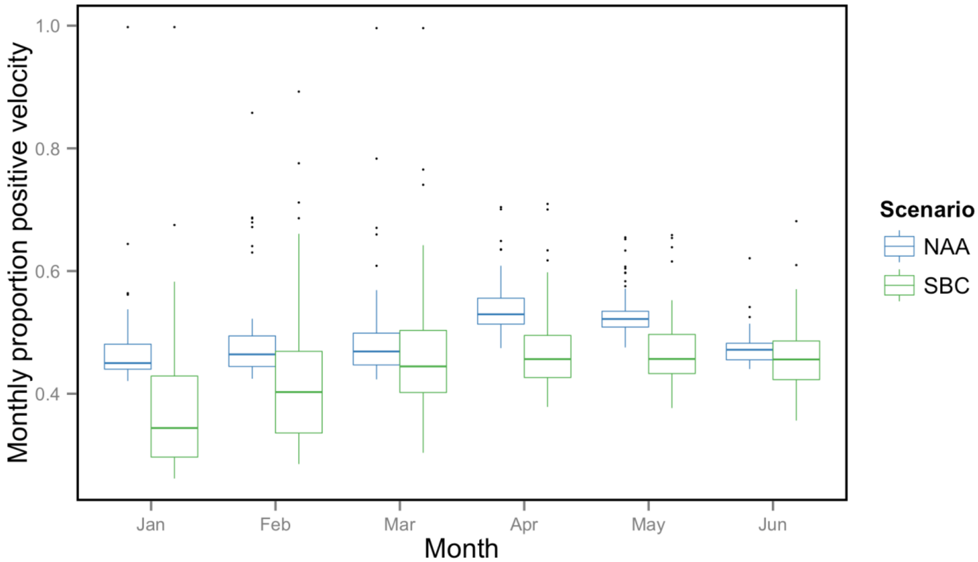

Figure 9K.3 Proportion of Monthly Positive Velocities in Old River Downstream of the Facilities under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

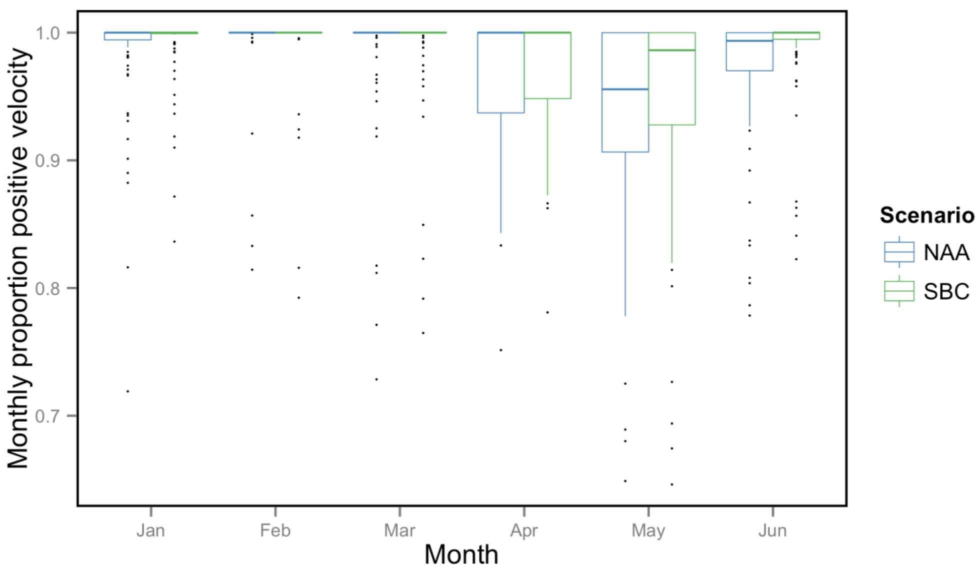

Figure 9K.4 Proportion of Monthly Positive Velocities in Sacramento River near Georgiana Slough under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

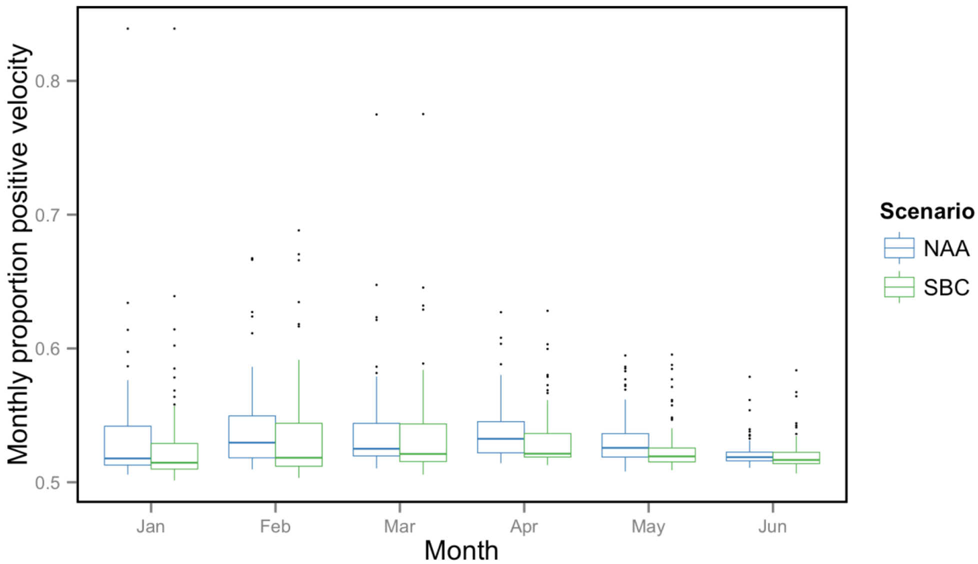

Figure 9K.5 Proportion of Monthly Positive Velocities in the San Joaquin River near Confluence with Mokelumne River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

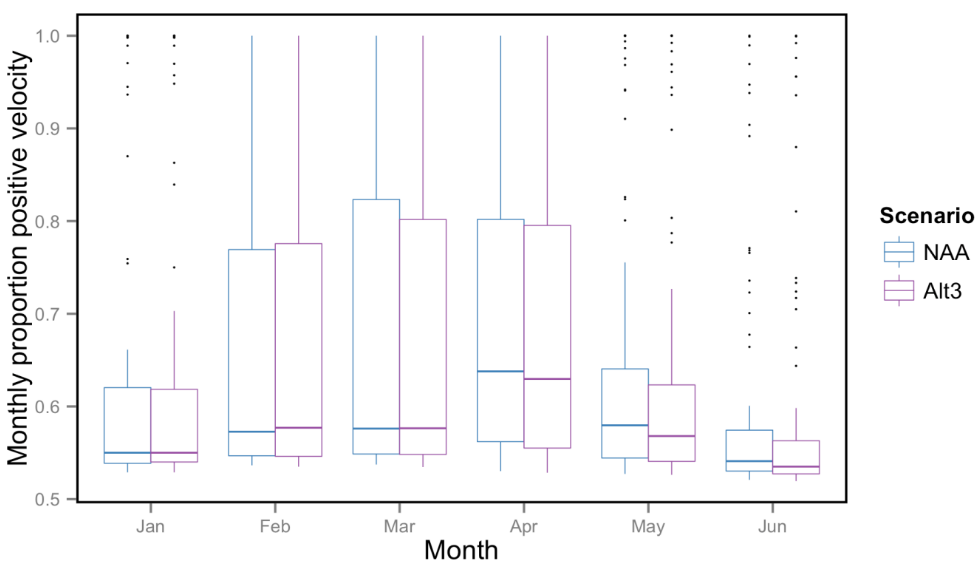

Figure 9K.6 Proportion of Monthly Positive Velocities in the San Joaquin River Downstream of the Head of Old River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

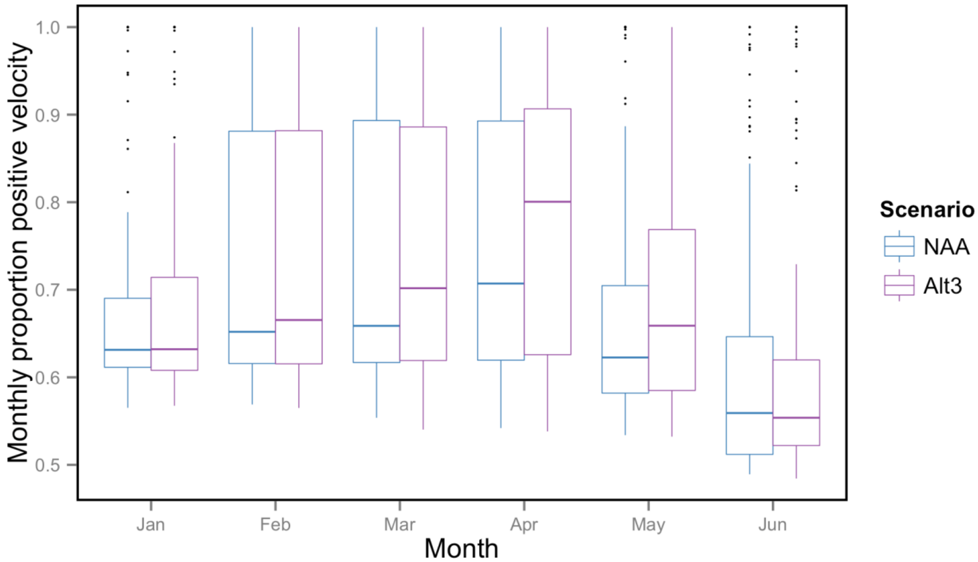

Figure 9K.7 Proportion of Monthly Positive Velocities in Old River Upstream of the Facilities under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

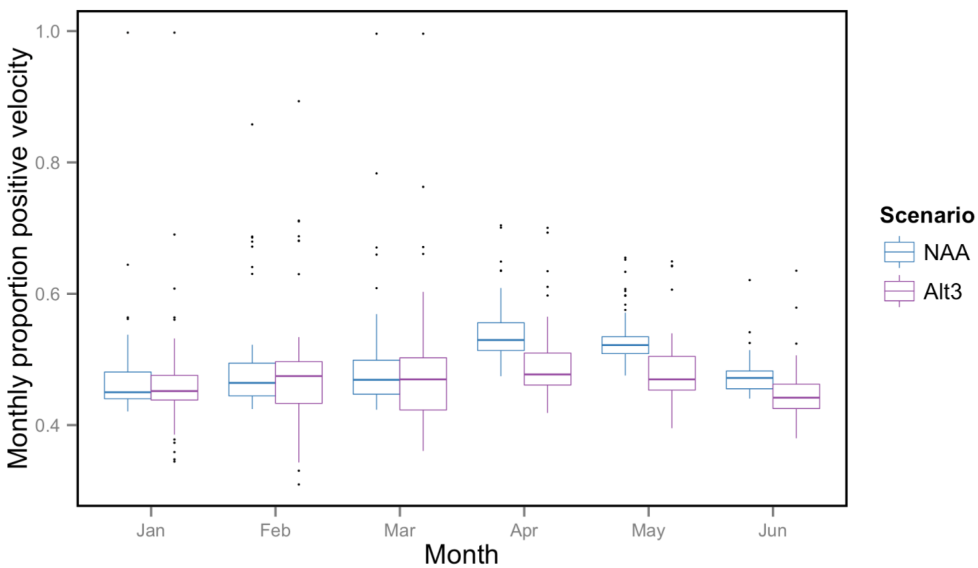

Figure 9K.8 Proportion of Monthly Positive Velocities in Old River Downstream of the Facilities under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

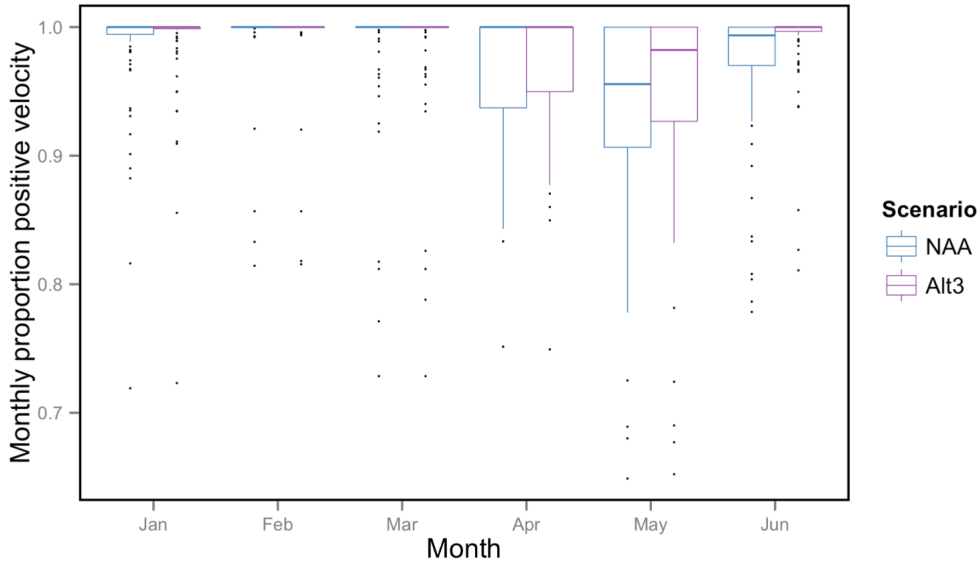

Figure 9K.9 Proportion of Monthly Positive Velocities in Sacramento River near Georgiana Slough under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

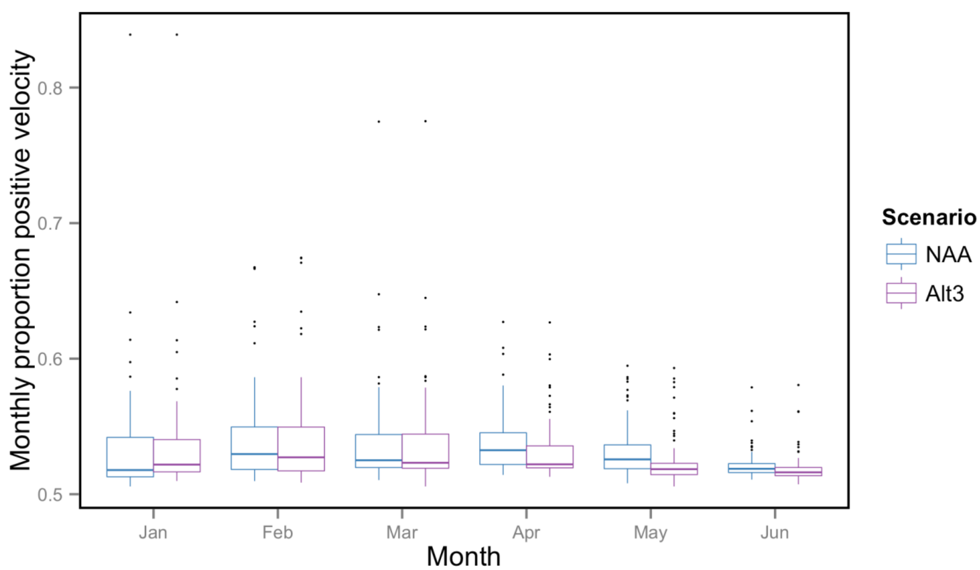

Figure 9K.10 Proportion of Monthly Positive Velocities in the San Joaquin River near Confluence with Mokelumne River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

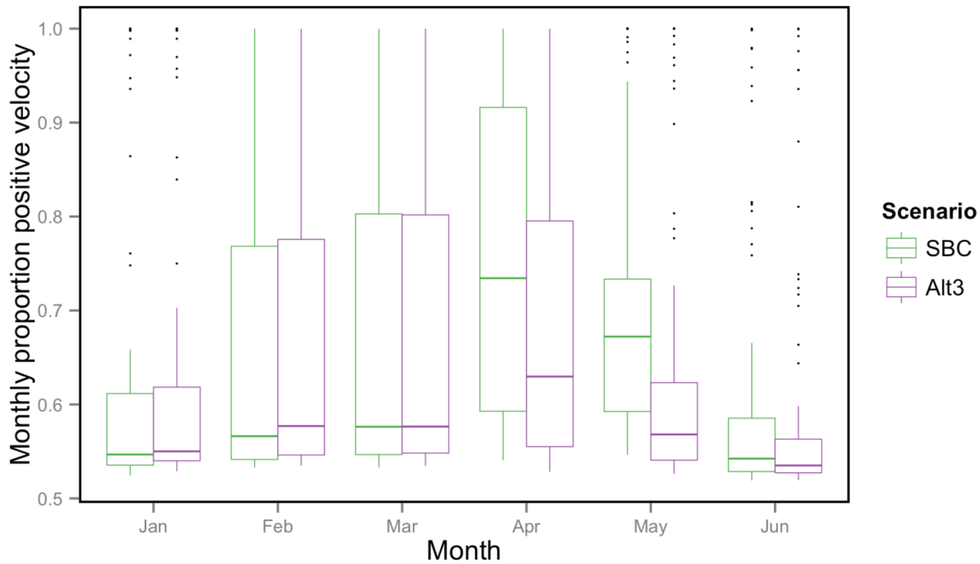

Figure 9K.11 Proportion of Monthly Positive Velocities in the San Joaquin River Downstream of the Head of Old River under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

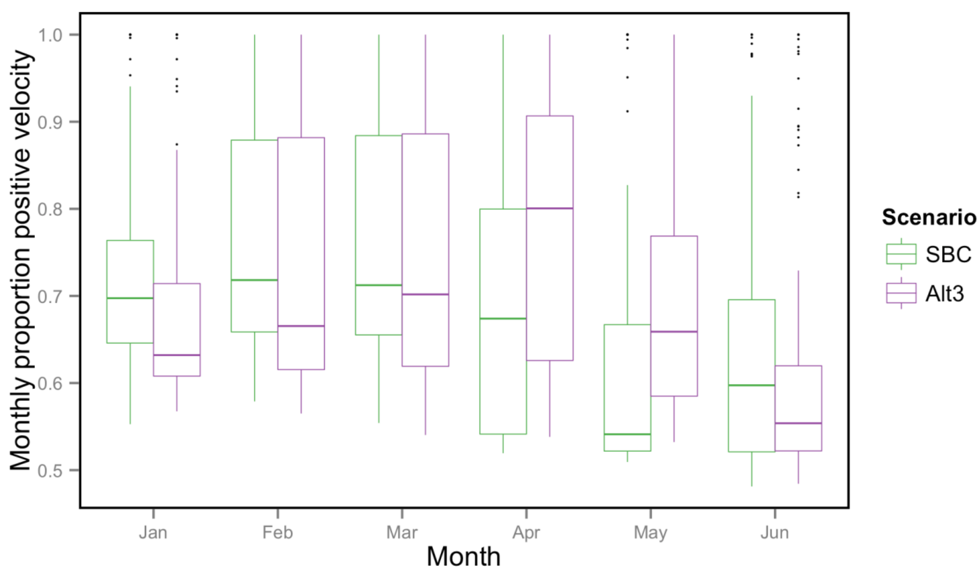

Figure 9K.12 Proportion of Monthly Positive Velocities in Old River Upstream of the Facilities under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

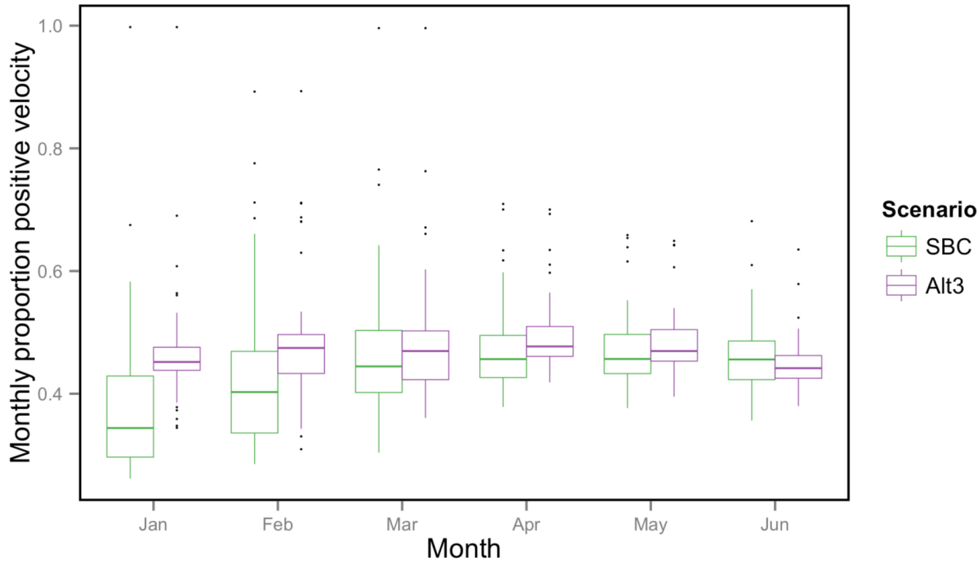

Figure 9K.13 Proportion of Monthly Positive Velocities in Old River Downstream of the Facilities under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

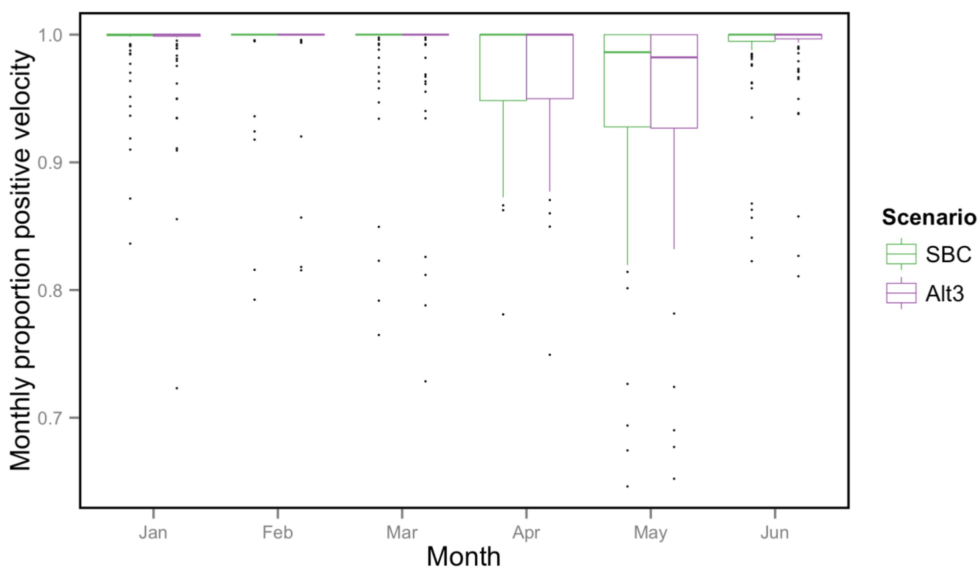

Figure 9K.14 Proportion of Monthly Positive Velocities in Sacramento River near Georgiana Slough under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

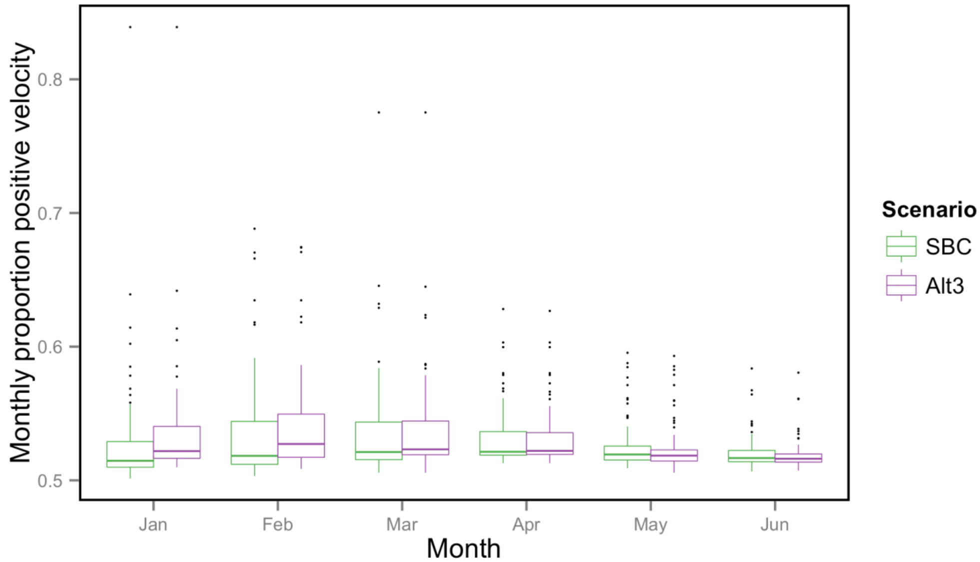

Figure 9K.15 Proportion of Monthly Positive Velocities in the San Joaquin River near Confluence with Mokelumne River under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison

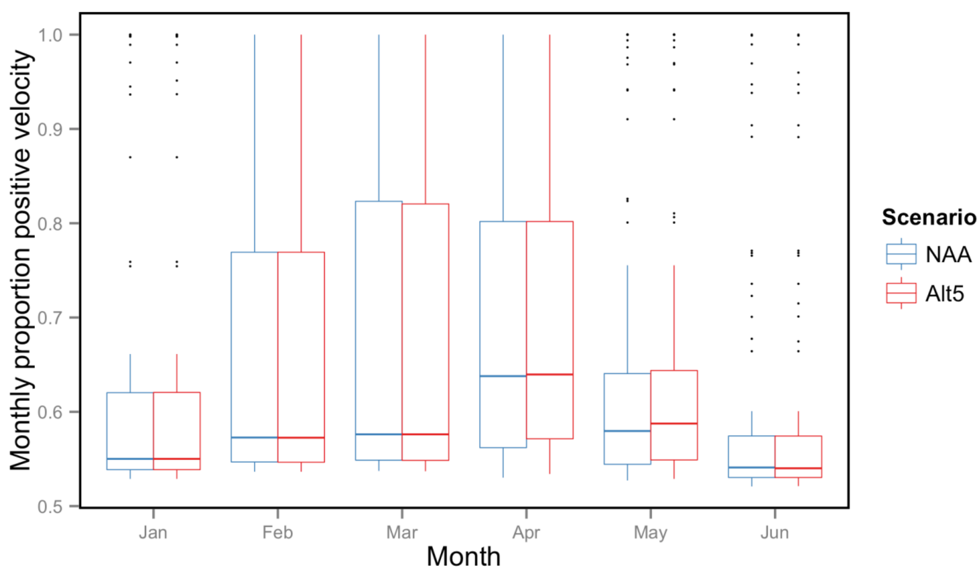

Figure 9K.16 Proportion of Monthly Positive Velocities in the San Joaquin River Downstream of the Head of Old River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

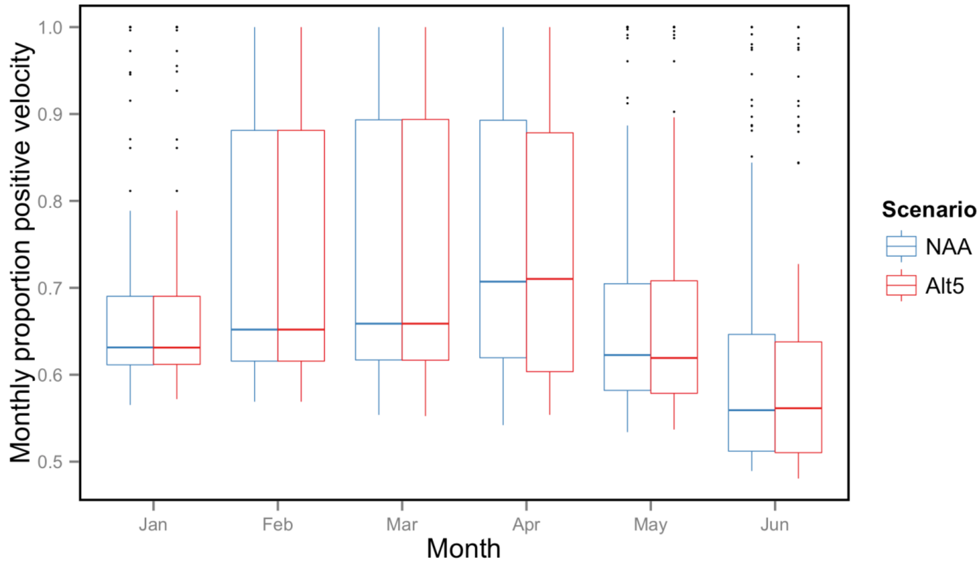

Figure 9K.17 Proportion of Monthly Positive Velocities in Old River Upstream of the Facilities under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

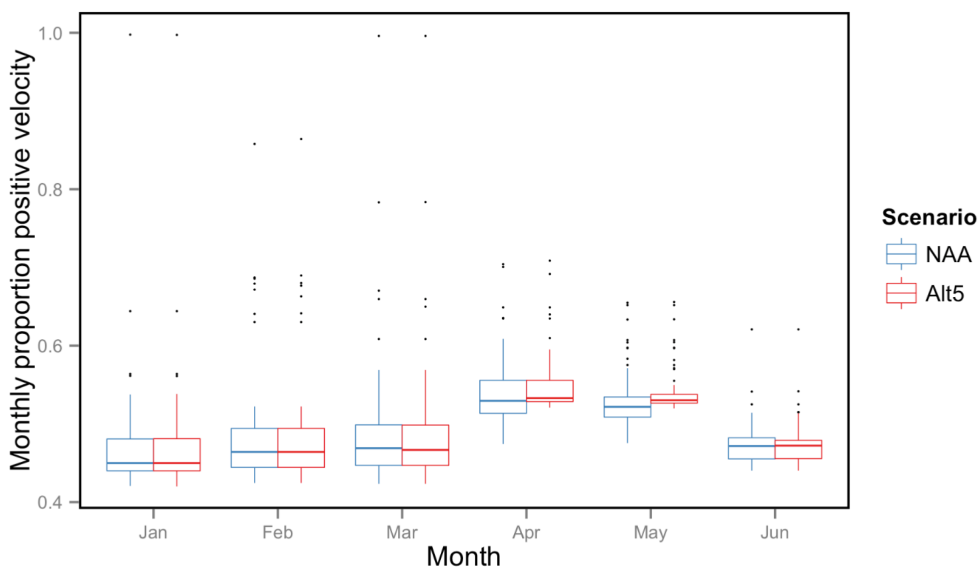

Figure 9K.18 Proportion of Monthly Positive Velocities in Old River Downstream of the Facilities under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

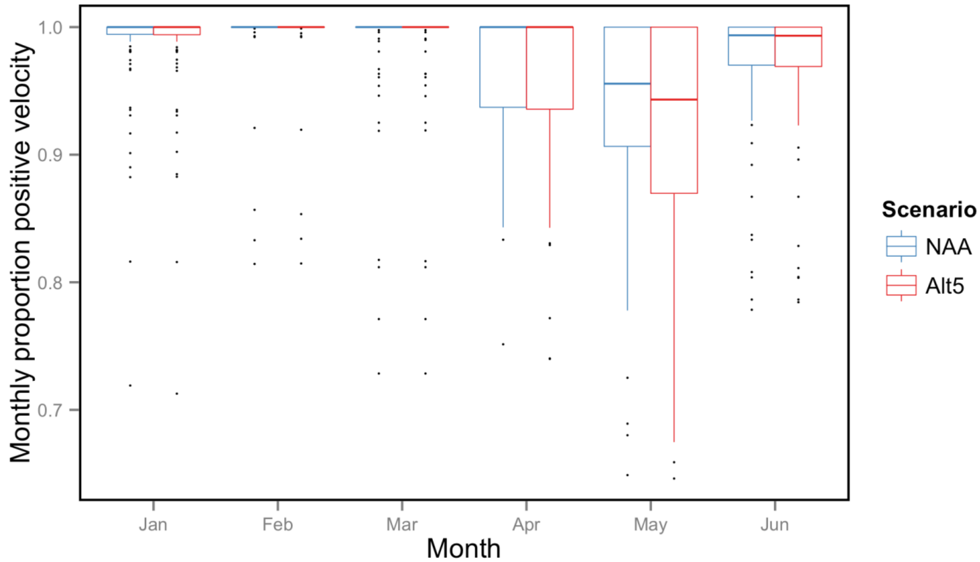

Figure 9K.19 Proportion of Monthly Positive Velocities in Sacramento River near Georgiana Slough under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

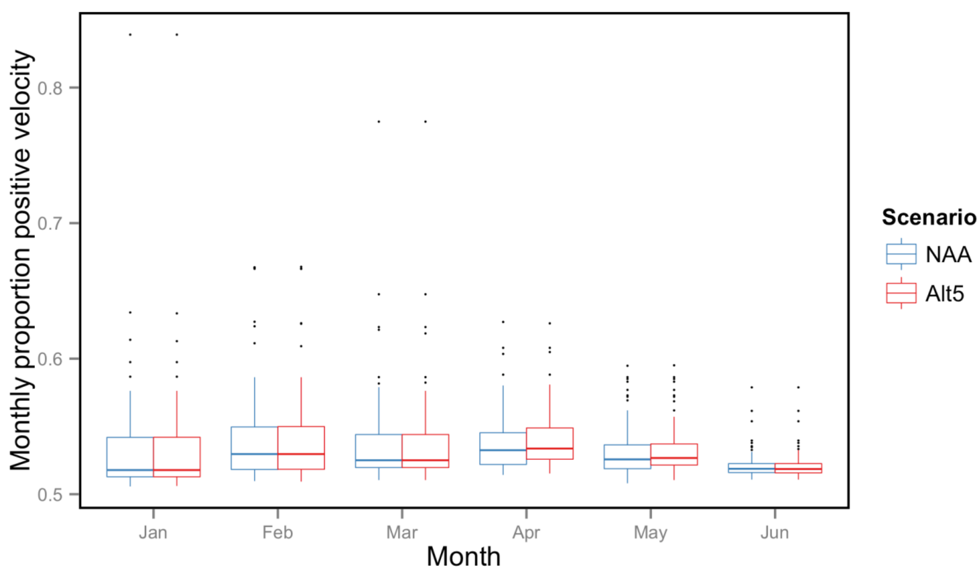

Figure 9K.20 Proportion of Monthly Positive Velocities in the San Joaquin River near Confluence with Mokelumne River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

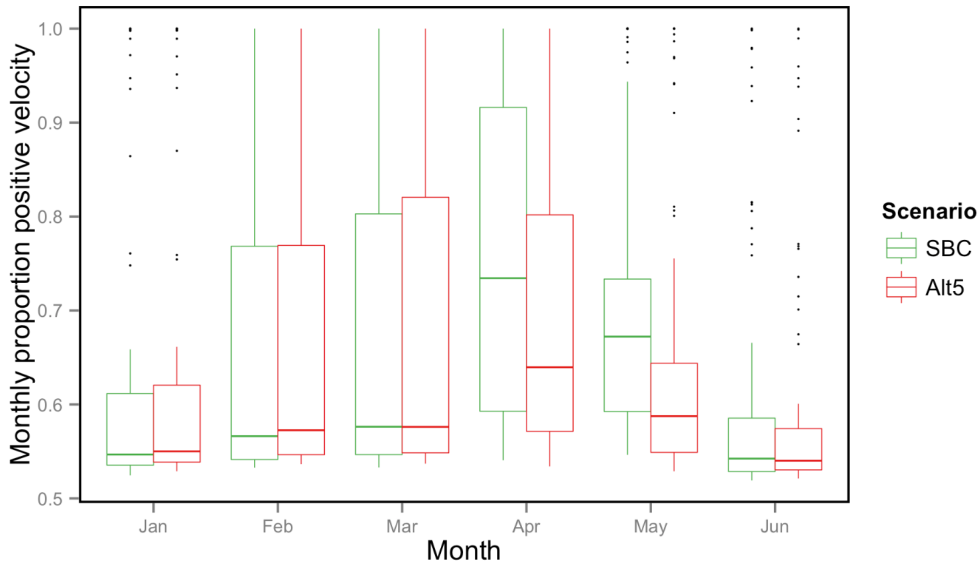

Figure 9K.21 Proportion of Monthly Positive Velocities in the San Joaquin River Downstream of the Head of Old River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

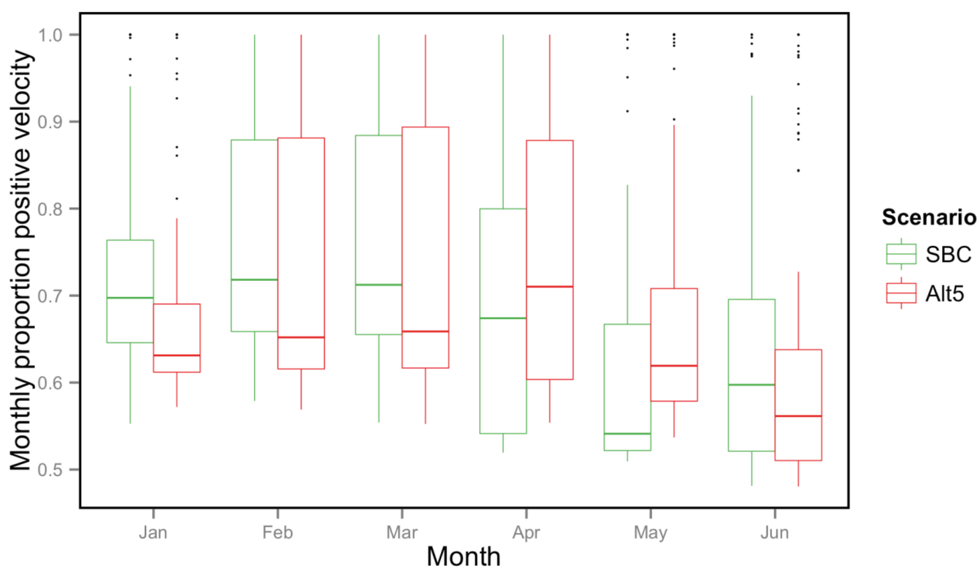

Figure 9K.22 Proportion of Monthly Positive Velocities in Old River Upstream of the Facilities under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

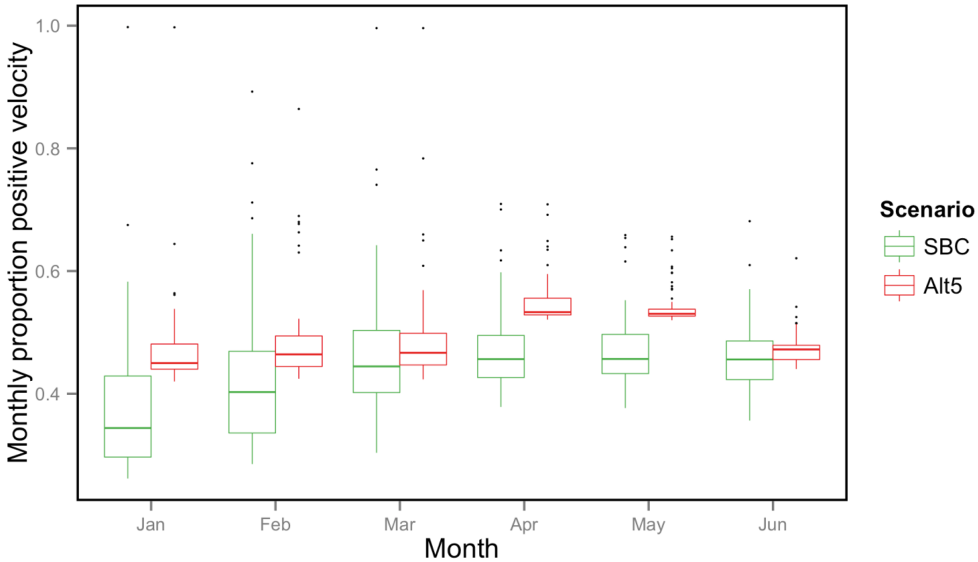

Figure 9K.23 Proportion of Monthly Positive Velocities in Old River Downstream of the Facilities under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

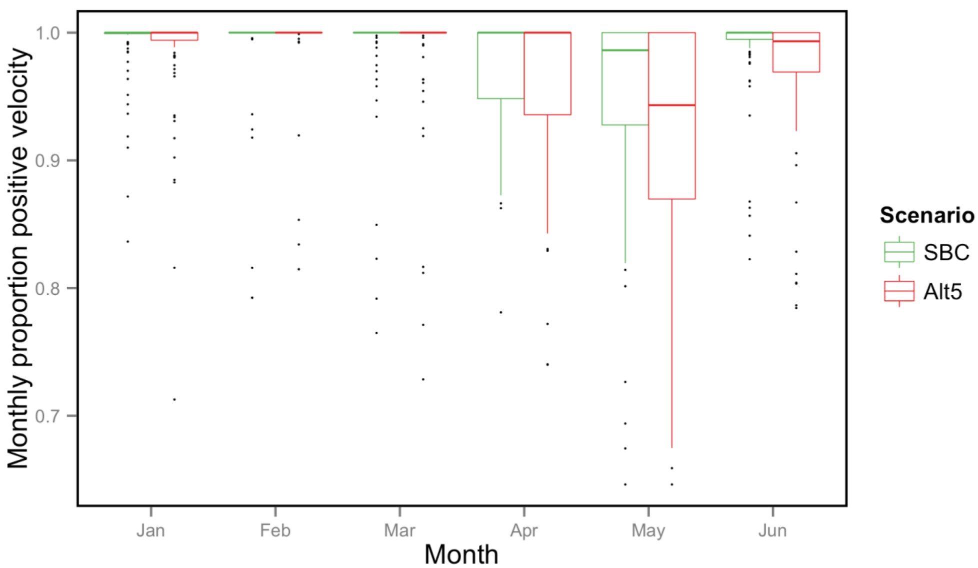

Figure 9K.24 Proportion of Monthly Positive Velocities in Sacramento River near Georgiana Slough under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

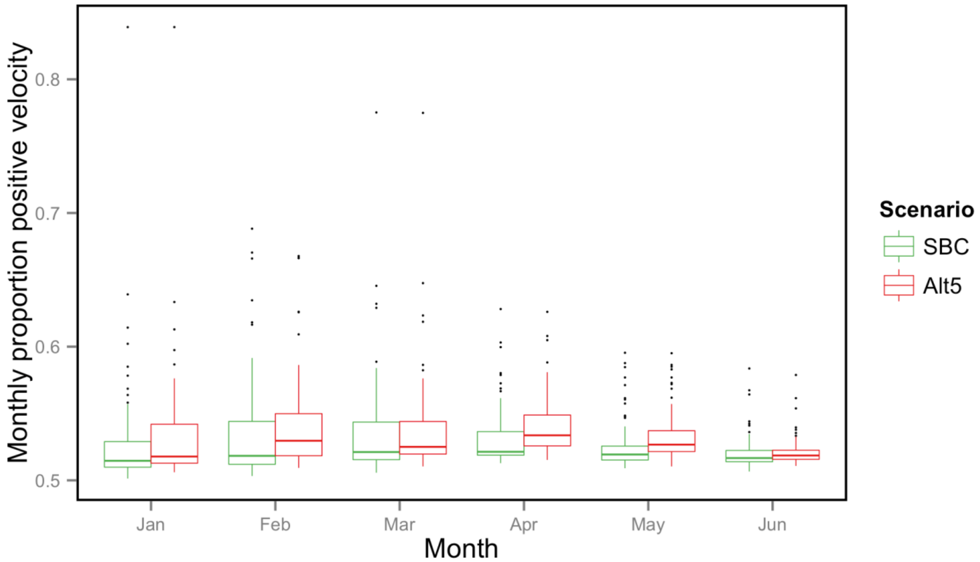

Figure 9K.25 Proportion of Monthly Positive Velocities in the San Joaquin River near Confluence with Mokelumne River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

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Appendix 9L

Junction Entrainment Analysis Documentation

This appendix provides information about the junction entrainment analysis methods and assumptions used for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis and pertinent results. This appendix is organized in two main sections:

- Section 9L.1: Methodology and Assumptions
  - The junction entrainment analysis uses the statistical relationship published in Cavallo et al. (2015) to predict the fish routing based on the proportion of flow moving through channel junctions in the Delta. This section briefly describes the approach and assumptions of the junction entrainment analysis.
- Section 9L.2: Results
  - This section presents the junction entrainment analysis results. Results are presented in a series of figures showing the probability of fish entrainment at various junctions in the Delta.

9L.1 Methodology and Assumptions

9L.1.1 Methodology

In this analysis, predicted entrainment into a distributary was based on 15-minute flow output from DSM2 over the 82-year simulation period following the statistical relationship reported in Cavallo et al. (2015). In that analysis, the proportion of acoustically tagged juvenile Chinook Salmon entrained in a distributary at seven junctions in the Delta was regressed against the proportion of flow into the distributary. The releases of tagged juvenile Chinook Salmon included fall- and late-fall-run fish.

The probability of fish entrainment was predicted at five Delta junctions: Georgiana Slough, Head of Old River, Turner Cut, Columbia Cut, and Middle River. Using the proportion of flow entering the distributary for every 15-minute observation in the 82-year simulation period, the mean daily proportion of flow into the distributary was calculated. The mean daily flow proportion was then used to calculate the predicted daily probability of fish entrainment.

9L.1.2 Scenario Assumptions

The junction entrainment analysis includes the following assumptions.

- The entrainment analysis is applicable to spring- and winter-run Chinook Salmon even though only fall- and late-fall-run Chinook Salmon were used to construct the statistical model.
- Hatchery fish used in the tagging studies behave similarly to natural-origin fish when migrating through channel junctions.
- The proportion of flow into a distributary could not exceed one.
- When flow was entering a junction from the distributary, the proportion of flow into the distributary was set to zero.

9L.2 Results

The following scenario comparisons are presented as box-whiskers plots[1] (Figures 9L.1 through 9L.30), comparing the probability of fish entrainment at various junctions:

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 3 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the No Action Alternative
- Alternative 5 compared to the Second Basis of Comparison

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

The EIS impact analysis starts with use of the monthly CalSim II model to project CVP and SWP water deliveries. Because this regional model uses monthly time steps to simulate requirements that change weekly or change through observations, it was determined that changes in the model of 5 percent or less were related to the uncertainties in the model processing. Therefore, reductions of 5 percent or less in this comparative analysis are considered to be not substantially different, or “similar.”

9L.3 Reference

Cavallo, B., P. Gaskill, J. Melgo, and S.C. Zeug. 2015. “Predicting juvenile Chinook Salmon routing in riverine and tidal channels of a freshwater estuary” 98:1571-1582.

[1] The box represents 25th and 75th percentiles, the line represents the median, and whiskers represent minimum and maximum (excluding the outliers). The outliers are defined as data points outside of 1.5 times the length of the box away from the box and are represented in points.

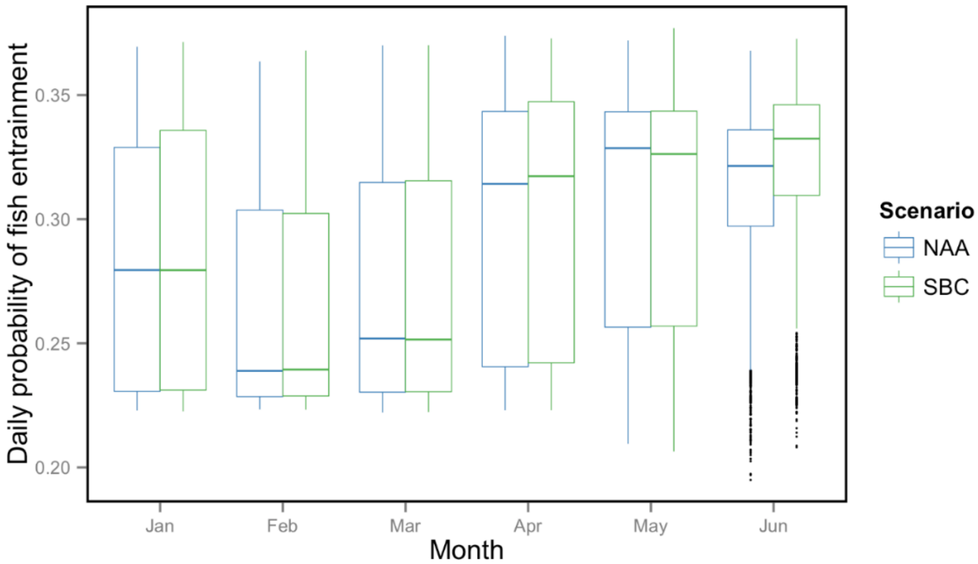


Figure 9L.1 Probability of Fish Entrainment into Georgiana Slough under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

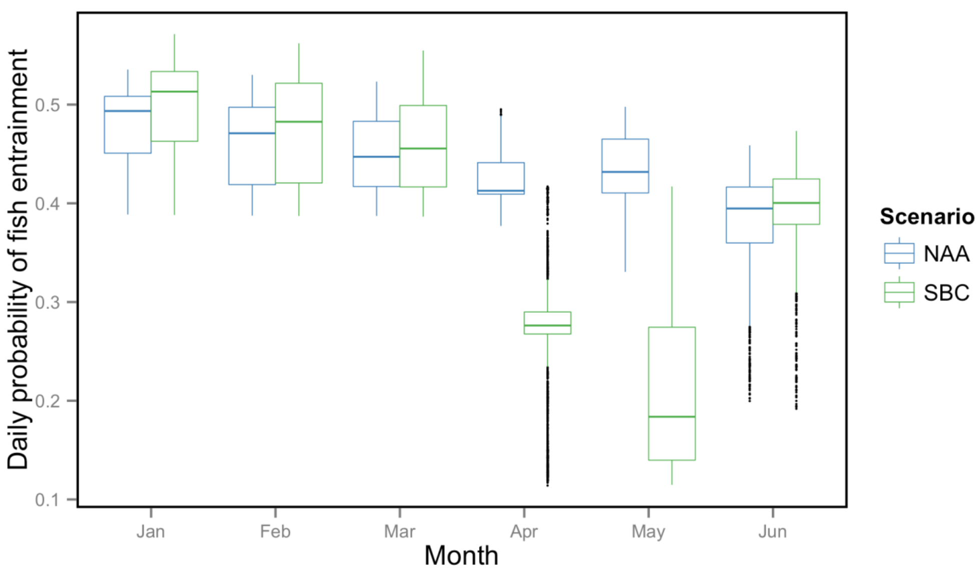


Figure 9L.2 Probability of Fish Entrainment into Head of Old River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

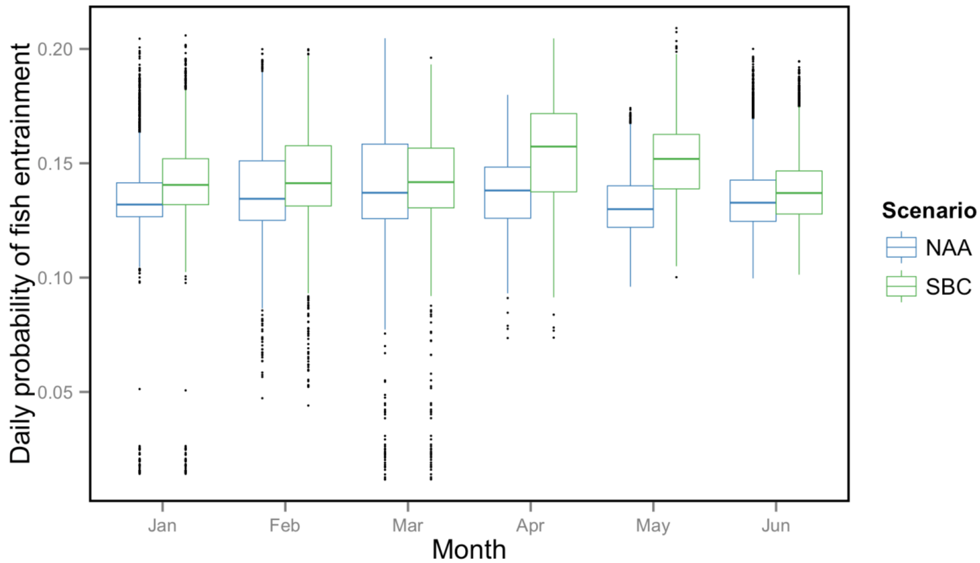


Figure 9L.3 Probability of Fish Entrainment into Turner Cut under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

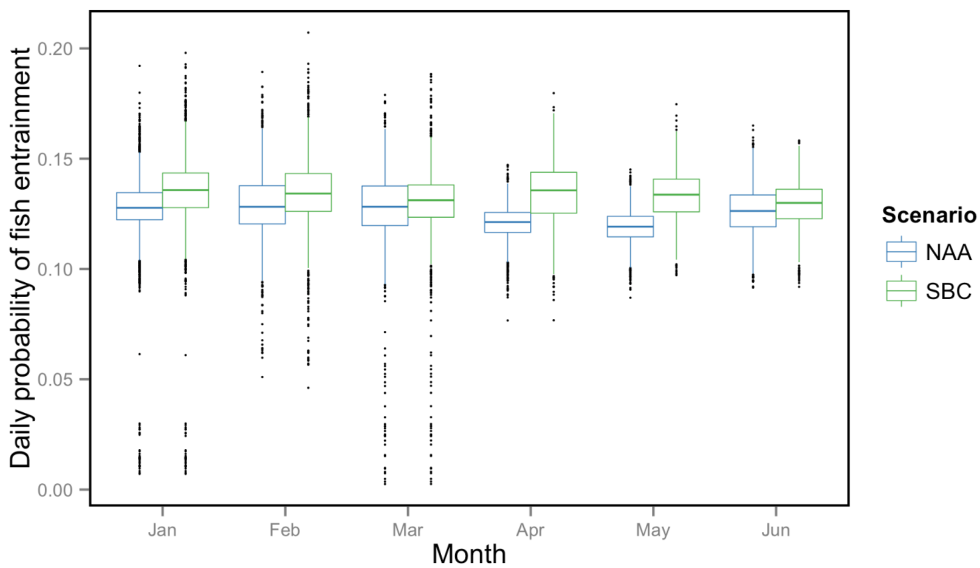


Figure 9L.4 Probability of Fish Entrainment into Columbia Cut under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

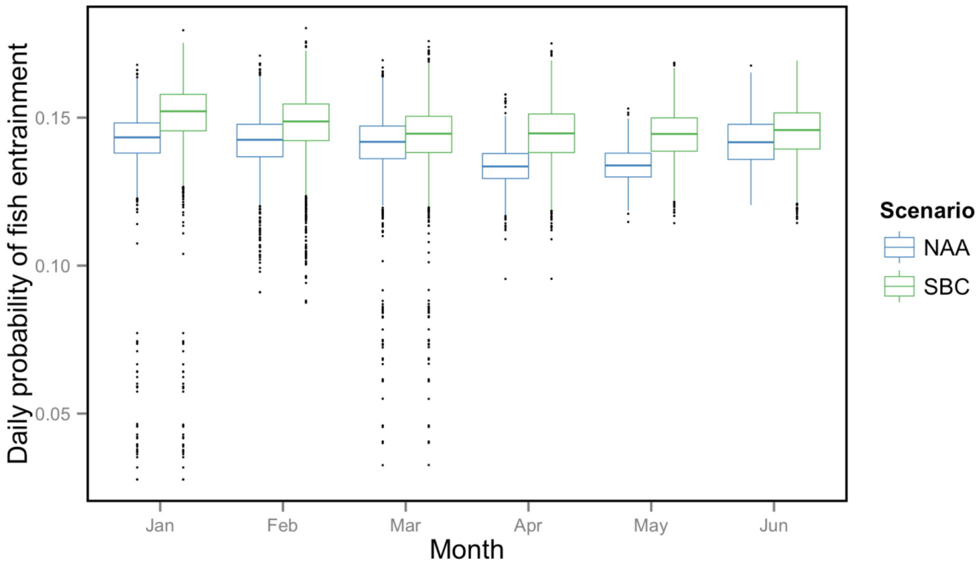


Figure 9L.5 Probability of Fish Entrainment into Middle River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

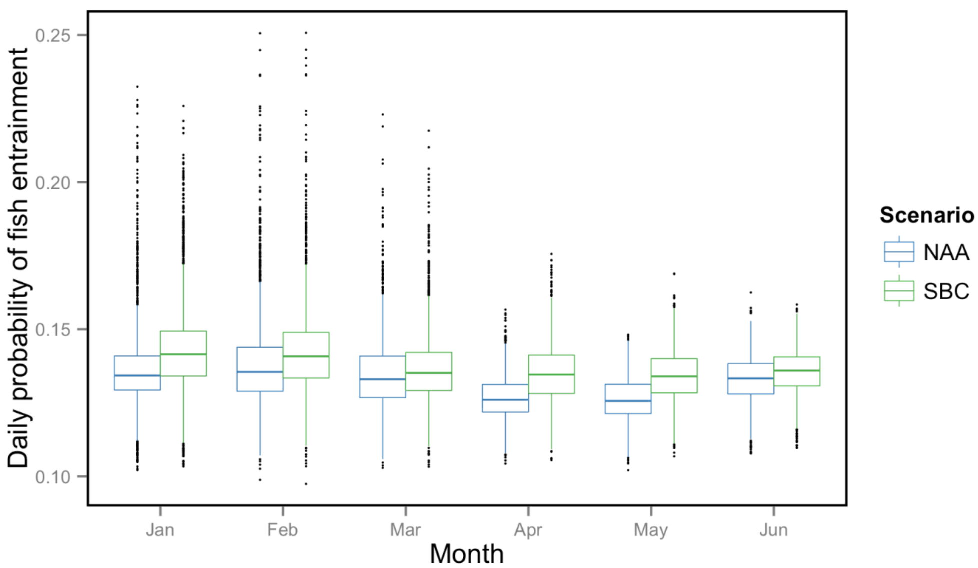


Figure 9L.6 Probability of Fish Entrainment into Old River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

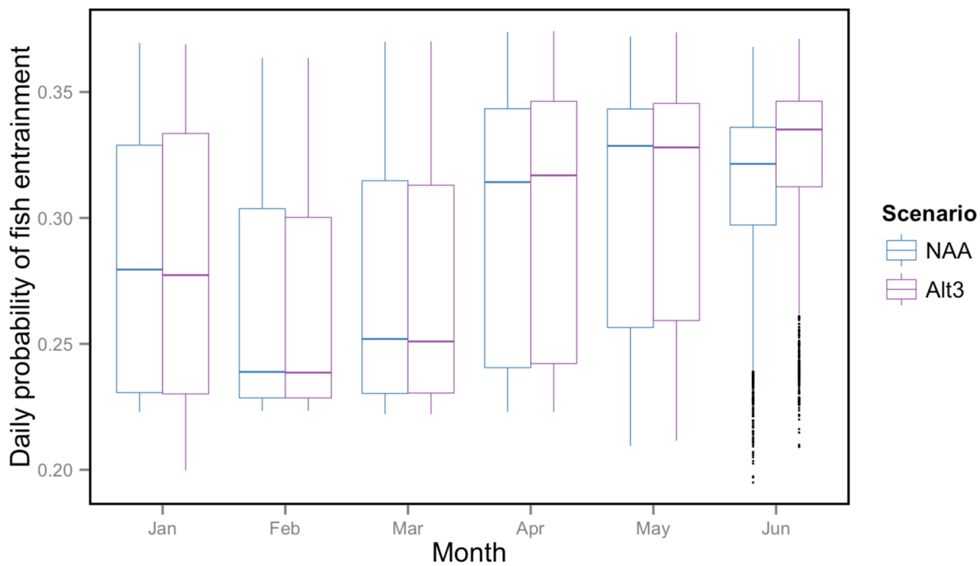


Figure 9L.7 Probability of Fish Entrainment into Georgiana Slough under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

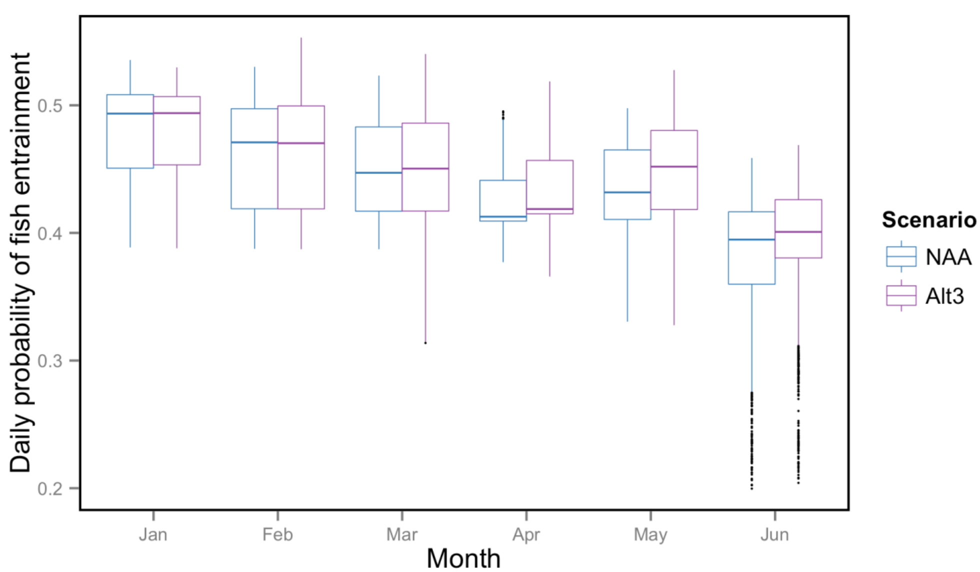


Figure 9L.8 Probability of Fish Entrainment into Head of Old River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

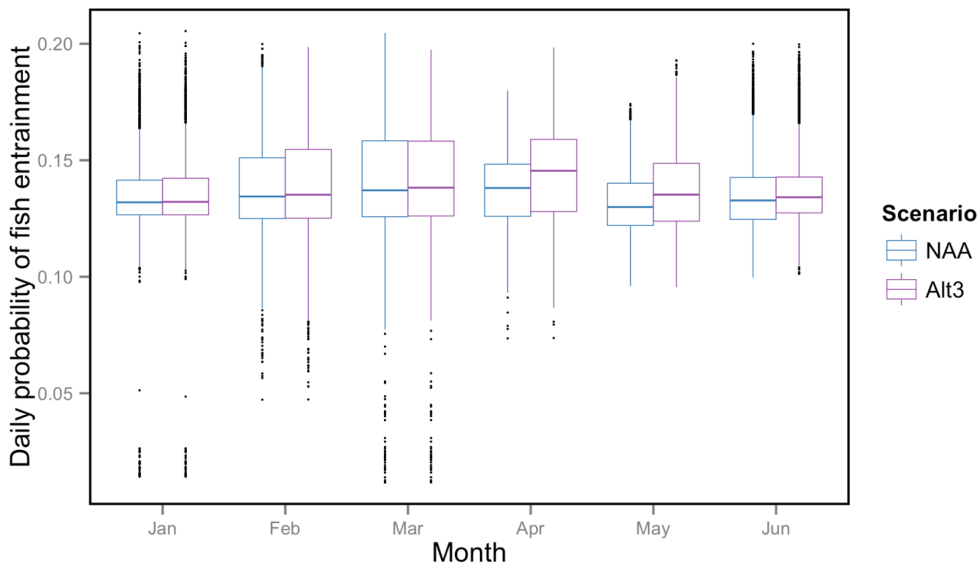


Figure 9L.9 Probability of Fish Entrainment into Turner Cut under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

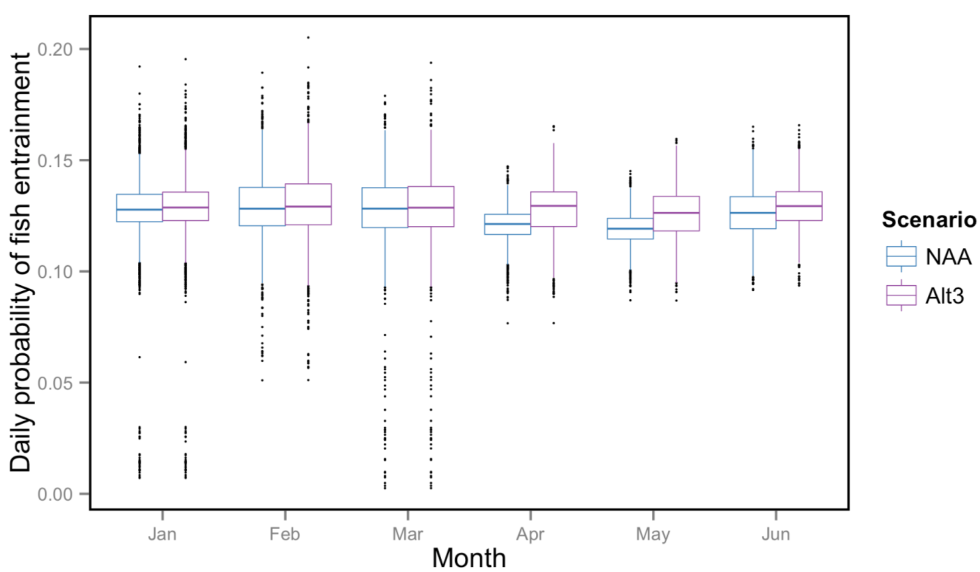


Figure 9L.10 Probability of Fish Entrainment into Columbia Cut under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

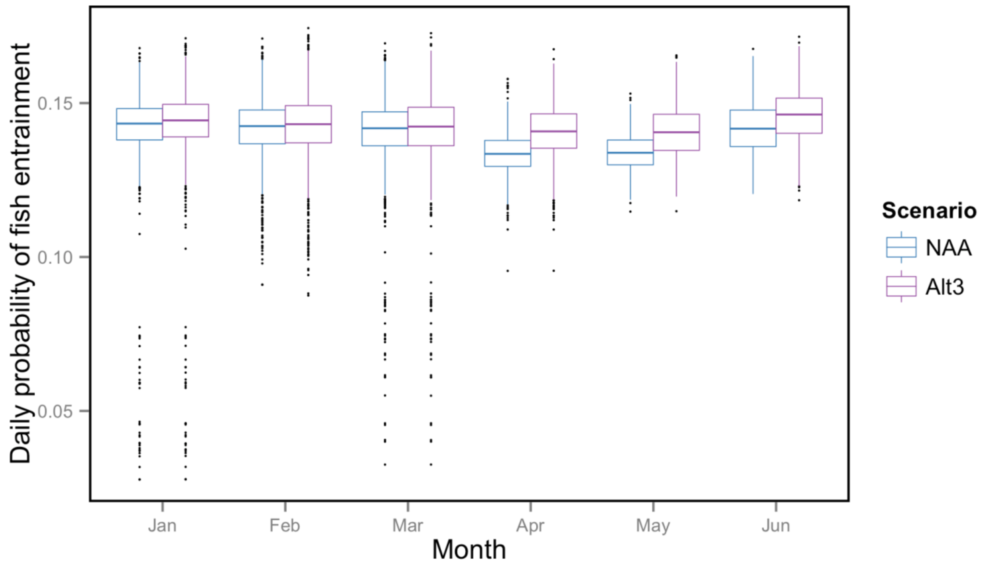


Figure 9L.11 Probability of Fish Entrainment into Middle River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

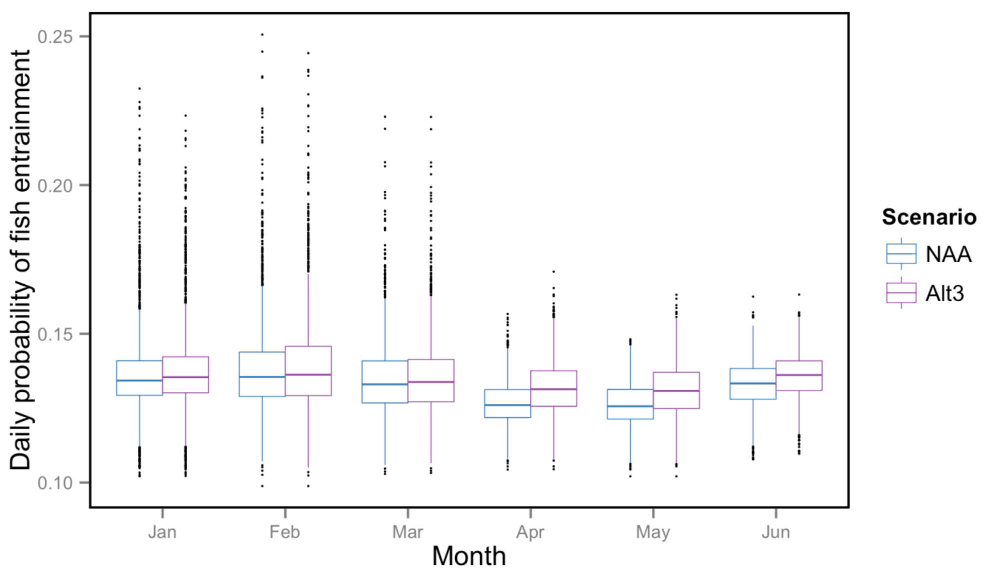
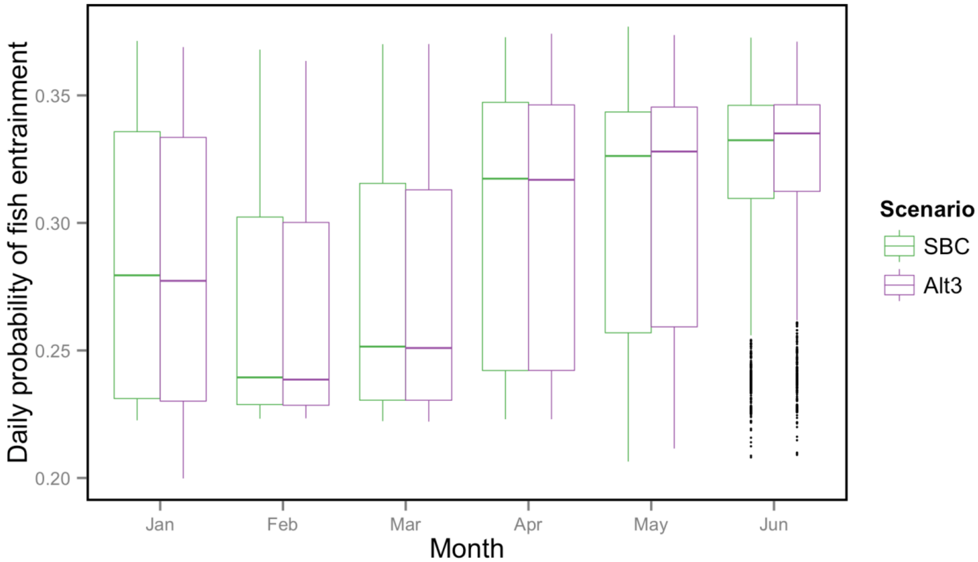
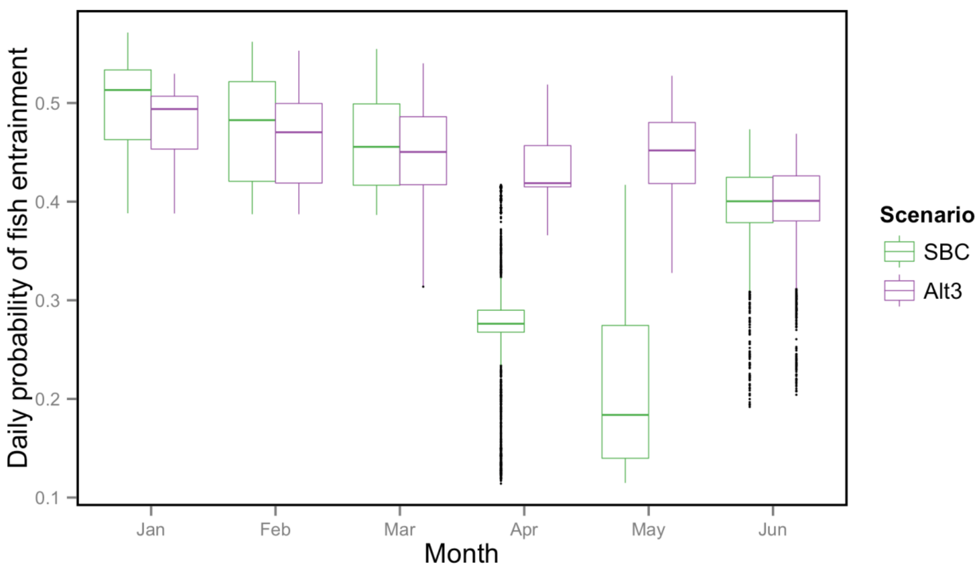


Figure 9L.12 Probability of Fish Entrainment into Old River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)



1

2 **Figure 9L.13 Probability of Fish Entrainment into Georgiana Slough under**
3 **Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)**



4

5 **Figure 9L.14 Probability of Fish Entrainment into Head of Old River under**
6 **Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)**

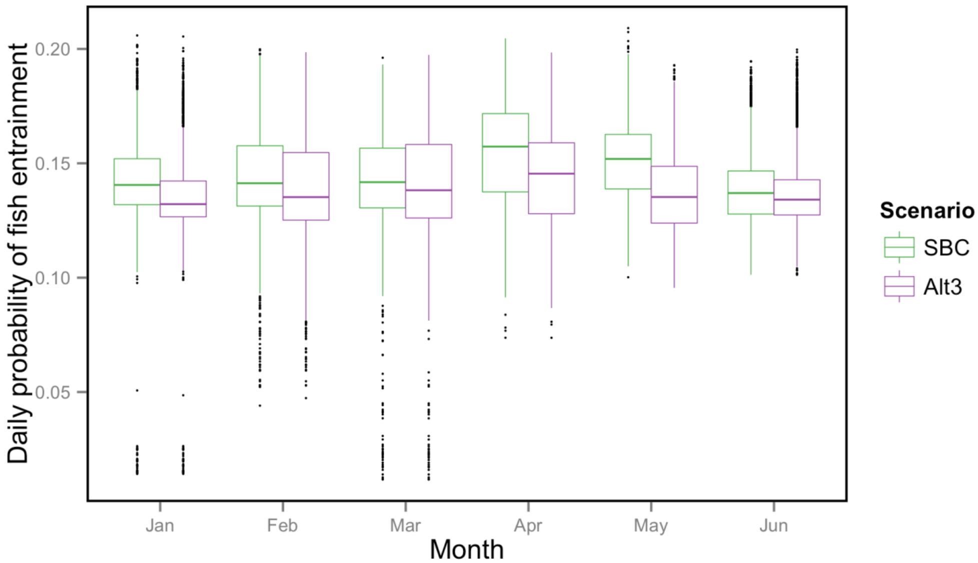


Figure 9L.15 Probability of Fish Entrainment into Turner Cut under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

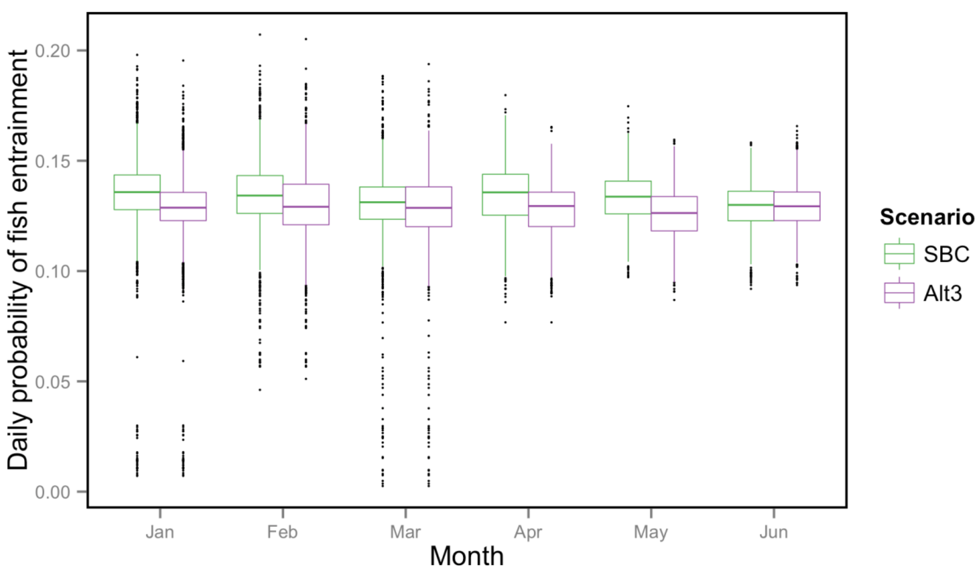


Figure 9L.16 Probability of Fish Entrainment into Columbia Cut under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

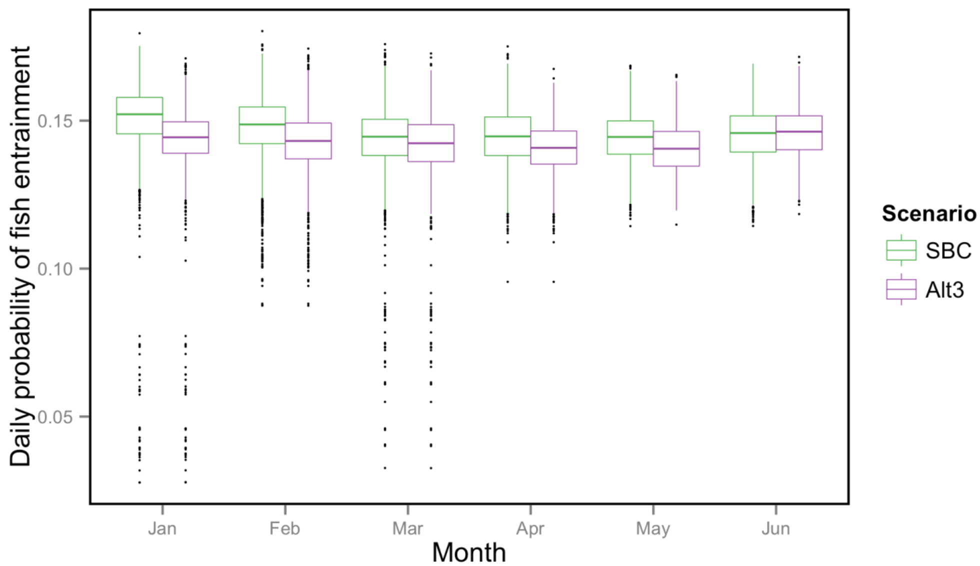


Figure 9L.17 Probability of Fish Entrainment into Middle River under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

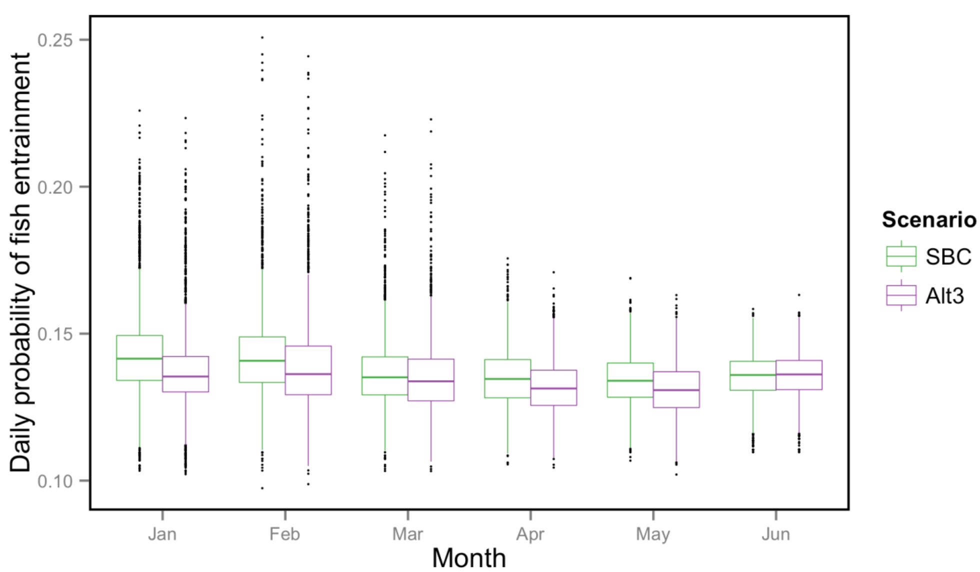


Figure 9L.18 Probability of Fish Entrainment into Old River under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

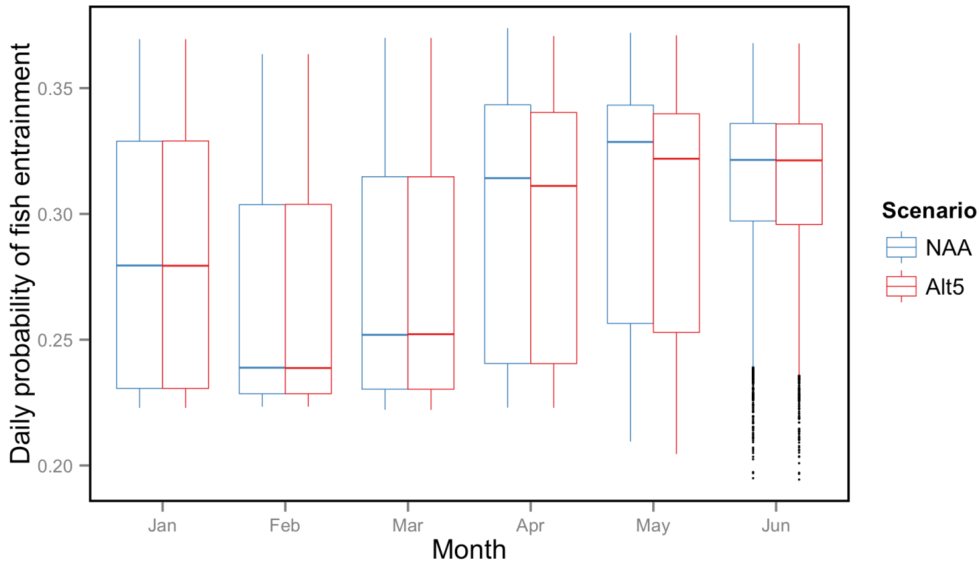


Figure 9L.19 Probability of Fish Entrainment into Georgiana Slough under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

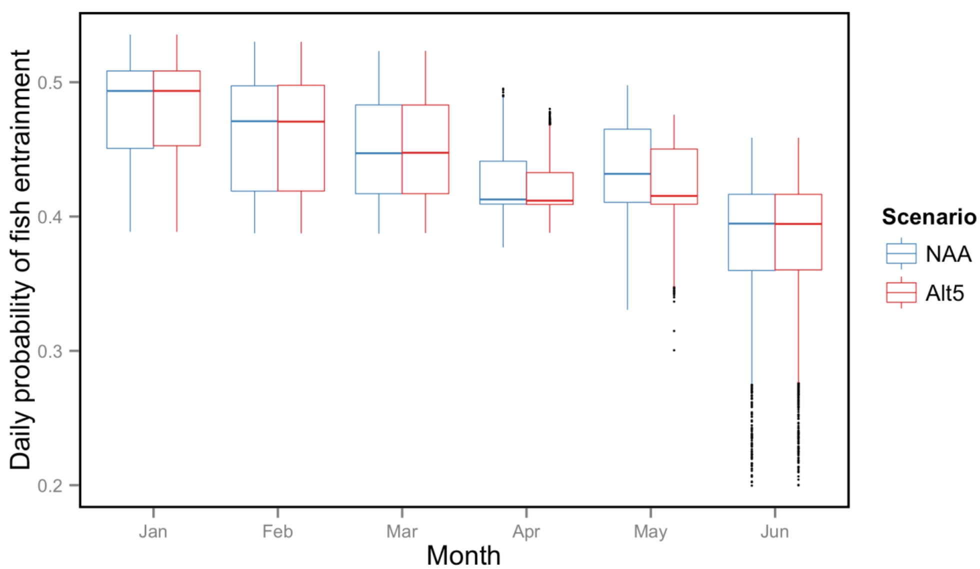


Figure 9L.20 Probability of Fish Entrainment into Head of Old River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

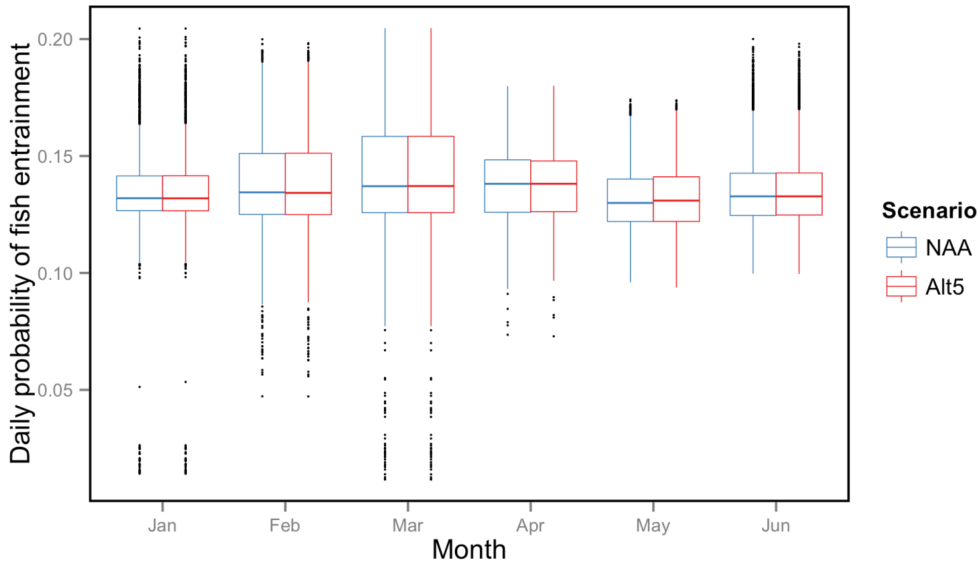


Figure 9L.21 Probability of Fish Entrainment into Turner Cut under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

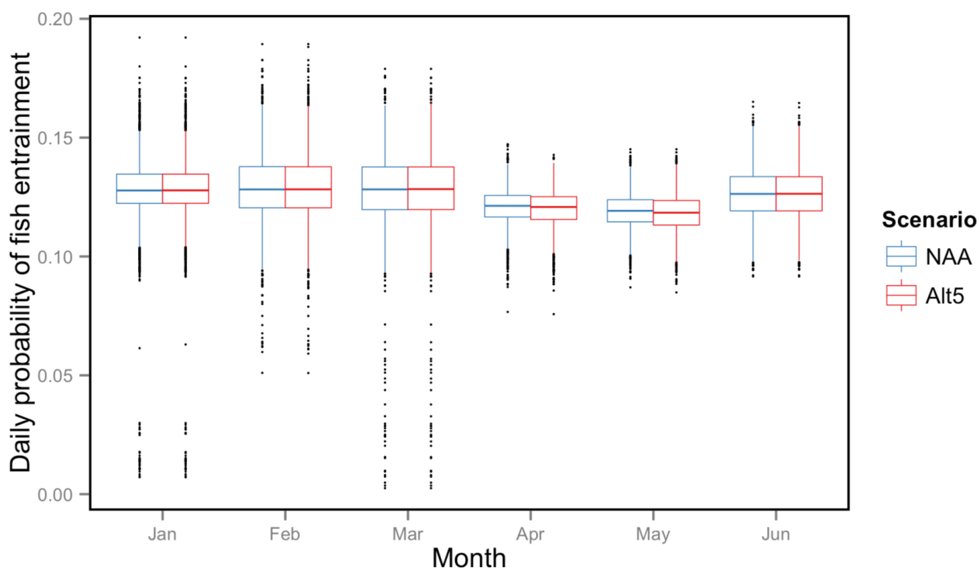


Figure 9L.22 Probability of Fish Entrainment into Columbia Cut under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

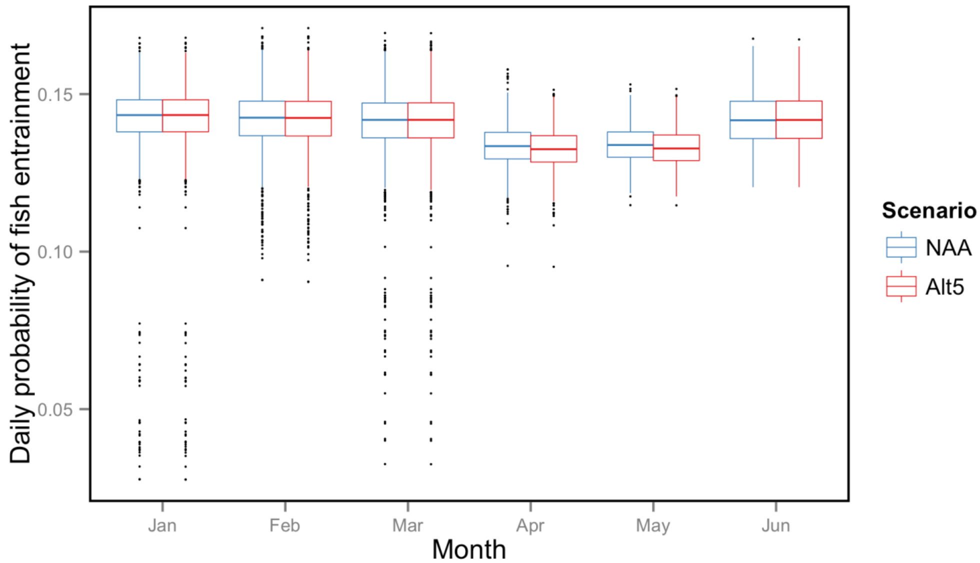


Figure 9L.23 Probability of Fish Entrainment into Middle River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

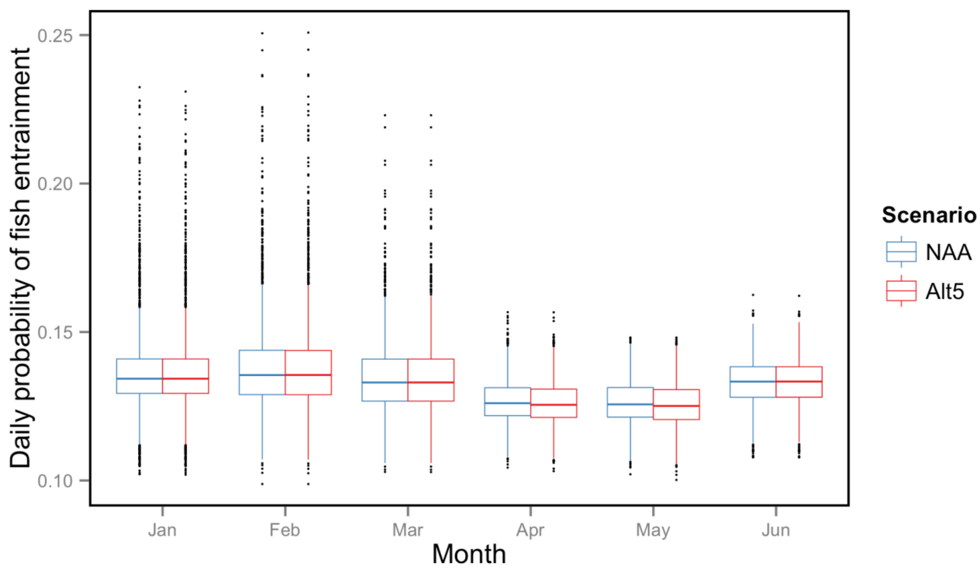


Figure 9L.24 Probability of Fish Entrainment into Old River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

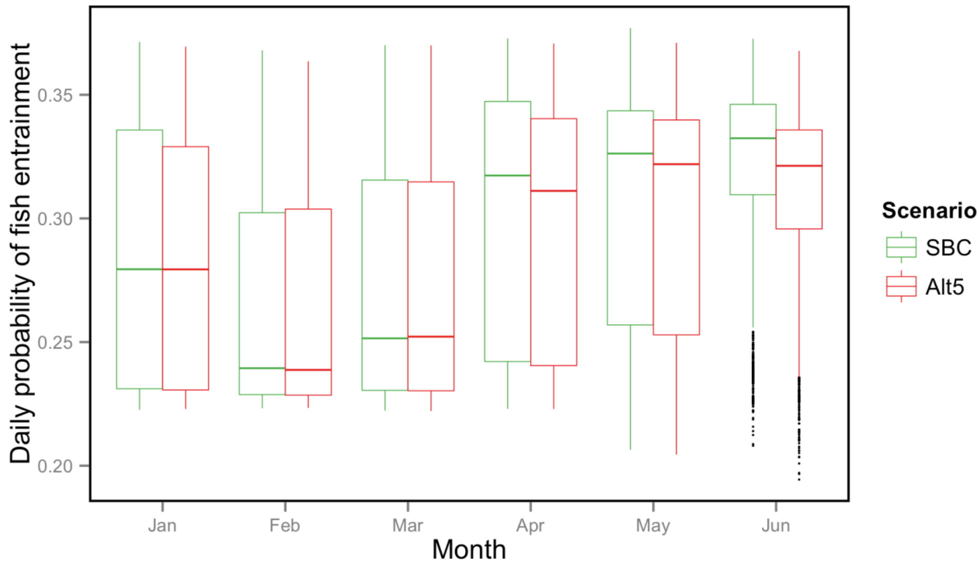


Figure 9L.25 Probability of Fish Entrainment into Georgiana Slough under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

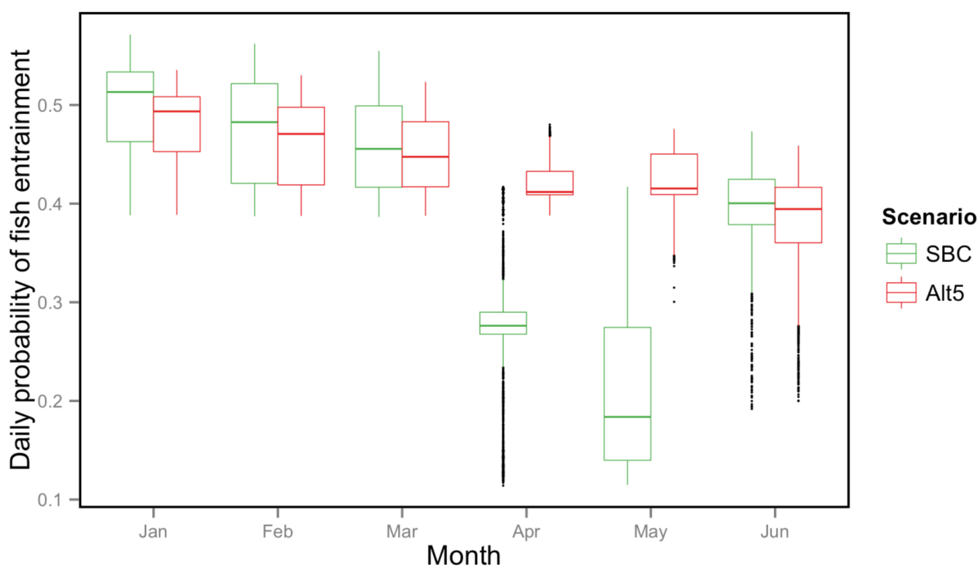


Figure 9L.26 Probability of Fish Entrainment into Head of Old River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

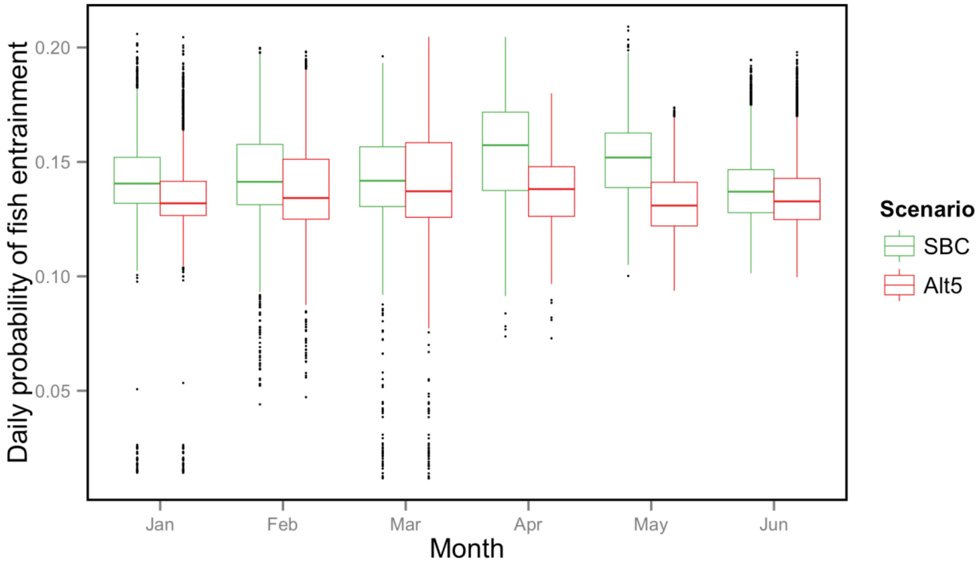


Figure 9L.27 Probability of Fish Entrainment into Turner Cut under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

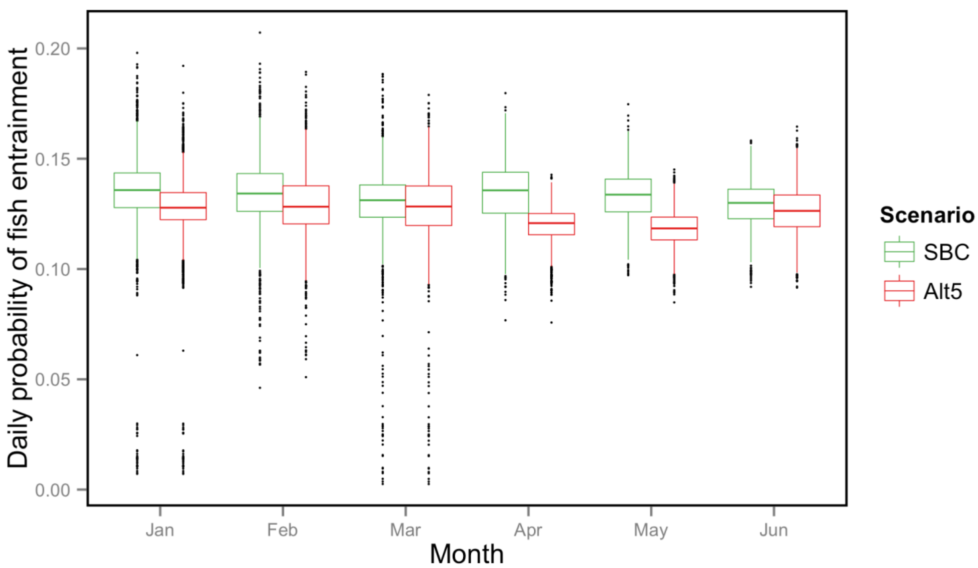


Figure 9L.28 Probability of Fish Entrainment into Columbia Cut under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

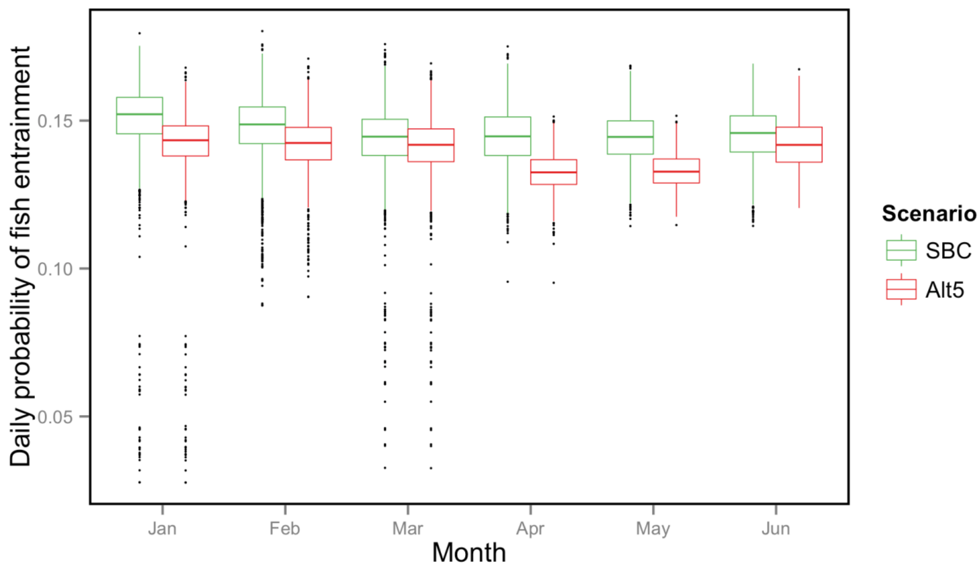


Figure 9L.29 Probability of Fish Entrainment into Middle River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

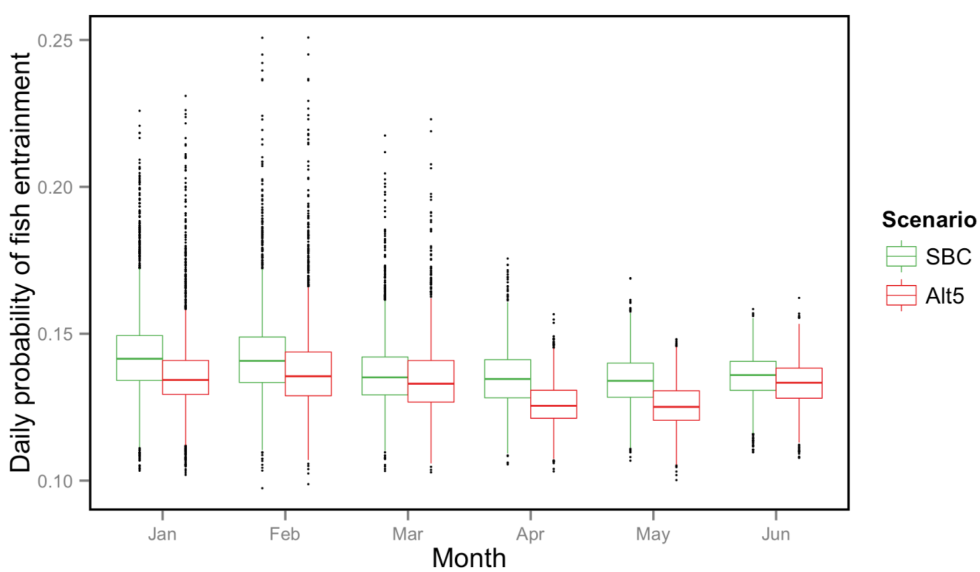


Figure 9L.30 Probability of Fish Entrainment into Old River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

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Appendix 9M

Salmonid Salvage Analysis Documentation

This appendix provides information about the methods and assumptions used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis using the Salmonid Salvage analysis. This appendix is organized in two main sections as follows:

- Section 9M.1: Salmonid Salvage Analysis Methodology and Assumptions
  - The Salmonid Salvage analysis uses the statistical relationship published in Zeug and Cavallo (2014) to estimate the proportion of Chinook Salmon juveniles predicted to be salvaged each month from January through June. This section briefly describes the approach and assumptions of the Salmonid Salvage analysis.
- Section 9M.2: Salmonid Salvage Analysis Results
  - This section presents the results of the Salmonid Salvage analysis. Results are presented in a series of figures showing the proportion of Chinook Salmon salvaged in each month.

9M.1 Salmonid Salvage Analysis Methodology and Assumptions

9M.1.1 Salmonid Salvage Analysis Methodology

Predicted monthly salvage from January through June for each scenario was estimated using statistical relationships reported in Zeug and Cavallo (2014). In that analysis, salvage at the CVP and SWP was modeled as a function of physical, biological, and hydrologic variables. The data set used for the Sacramento River was comprised of over 700 releases between 1993 and 2007, which was made up of approximately 30 million individual Chinook Salmon. Three of the four Chinook Salmon races were represented (winter, fall, and late-fall runs) in the model. The salvage of San Joaquin River origin Chinook Salmon was also modeled. However, the range of data used to construct the San Joaquin River statistical model was significantly narrower than the range of flows and exports represented in the scenarios examined in this report. Thus, only the Sacramento River model was used to predict salvage of Sacramento River-origin Chinook Salmon races.

The statistical model presented in Zeug and Cavallo (2014) included several predictors that were not well supported by the data (not found to be significant in their analysis) or were not relevant for the prediction function used in this analysis. For example, a variable of "ocean recoveries" was used by Zeug and

Cavallo (2014) to quantify the effect of salvage on future recoveries in the ocean. This variable was not relevant to the evaluation goals of the scenarios proposed herein. Thus, the statistical model was refitted using only significant and relevant predictor variables that included exports, river inflow, and fish size.

The resulting predictions of salvage probability were performed using average flow and export values in January, February, March, April, May, and June for each scenario. These flow and export values were model outputs from DSM2 and CalSim II hydrologic models. Fish size was fixed at 80 millimeter. The statistical model constructed by Zeug and Cavallo (2014) produced an estimated count of fish salvage with an offset variable that equals the number of fish in each release. To obtain a probability, the estimated count was divided by an offset variable. The probability of salvage was calculated for each week and then averaged for each month. The probability of salvage calculated by the model is independent of the number of fish available for salvage. Thus, a high probability of salvage may not be important if few fish are migrating through the delta at that time.

9M.1.2 Salmonid Salvage Analysis Scenario Assumptions

The Salmonid Salvage analysis includes the following assumptions:

- The salvage model is applicable to spring-run Chinook Salmon, although only winter, fall, and late fall run Chinook Salmon were used to construct the statistical model.
- Exclusion of non-significant or irrelevant variables has little or no effect on predicted salvage.
- Hatchery fish used in the coded wire tag experiments are salvaged at a similar rate as natural-origin fish.

9M.2 Salmonid Salvage Analysis Results

The following scenario comparisons are presented as box-whiskers plots[1] (Figures 9M.1 through 9M.5), comparing the predicted proportion of Chinook Salmon salvaged in each month over the 82-year CalSim II simulation period:

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 3 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the No Action Alternative
- Alternative 5 compared to the Second Basis of Comparison

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented separately. Model

[1] The box represents 25th and 75th percentiles, the line represents the median, and whiskers represent minimum and maximum (excluding the outliers). The outliers are defined as data points outside of 1.5 times the length of the box away from the box and are represented in points.

results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

The EIS impact analysis starts with use of the monthly CalSim II model to project CVP and SWP water deliveries. Because this regional model uses monthly time steps to simulate requirements that change weekly or change through observations, it was determined that changes in the model of 5 percent or less were related to the uncertainties in the model processing. Therefore, reductions of 5 percent or less in this comparative analysis are considered to be not substantially different, or "similar."

9M.3 Reference

Zeug SZ, Cavallo BJ. 2014. "Controls on the Entrainment of Juvenile Chinook Salmon (Oncorhynchus tshawytscha) into Large Water Diversions and Estimates of Population-level Loss." *PLoS ONE* 9(7): e101479. Doi:10.1371/journal.pone.0101479

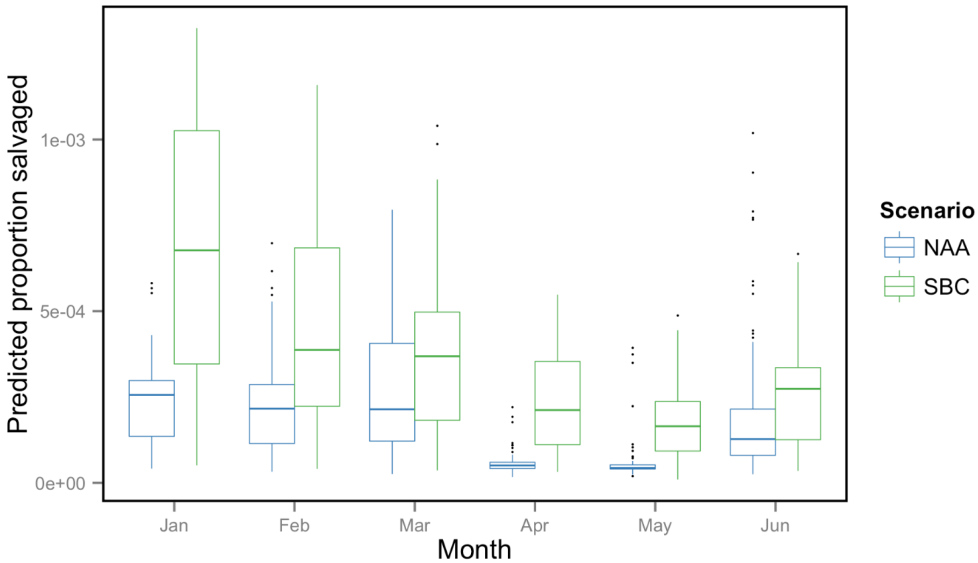

Figure 9M.1 Proportion of Chinook Salmon Salvaged in Each Month under the No Action Alternative (NAA) Compared to the Second Basis of Comparison (SBC)

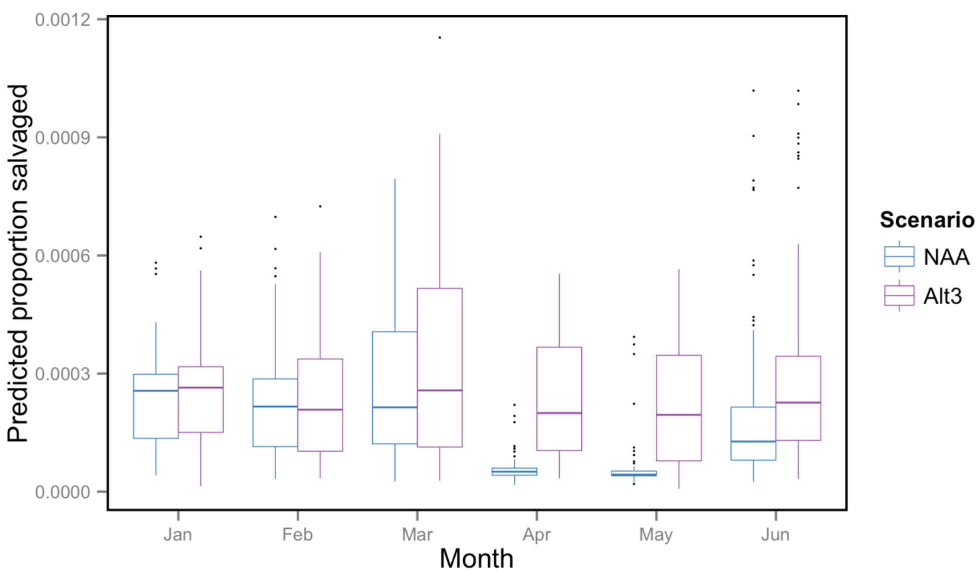

Figure 9M.2 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 3 (Alt 3) Compared to the No Action Alternative (NAA)

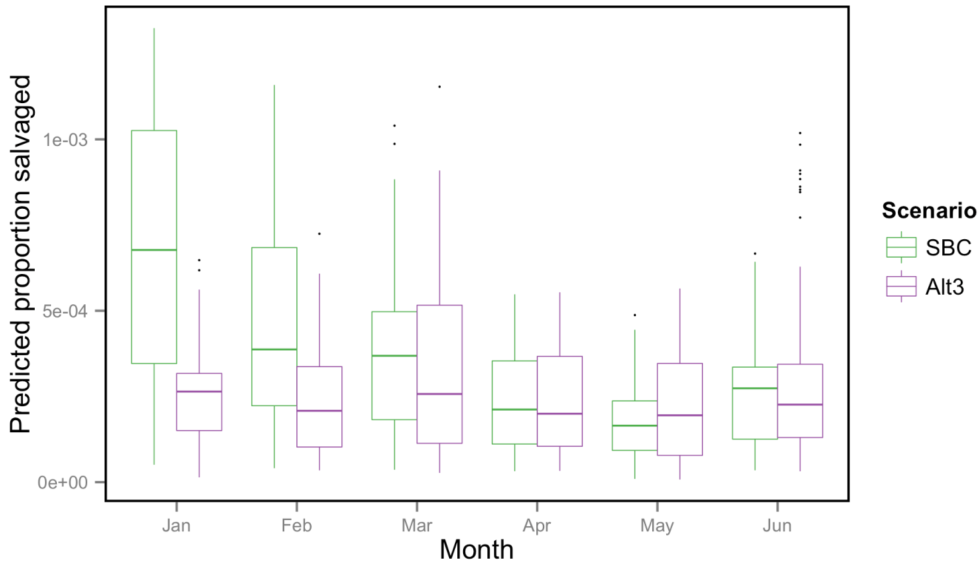

Figure 9M.3 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 3 (Alt 3) as Compared to the Second Basis of Comparison (SBC)

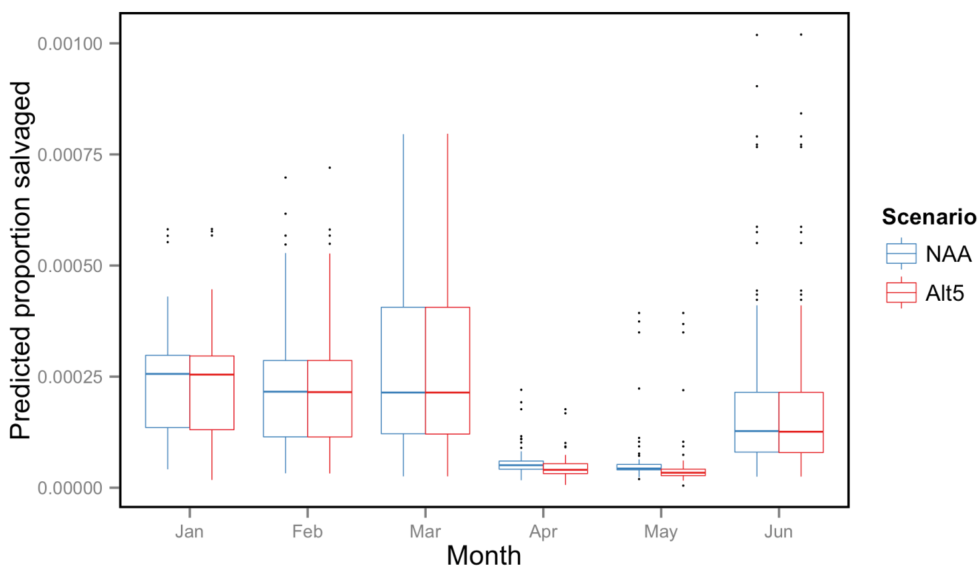

Figure 9M.4 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 5 (Alt 5) as Compared to the No Action Alternative (NAA)

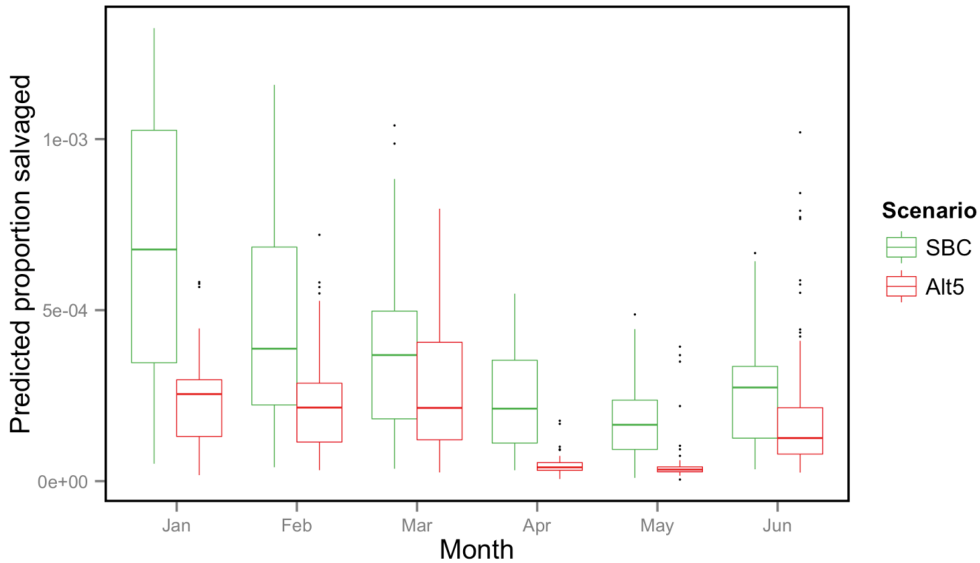

Figure 9M.5 Proportion of Chinook Salmon Salvaged in Each Month under Alternative 5 (Alt 5) as Compared to the Second Basis of Comparison (SBC)

Appendix 9N

Temperature Threshold Analysis

9N.1 Temperature Threshold Methodology and Assumptions

Monthly temperature data described in Appendix 6B were used to calculate the percentage of time (over the period 81-year simulation record) monthly temperature thresholds for different fish species and life stages were exceeded on the Trinity River, Clear Creek, Sacramento River, Feather River, American River, and Stanislaus River.

9N.2 Temperature Threshold Results

Table 9N.B.1 shows the percentage of years, over the 81-year simulation period, each of the different temperature thresholds was exceeded for the No Action Alternative, Second Basis of Comparison (Alternative 1), Alternative 3, and Alternative 5 as well as differences between the alternatives and the bases of comparison. Columns A through H describe the specific temperature threshold by species, life stage, river, reach, water year type, month, the actual temperature objective, and the reference where the target came from. Columns I through R show the threshold exceedances for each alternative and alternative comparison.

9N.3 References

DWR et al. (California Department of Water Resources, Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service). 2013. *Environmental Impact Report/ Environmental Impact Statement for the Bay Delta Conservation Plan. Draft*. December.

National Marine Fisheries Service 2009. Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project. June.

USFWS (U.S. Fish and Wildlife Service). 1999. *Trinity River Flow Evaluation. Final Report.* June.

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Table 9N.B.1. Temperature Threshold Exceedances

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Spring-Run Chinook	Holding	Trinity	Lewiston to Douglas City Bridge	All	July	60	USFWS 1999	1%	1%	0%	1%	0%	-1%	0%	0%	-1%	0%
Spring-Run Chinook	Holding	Trinity	Lewiston to Douglas City Bridge	All	August	60	USFWS 1999	2%	2%	2%	0%	0%	0%	-2%	0%	0%	-2%
Spring-Run Chinook	Spawning	Trinity	Lewiston to Douglas City Bridge	All	September	56	USFWS 1999	9%	11%	9%	7%	2%	1%	-1%	-2%	-1%	-4%
Chinook	Spawning	Trinity	Lewiston to NF confluence	All	October	56	USFWS 1999	8%	6%	6%	7%	-1%	-2%	0%	1%	-1%	1%
Coho	Spawning	Trinity	Lewiston to NF confluence	All	October	56	USFWS 1999	8%	6%	6%	7%	-1%	-2%	0%	1%	-1%	1%
Steelhead	Spawning	Trinity	Lewiston to NF confluence	All	October	56	USFWS 1999	8%	6%	6%	7%	-1%	-2%	0%	1%	-1%	1%
Chinook	Spawning	Trinity	Lewiston to NF confluence	All	November	56	USFWS 1999	2%	2%	0%	2%	0%	-2%	0%	0%	-2%	0%
Coho	Spawning	Trinity	Lewiston to NF confluence	All	November	56	USFWS 1999	2%	2%	0%	2%	0%	-2%	0%	0%	-2%	0%
Steelhead	Spawning	Trinity	Lewiston to NF confluence	All	November	56	USFWS 1999	2%	2%	0%	2%	0%	-2%	0%	0%	-2%	0%
Chinook	Spawning	Trinity	Lewiston to NF confluence	All	December	56	USFWS 1999	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Coho	Spawning	Trinity	Lewiston to NF confluence	All	December	56	USFWS 1999	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Spawning	Trinity	Lewiston to NF confluence	All	December	56	USFWS 1999	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Clear Creek	Igo	All	June	60	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Clear Creek	Igo	All	July	60	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Clear Creek	Igo	All	August	60	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Spring-Run Chinook	Rearing	Clear Creek	Igo	All	September	56	BDCP 2013	15%	13%	12%	14%	-3%	-4%	-2%	3%	-1%	1%
Spring-Run Chinook	Rearing	Clear Creek	Igo	All	October	56	BDCP 2013	12%	10%	11%	12%	-2%	-2%	0%	2%	1%	2%
Winter-Run Chinook	Egg incubation	Sacramento	Balls Ferry	All	April	56	NMFS NMFS BiOp 2009 2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Winter-Run Chinook	Egg incubation	Sacramento	Balls Ferry	All	May	56	NMFS BiOp 2009	3%	4%	4%	3%	1%	1%	0%	-1%	0%	-1%
Winter-Run Chinook	Egg incubation	Sacramento	Balls Ferry	All	June	56	NMFS BiOp 2009	6%	4%	4%	7%	-2%	-2%	1%	2%	0%	3%
Winter-Run Chinook	Egg incubation	Sacramento	Balls Ferry	All	July	56	NMFS BiOp 2009	14%	11%	11%	13%	-3%	-3%	-1%	3%	0%	2%
Winter-Run Chinook	Egg incubation	Sacramento	Balls Ferry	All	August	56	NMFS BiOp 2009	32%	28%	28%	31%	-3%	-4%	0%	3%	0%	3%
Winter-Run Chinook	Egg incubation	Sacramento	Balls Ferry	All	September	56	NMFS BiOp 2009	42%	52%	49%	41%	10%	6%	-1%	-10%	-4%	-11%
Winter-Run Chinook	Egg incubation	Sacramento	Bend Bridge	All	April	56	NMFS BiOp 2009	4%	4%	4%	4%	-1%	-1%	0%	1%	0%	1%
Winter-Run Chinook	Egg incubation	Sacramento	Bend Bridge	All	May	56	NMFS BiOp 2009	44%	42%	44%	47%	-2%	0%	3%	2%	2%	5%
Winter-Run Chinook	Egg incubation	Sacramento	Bend Bridge	All	June	56	NMFS BiOp 2009	52%	44%	44%	54%	-8%	-8%	1%	8%	0%	10%
Winter-Run Chinook	Egg incubation	Sacramento	Bend Bridge	All	July	56	NMFS BiOp 2009	55%	59%	58%	54%	4%	3%	-1%	-4%	-1%	-5%
Winter-Run Chinook	Egg incubation	Sacramento	Bend Bridge	All	August	56	NMFS BiOp 2009	89%	85%	89%	90%	-4%	0%	1%	4%	4%	5%
Winter-Run Chinook	Egg incubation	Sacramento	Bend Bridge	All	September	56	NMFS BiOp 2009	62%	90%	87%	60%	29%	26%	-1%	-29%	-3%	-30%
Green Sturgeon	Egg incubation	Sacramento	Bend Bridge	All	May	63	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Egg incubation	Sacramento	Bend Bridge	All	June	63	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Green Sturgeon	Egg incubation	Sacramento	Bend Bridge	All	July	63	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Egg incubation	Sacramento	Bend Bridge	All	August	63	BDCP 2013	7%	6%	6%	7%	-1%	-1%	0%	1%	0%	1%
Green Sturgeon	Egg incubation	Sacramento	Bend Bridge	All	September	63	BDCP 2013	12%	10%	9%	12%	-3%	-3%	-1%	3%	-1%	2%
Spring-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	October	56	BDCP 2013	82%	79%	78%	80%	-4%	-4%	-2%	4%	0%	2%
Spring-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	November	56	BDCP 2013	8%	7%	8%	7%	-1%	0%	-2%	1%	1%	-1%
Spring-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	December	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	March	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	April	56	BDCP 2013	15%	13%	14%	14%	-2%	-1%	-1%	2%	1%	1%
Fall-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	October	56	BDCP 2013	82%	79%	78%	80%	-4%	-4%	-2%	4%	0%	2%
Fall-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	November	56	BDCP 2013	8%	7%	8%	7%	-1%	0%	-2%	1%	1%	-1%
Fall-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	December	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	March	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Fall-Run Chinook	Egg incubation	Sacramento	Red Bluff	All	April	56	BDCP 2013	15%	13%	14%	14%	-2%	-1%	-1%	2%	1%	1%
Spring-Run Chinook	Spawning	Sacramento	Red Bluff	All	October	56	BDCP 2013	82%	79%	78%	80%	-4%	-4%	-2%	4%	0%	2%
Spring-Run Chinook	Spawning	Sacramento	Red Bluff	All	November	56	BDCP 2013	8%	7%	8%	7%	-1%	0%	-2%	1%	1%	-1%
Spring-Run Chinook	Spawning	Sacramento	Red Bluff	All	December	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Spawning	Sacramento	Red Bluff	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Spawning	Sacramento	Red Bluff	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Spawning	Sacramento	Red Bluff	All	March	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Spawning	Sacramento	Red Bluff	All	April	56	BDCP 2013	15%	13%	14%	14%	-2%	-1%	-1%	2%	1%	1%
Fall-Run Chinook	Spawning	Sacramento	Red Bluff	All	October	56	BDCP 2013	82%	79%	78%	80%	-4%	-4%	-2%	4%	0%	2%
Fall-Run Chinook	Spawning	Sacramento	Red Bluff	All	November	56	BDCP 2013	8%	7%	8%	7%	-1%	0%	-2%	1%	1%	-1%
Fall-Run Chinook	Spawning	Sacramento	Red Bluff	All	December	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall-Run Chinook	Spawning	Sacramento	Red Bluff	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall-Run Chinook	Spawning	Sacramento	Red Bluff	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall-Run Chinook	Spawning	Sacramento	Red Bluff	All	March	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall-Run Chinook	Spawning	Sacramento	Red Bluff	All	April	56	BDCP 2013	15%	13%	14%	14%	-2%	-1%	-1%	2%	1%	1%
White Sturgeon	Spawning	Sacramento	Hamilton City	All	March	61	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
White Sturgeon	Spawning	Sacramento	Hamilton City	All	April	61	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Spawning	Sacramento	Hamilton City	All	May	61	BDCP 2013	55%	49%	49%	56%	-6%	-6%	1%	6%	0%	7%
White Sturgeon	Spawning	Sacramento	Hamilton City	All	June	61	BDCP 2013	86%	74%	74%	87%	-13%	-13%	1%	13%	0%	13%
White Sturgeon	Spawning	Sacramento	Hamilton City	All	March	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Spawning	Sacramento	Hamilton City	All	April	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Spawning	Sacramento	Hamilton City	All	May	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Spawning	Sacramento	Hamilton City	All	June	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	March	61	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	April	61	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	May	61	BDCP 2013	55%	49%	49%	56%	-6%	-6%	1%	6%	0%	7%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	June	61	BDCP 2013	86%	74%	74%	87%	-13%	-13%	1%	13%	0%	13%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	March	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	April	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	May	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
White Sturgeon	Egg incubation	Sacramento	Hamilton City	All	June	68	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	September	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	October	56	BDCP 2013	98%	97%	97%	97%	-1%	-1%	-1%	1%	-1%	0%
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	November	56	BDCP 2013	27%	26%	26%	28%	-1%	-1%	1%	1%	-1%	2%
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	December	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	March	56	BDCP 2013	18%	20%	19%	19%	2%	1%	1%	-2%	-1%	-1%
Spring-Run Chinook	Egg incubation	Feather	Robinson Riffle	All	April	56	BDCP 2013	75%	75%	75%	75%	0%	0%	0%	0%	0%	0%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	September	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	October	56	BDCP 2013	98%	97%	97%	97%	-1%	-1%	-1%	1%	-1%	0%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	November	56	BDCP 2013	27%	26%	26%	28%	-1%	-1%	1%	1%	-1%	2%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	December	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	March	56	BDCP 2013	18%	20%	19%	19%	2%	1%	1%	-2%	-1%	-1%
Steelhead	Egg incubation	Feather	Robinson Riffle	All	April	56	BDCP 2013	75%	75%	75%	75%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	September	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	October	56	BDCP 2013	98%	97%	97%	97%	-1%	-1%	-1%	1%	-1%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	November	56	BDCP 2013	27%	26%	26%	28%	-1%	-1%	1%	1%	-1%	2%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	December	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	March	56	BDCP 2013	18%	20%	19%	19%	2%	1%	1%	-2%	-1%	-1%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	April	56	BDCP 2013	75%	75%	75%	75%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	September	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	October	56	BDCP 2013	98%	97%	97%	97%	-1%	-1%	-1%	1%	-1%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	November	56	BDCP 2013	27%	26%	26%	28%	-1%	-1%	1%	1%	-1%	2%
Steelhead	Rearing	Feather	Robinson Riffle	All	December	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%
Steelhead	Rearing	Feather	Robinson Riffle	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	February	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	March	56	BDCP 2013	18%	20%	19%	19%	2%	1%	1%	-2%	-1%	-1%
Steelhead	Rearing	Feather	Robinson Riffle	All	April	56	BDCP 2013	75%	75%	75%	75%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	May	63	BDCP 2013	60%	51%	55%	57%	-9%	-5%	-2%	9%	4%	6%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	June	63	BDCP 2013	97%	97%	97%	97%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	July	63	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Spring-Run Chinook	Rearing	Feather	Robinson Riffle	All	August	63	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	May	63	BDCP 2013	60%	51%	55%	57%	-9%	-5%	-2%	9%	4%	6%
Steelhead	Rearing	Feather	Robinson Riffle	All	June	63	BDCP 2013	97%	97%	97%	97%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	July	63	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Robinson Riffle	All	August	63	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall Chinook	Spawning	Feather	Gridley Bridge	All	October	56	BDCP 2013	98%	98%	98%	98%	-1%	-1%	0%	1%	0%	0%
Fall Chinook	Spawning	Feather	Gridley Bridge	All	November	56	BDCP 2013	26%	24%	23%	26%	-1%	-3%	0%	1%	-1%	1%
Fall Chinook	Spawning	Feather	Gridley Bridge	All	December	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%
Fall Chinook	Spawning	Feather	Gridley Bridge	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fall Chinook	Spawning	Feather	Gridley Bridge	All	February	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%
Fall Chinook	Spawning	Feather	Gridley Bridge	All	March	56	BDCP 2013	29%	28%	26%	29%	-2%	-4%	0%	2%	-2%	2%
Fall Chinook	Spawning	Feather	Gridley Bridge	All	April	56	BDCP 2013	85%	85%	85%	85%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Gridley Bridge	All	October	56	BDCP 2013	98%	98%	98%	98%	-1%	-1%	0%	1%	0%	0%
Steelhead	Rearing	Feather	Gridley Bridge	All	November	56	BDCP 2013	26%	24%	23%	26%	-1%	-3%	0%	1%	-1%	1%
Steelhead	Rearing	Feather	Gridley Bridge	All	December	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Steelhead	Rearing	Feather	Gridley Bridge	All	January	56	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Rearing	Feather	Gridley Bridge	All	February	56	BDCP 2013	1%	0%	0%	1%	-1%	-1%	0%	1%	0%	1%
Steelhead	Rearing	Feather	Gridley Bridge	All	March	56	BDCP 2013	29%	28%	26%	29%	-2%	-4%	0%	2%	-2%	2%
Steelhead	Rearing	Feather	Gridley Bridge	All	April	56	BDCP 2013	85%	85%	85%	85%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Spawning	Feather	Gridley Bridge	All	May	64	BDCP 2013	65%	56%	57%	64%	-9%	-7%	-1%	9%	1%	7%
Green Sturgeon	Spawning	Feather	Gridley Bridge	All	June	64	BDCP 2013	97%	97%	97%	97%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Spawning	Feather	Gridley Bridge	All	July	64	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Spawning	Feather	Gridley Bridge	All	August	64	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Spawning	Feather	Gridley Bridge	All	September	64	BDCP 2013	48%	83%	81%	49%	35%	33%	2%	-35%	-2%	-33%
Green Sturgeon	Egg incubation	Feather	Gridley Bridge	All	May	64	BDCP 2013	65%	56%	57%	64%	-9%	-7%	-1%	9%	1%	7%
Green Sturgeon	Egg incubation	Feather	Gridley Bridge	All	June	64	BDCP 2013	97%	97%	97%	97%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Egg incubation	Feather	Gridley Bridge	All	July	64	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Egg incubation	Feather	Gridley Bridge	All	August	64	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Egg incubation	Feather	Gridley Bridge	All	September	64	BDCP 2013	48%	83%	81%	49%	35%	33%	2%	-35%	-2%	-33%
Green Sturgeon	Rearing	Feather	Gridley Bridge	All	May	64	BDCP 2013	65%	56%	57%	64%	-9%	-7%	-1%	9%	1%	7%
Green Sturgeon	Rearing	Feather	Gridley Bridge	All	June	64	BDCP 2013	97%	97%	97%	97%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Green Sturgeon	Rearing	Feather	Gridley Bridge	All	July	64	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Rearing	Feather	Gridley Bridge	All	August	64	BDCP 2013	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Green Sturgeon	Rearing	Feather	Gridley Bridge	All	September	64	BDCP 2013	48%	83%	81%	49%	35%	33%	2%	-35%	-2%	-33%
Juvenile steelhead	Rearing	American	Watt Ave Bridge	All	May	65	BDCP 2013	31%	31%	33%	32%	0%	2%	0%	0%	2%	0%
Juvenile steelhead	Rearing	American	Watt Ave Bridge	All	June	65	BDCP 2013	56%	57%	55%	56%	1%	0%	0%	-1%	-1%	-1%
Juvenile steelhead	Rearing	American	Watt Ave Bridge	All	July	65	BDCP 2013	99%	99%	99%	99%	0%	0%	0%	0%	0%	0%
Juvenile steelhead	Rearing	American	Watt Ave Bridge	All	August	65	BDCP 2013	93%	93%	93%	94%	-1%	0%	0%	1%	1%	1%
Juvenile steelhead	Rearing	American	Watt Ave Bridge	All	September	65	BDCP 2013	89%	96%	96%	90%	7%	7%	1%	-7%	0%	-6%
Juvenile steelhead	Rearing	American	Watt Ave Bridge	All	October	65	BDCP 2013	28%	28%	30%	28%	0%	2%	0%	0%	3%	0%
Steelhead	Adult Migration	Stanislaus	Orange Blossom Bridge	All	October	56	NMFS BiOp 2009	57%	85%	87%	58%	28%	31%	2%	-28%	2%	-27%
Steelhead	Adult Migration	Stanislaus	Orange Blossom Bridge	All	November	56	NMFS BiOp 2009	33%	28%	24%	36%	-5%	-9%	3%	5%	-4%	8%
Steelhead	Adult Migration	Stanislaus	Orange Blossom Bridge	All	December	56	NMFS BiOp 2009	0%	0%	0%	3%	0%	0%	3%	0%	0%	3%
Steelhead	Smoltification	Stanislaus	Knights Ferry (*Used Below Goodwin Dam)	All	January	52	NMFS BiOp 2009	0%	2%	2%	2%	2%	2%	2%	-2%	0%	0%
Steelhead	Smoltification	Stanislaus	Knights Ferry (*Used Below Goodwin Dam)	All	February	52	NMFS BiOp 2009	0%	2%	2%	0%	2%	2%	0%	-2%	0%	-2%
Steelhead	Smoltification	Stanislaus	Knights Ferry (*Used Below Goodwin Dam)	All	March	52	NMFS BiOp 2009	8%	9%	12%	8%	1%	4%	0%	-1%	3%	-1%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Steelhead	Smoltification	Stanislaus	Knights Ferry (*Used Below Goodwin Dam)	All	April	52	NMFS BiOp 2009	33%	31%	30%	37%	-2%	-2%	5%	2%	-1%	6%
Steelhead	Smoltification	Stanislaus	Knights Ferry (*Used Below Goodwin Dam)	All	May	52	NMFS BiOp 2009	63%	66%	63%	68%	3%	0%	5%	-3%	-3%	2%
Steelhead	Smoltification	Stanislaus	Orange Blossom Bridge	All	January	57	NMFS BiOp 2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Smoltification	Stanislaus	Orange Blossom Bridge	All	February	57	NMFS BiOp 2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Smoltification	Stanislaus	Orange Blossom Bridge	All	March	57	NMFS BiOp 2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Smoltification	Stanislaus	Orange Blossom Bridge	All	April	57	NMFS BiOp 2009	2%	8%	3%	0%	6%	1%	-2%	-6%	-4%	-8%
Steelhead	Smoltification	Stanislaus	Orange Blossom Bridge	All	May	57	NMFS BiOp 2009	18%	10%	17%	8%	-8%	-1%	-11%	8%	7%	-3%
Steelhead	Spawning	Stanislaus	Orange Blossom Bridge	All	January	55	NMFS BiOp 2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steelhead	Spawning	Stanislaus	Orange Blossom Bridge	All	February	55	NMFS BiOp 2009	0%	0%	1%	0%	0%	1%	0%	0%	1%	0%
Steelhead	Spawning	Stanislaus	Orange Blossom Bridge	All	March	55	NMFS BiOp 2009	21%	16%	25%	21%	-5%	3%	-1%	5%	8%	4%
Steelhead	Spawning	Stanislaus	Orange Blossom Bridge	All	April	55	NMFS BiOp 2009	16%	34%	17%	7%	17%	1%	-9%	-17%	-16%	-26%
Steelhead	Spawning	Stanislaus	Orange Blossom Bridge	All	May	55	NMFS BiOp 2009	49%	43%	53%	40%	-5%	4%	-8%	5%	10%	-3%
Steelhead	Rearing	Stanislaus	Orange Blossom Bridge	All	June	65	NMFS BiOp 2009	6%	2%	4%	6%	-3%	-1%	0%	3%	2%	3%
Steelhead	Rearing	Stanislaus	Orange Blossom Bridge	All	July	65	NMFS BiOp 2009	16%	16%	19%	21%	-1%	3%	5%	1%	4%	6%

[1]See section 9N.C for the full reference

Species	Lifestage	River	Reach	Water Year Type	Month	Temperature Objective (Degree F)	Temperature Objective Reference[1]	No Action Alternative	Second Basis of Comparison (Alternative 1)	Alternative 3	Alternative 5	Alternative 1 minus No Action Alternative	Alternative 3 minus No Action Alternative	Alternative 5 minus No Action Alternative	No Action Alternative minus Second Basis of Comparison	Alternative 3 minus Second Basis of Comparison	Alternative 5 minus Second Basis of Comparison
Steelhead	Rearing	Stanislaus	Orange Blossom Bridge	All	August	65	NMFS BiOp 2009	15%	13%	9%	21%	-2%	-6%	6%	2%	-4%	8%
Steelhead	Rearing	Stanislaus	Orange Blossom Bridge	All	September	65	NMFS BiOp 2009	11%	10%	7%	18%	0%	-4%	8%	0%	-3%	8%
Steelhead	Rearing	Stanislaus	Orange Blossom Bridge	All	October	65	NMFS BiOp 2009	7%	8%	4%	11%	1%	-3%	4%	-1%	-4%	3%
Steelhead	Rearing	Stanislaus	Orange Blossom Bridge	All	November	65	NMFS BiOp 2009	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1]See section 9N.C for the full reference

Appendix 9O

Trap and Haul Program Background Information

Poor survival of juvenile salmonids in the Sacramento-San Joaquin Delta has been hypothesized as a major contributor to declines in the number of returning adults and may be a significant impediment to the recovery of threatened or endangered populations (NOAA 2009). Alternative 3 and Alternative 4 contain a trap and haul program for juvenile salmonids entering the Delta from the San Joaquin River, similar to the program in place on the Columbia River in Oregon. This appendix provides background information that was used in the qualitative analysis of the potential effects of a trap and haul program that would be implemented under Alternatives 3 and 4.

9O.1 Survival of Transported Versus In-river Releases

To assess the potential benefits and risks of a transportation program for salmonids in the San Joaquin River, Cramer Fish Sciences conducted an analysis of coded-wire-tag (CWT) recovery rates for Chinook salmon reared at the Feather River Hatchery and the Mokelumne River Hatchery. In certain years, fish from both hatcheries were released in-river and trucked to San Pablo Bay allowing them to bypass the Delta. Fish from these releases were implanted with CWTs at the hatchery and their adipose fin was clipped which allowed them to be identified when recaptured. Tagged fish were recovered 2 to 4 years later in the commercial and recreational ocean fishery as well as on the spawning grounds and at the hatchery of origin. The ratio of tags recovered from transported (T) releases to tags recovered from in-river (I) releases in each year was estimated to produce a metric used evaluate the transportation program. This value (T/I) is referred to as the T/I ratio. When the value of T/I is > 1 the transportation program has a net positive effect. Although fish from the Feather and Mokelumne Rivers generally do not migrate through the same route as San Joaquin River-origin fish, we assume that their response to transport is representative of Central Valley stocks.

Paired transported and in-river releases of Mokelumne River-origin Chinook occurred in 1979, 1982 and 1994-1997 whereas paired releases of Feather River Hatchery Chinook occurred from 2002-2008. In-river releases of Mokelumne-origin fish occurred at the hatchery and at Woodbridge Dam. Paired bay releases occurred at several locations in Carquinez Strait and Eastern San Pablo Bay. In-river releases of Feather River-origin fish occurred at three different locations and paired bay releases occurred in Carquinez Strait and San Pablo Bay. Transportation of Feather River-origin salmonids bypassed a maximum of ≈ 230 km of the migration route and transport of Mokelumne River-origin fish bypassed a maximum of ≈ 170 km of the migration route. Exact estimates are unknown because multiple migration routes are available to salmonids in the Delta.

Several sources of uncertainty could influence the estimate of T/I, including variation in the release site among and within years, differences in release group size, and error in the recovery process. To account for this uncertainty, a Monte Carlo resampling strategy was employed. Release and recovery data was used to inform a binomial probability distribution for each in-river and transported release and one hundred resamples were performed. For each of the 100 resamples, the recovery rate for in-river and transported releases were averaged by river and year. The minimum 25th percentile, 50th percentile, 75th percentile, maximum and mean value of T/I was then calculated for each river in each year.

The distribution of T/I ratio for Feather River-origin Chinook salmon indicated that CWT recoveries of transported fish was almost always greater than in-river releases suggesting a consistent net benefit of transportation (Table 9O.1). Mean values of the T/I ratio ranged from 1.067 to 54.567 over the 7 year period and the only value below 1.0 was the minimum estimated value for 2002 (0.996). A plot of the mean recovery rate for transported and in-river releases with the T/I values suggest that the high value in 2004 was driven by extremely low recoveries of in-river releases (Figure 9O.1).

Table 9O.1 Distribution of the Ratio of CWT Recoveries for Transported and In-river Releases (T/I) of Feather River-origin Chinook Salmon

	2002	2003	2004	2005	2006	2007	2008
Mean	1.067	2.811	54.567	2.084	1.276	2.117	1.491
Minimum	0.996	2.709	39.492	1.930	1.102	1.884	1.339
25th	1.031	2.788	50.374	2.054	1.208	2.047	1.465
Median	1.064	2.808	54.016	2.086	1.272	2.101	1.489
75th	1.096	2.839	58.105	2.121	1.332	2.178	1.514
Maximum	1.210	2.905	70.976	2.221	1.495	2.399	1.597

Note:
Values greater than 1.0 indicate a net benefit of transportation.

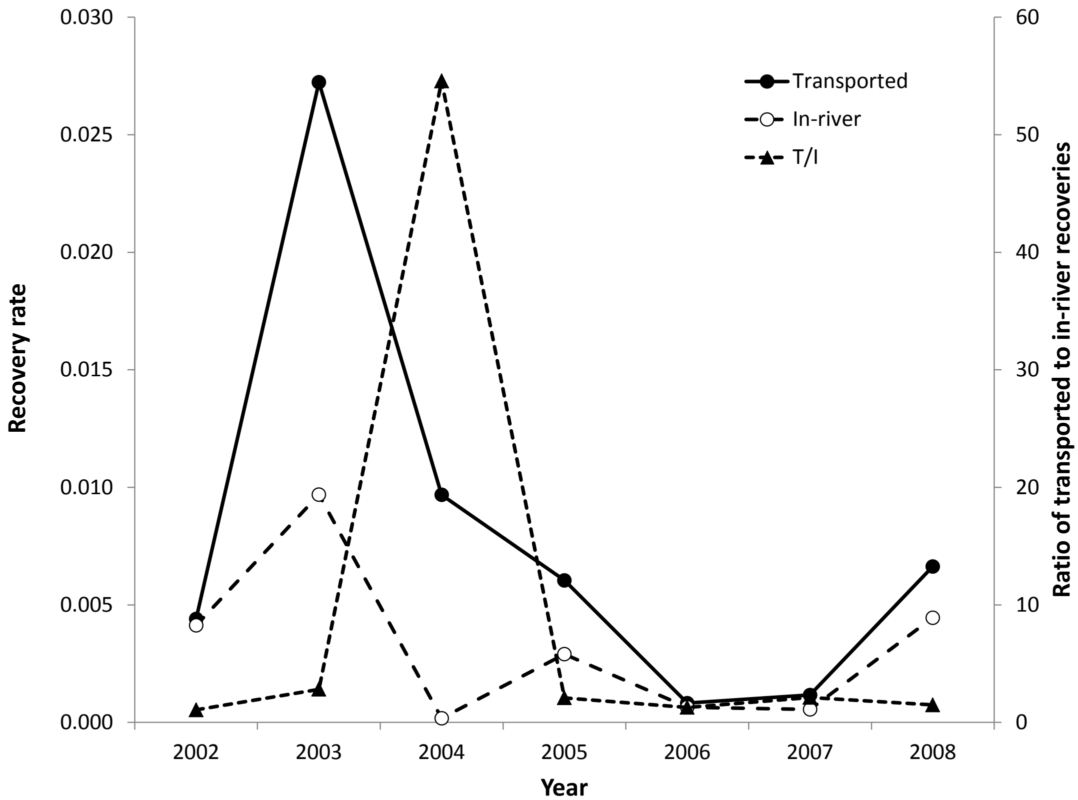

Figure 9O.1 Mean Recovery Rate of CWT Chinook Salmon Released in the Feather River and Transported to San Pablo Bay

Note: The ratio of transported to in-river recoveries (T/I) is plotted on the secondary y-axis.

Releases of Mokelume River-origin Chinook salmon followed a similar pattern to releases of Feather River-origin fish. Mean values of the T/I ratio were all above one and three years had mean values above 10.0 (Table 9O.2). A greater number of T/I values were less than 1.0 for Mokelumne releases; however all values less than one were minimum or 25th percentile values (Table 9O.2). The highest value of the T/I ratio for Mokelumne River-origin fish was greatest in the year when in river recovery rates were very low (Figure 9O.2).

Table 9O.2 Distribution of the Ratio of CWT Recoveries for Transported and In-river Releases (T/I) of Mokelumne River-origin Chinook Salmon

	1979	1982	1994	1995	1996	1997
Mean	1.78	1.23	10.88	138.18	1.01	17.07
Minimum	1.41	0.93	9.46	48.23	0.81	12.89
25th	1.68	1.15	10.30	83.93	0.95	15.69
Median	1.77	1.22	10.88	107.08	1.00	17.05
75th	1.87	1.29	11.23	173.92	1.05	18.20
Maximum	2.07	1.72	13.11	525.44	1.19	24.22

Note:
Values greater than 1.0 indicate a net benefit of transportation.

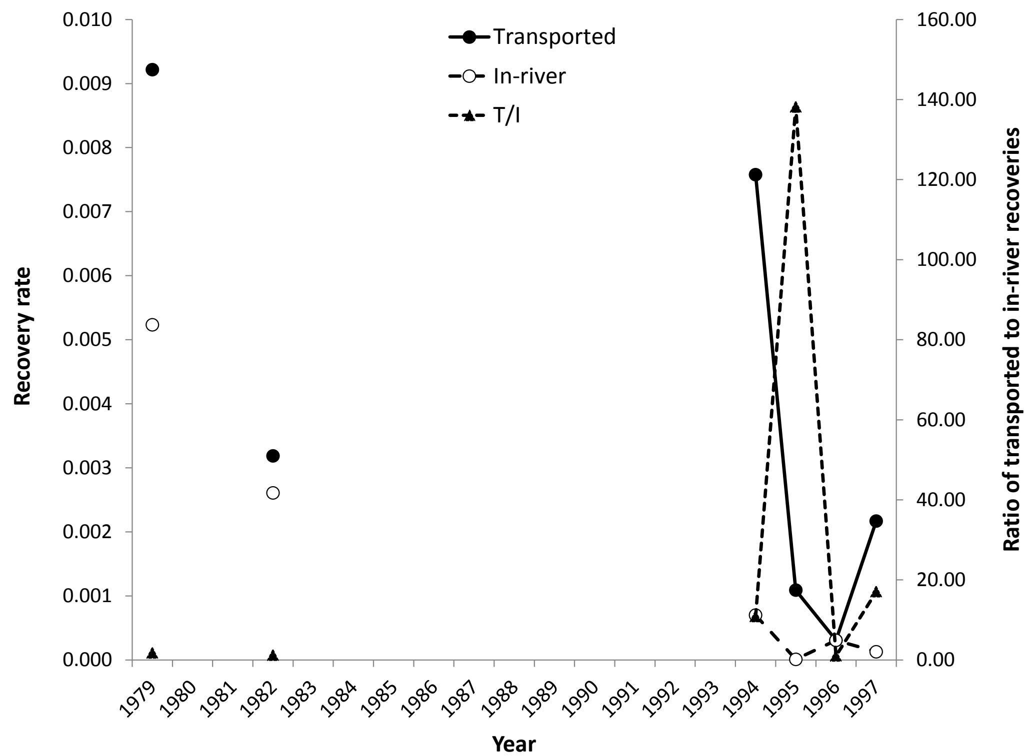

Figure 9O.2 Mean Recovery Rate of CWT Chinook Salmon Released in the Mokelumne River and Transported to San Pablo Bay

Note: The ratio of transported to in-river recoveries (T/I) is plotted on the secondary y-axis.

9O.2 Straying Rates of Transported Versus In-river Releases

One of the potential risks associated with a transportation program is an increase in the staying rates of transported fish. To estimate the straying rates of transported and in-river releases of fish from the Feather River and Mokelumne River hatcheries, CWT recoveries from spawning ground surveys and hatchery returns were used. The stray rate for each release was calculated as:

$$s = r_o/R_f$$

Where S is the estimate of straying rate, r_0 is the number of out-of-basin recoveries and R_f is the total number of freshwater recoveries.

Stray rates of transported fish was always greater than in-river releases for Feather River-origin fish (Figure 9O.3). However, from 2006-2008, stray rates increased for both transported and in-river releases. A similar pattern was observed for Mokelumne River-origin fish (Figure 9O.4). However, freshwater recoveries of Mokelumne River fish were low in all the years when paired releases of transported and in-river occurred. In 1982, there were no freshwater recoveries for either release group and until 1997, there were never more than 5 CWT recoveries of Mokelumne River-origin for any release group.

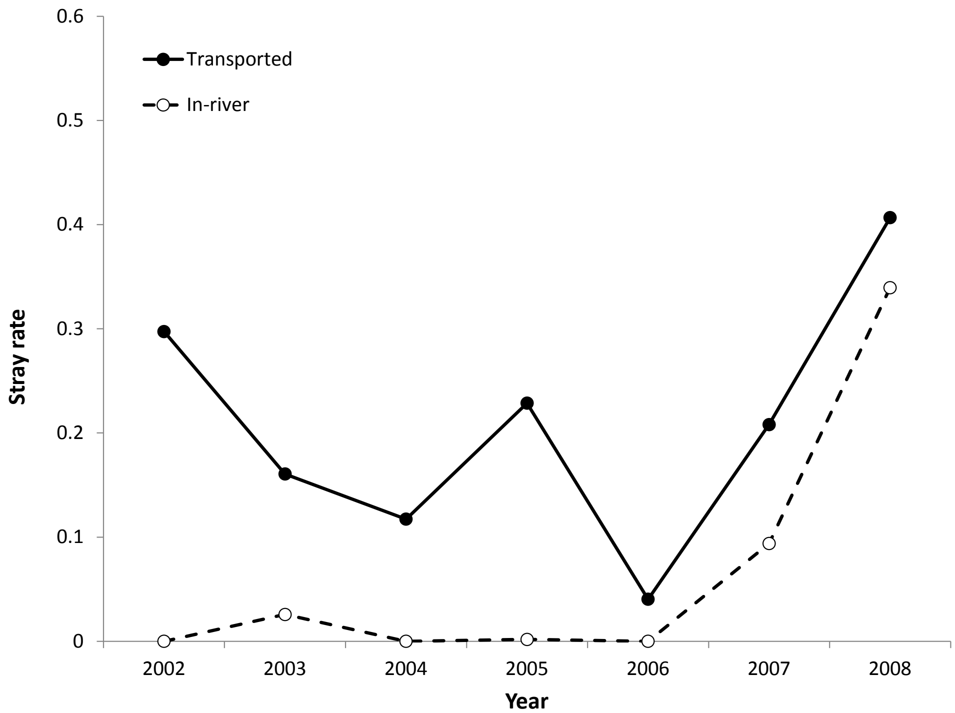

Figure 9O.3 Stray Rate of In-river and Transported Releases of Feather River-origin Chinook Salmon between 2002 and 2008

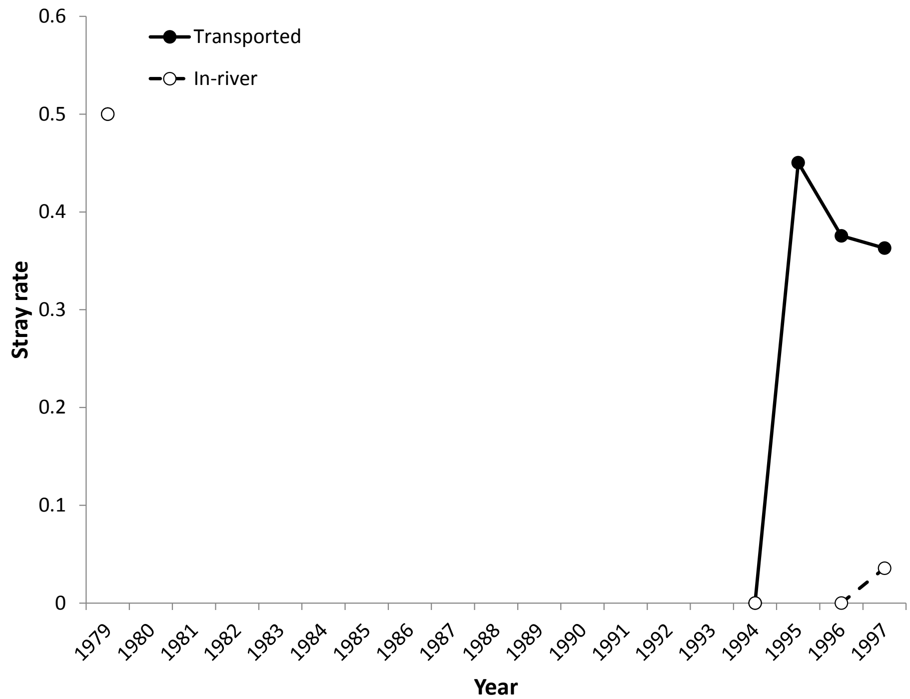

Figure 9O.4 Stray Rate of In-river and Transported Releases of Mokelumne River-origin Chinook Salmon in 1979, 1982, and 1994-1997

9O.3 References

Budy, P., G.P. Thiede, N. Bouwes, C.E. Petrosky, and H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fisheries Management, 22(1), 35-51.

Congleton, J. L., W.J. LaVoie, C.B. Schreck, and L.E. Davis. (2000). Stress indices in migrating juvenile Chinook salmon and steelhead of wild and hatchery origin before and after barge transportation. Transactions of the American Fisheries Society, 129(4), 946-961.

Appendix 9P

Sturgeon Analysis Documentation

This appendix provides information about the methods and assumptions used for the Coordinated Long Term Operation of the CVP and SWP EIS (LTO EIS) Environmental Consequences analysis of effects on Green Sturgeon and White Sturgeon. It is organized in two main sections that are briefly described below:

- Section 9P.1: Sturgeon Analysis Methodology and Assumptions
  - The LTO EIS Sturgeon Analysis uses estimated Delta outflow as a metric for evaluating the potential for effects on sturgeon. This section briefly describes the overall analytical approach and assumptions of the Sturgeon Analysis.
- Section 9P.2: Sturgeon Analysis Results
  - This section presents the results of the Sturgeon Analysis in terms of the median values for mean (March-July) Delta outflow and the likelihood of mean (March-July) Delta outflow exceeding 50,000 cubic-feet-per-second during this time period.

9P.1 Sturgeon Analysis Methodology and Assumptions

9P.1.1 Sturgeon Analysis Methodology

Estimated Delta outflow from the CalSim II model was used to analyze the potential effects on sturgeon. The evaluation method used to assess the influence of Delta outflow on sturgeon was developed using the hypothesized relationship between Delta outflow and the age-0 Year Class Index (YCI) from the Bay Study in the presentation by Gingras et al. (2014) at the annual IEP Workshop. In that presentation, the relationship between the age-0 YCI and mean Delta outflow was examined for a variety of time periods with a strong relationship shown for the period when white sturgeon are spawning and when young white sturgeon are migrating downstream (March-July). Their analysis using a generalized linear model indicated that there is threshold at about 50,000 cfs, such that year classes are generally strong when flows are above the threshold (Gingras et al. 2014).

For this analysis, the mean Delta outflow during the March to July period for each year was calculated from the CalSim II output and used as an indicator of potential year class strength. This same values were used as an indicator of the likelihood of producing a strong year class of sturgeon by examining the number of years (over the 82-year CalSim II simulation) that mean (March-July) Delta outflow would exceed a threshold of 50,000 cfs.

The hypothesized relationships between White Sturgeon and Delta outflow was used as a surrogate for Green Sturgeon. It is recognized that while White Sturgeon have unique biology and ecology compared to Green Sturgeon, the mechanisms underlying this relationship for White Sturgeon are assumed to be similar to those for Green Sturgeon. The analysis presented in this appendix does not include other mechanisms such as temperature and habitat that may influence Green Sturgeon differently than White Sturgeon. The impact analysis in Chapter 9 takes into account both temperature and Delta outflow analysis results.

9P.1.2 Sturgeon Analysis Scenario Assumptions

This section describes the assumptions for the Sturgeon analysis for the No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5.

The following CalSim II model simulations were performed as the basis of evaluating the impacts of the other alternatives:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for simulation purposes, considered the same as Second Basis of Comparison.
- Alternative 5

Assumptions for each of these alternatives were developed with the surface water modeling tools and are described in Appendix 5A Section B.

9P.2 Sturgeon Analysis Results

Results are provided for each of the following runs separately:

- No Action Alternative
- Second Basis of Comparison
- Alternative 3
- Alternative 5

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

The following results are presented in this section:

- Figure 9.P.2.1. Box-Whisker plots of mean (March-July) Delta outflow showing the mean, median, inter-quartile range, and range of values for each alternative.
- Figure 9.P.2.2. Flow exceedance graph of mean (March-July) Delta outflow over the 82-year simulation period.
- Table 9.P.2.1. Table of percent difference between the alternatives for median, long-term average, and average by water year type over the 82-year simulation period.

The impact analysis starts with use of the CalSim II model based on a monthly time step to project CVP and SWP water deliveries. Because this regional model uses monthly time steps to simulate requirements that change weekly or change through observations, it was determined that changes in the model of 5 percent or less were related to the uncertainties in the model processing. Therefore, reductions of 5 percent or less in this comparative analysis are considered to be not substantially different, or "similar."

A summary and analysis of these results for purposes of the LTO EIS Environmental Consequences is provided in Chapter 9.

9P.3 References

Gingras, M., J. DuBois, and M. Fish. 2014. *Impact of Water Operations and Overfishing on White Sturgeon*. Presentation at the IEP Annual Workshop, Folsom, CA. 27 February 2014.

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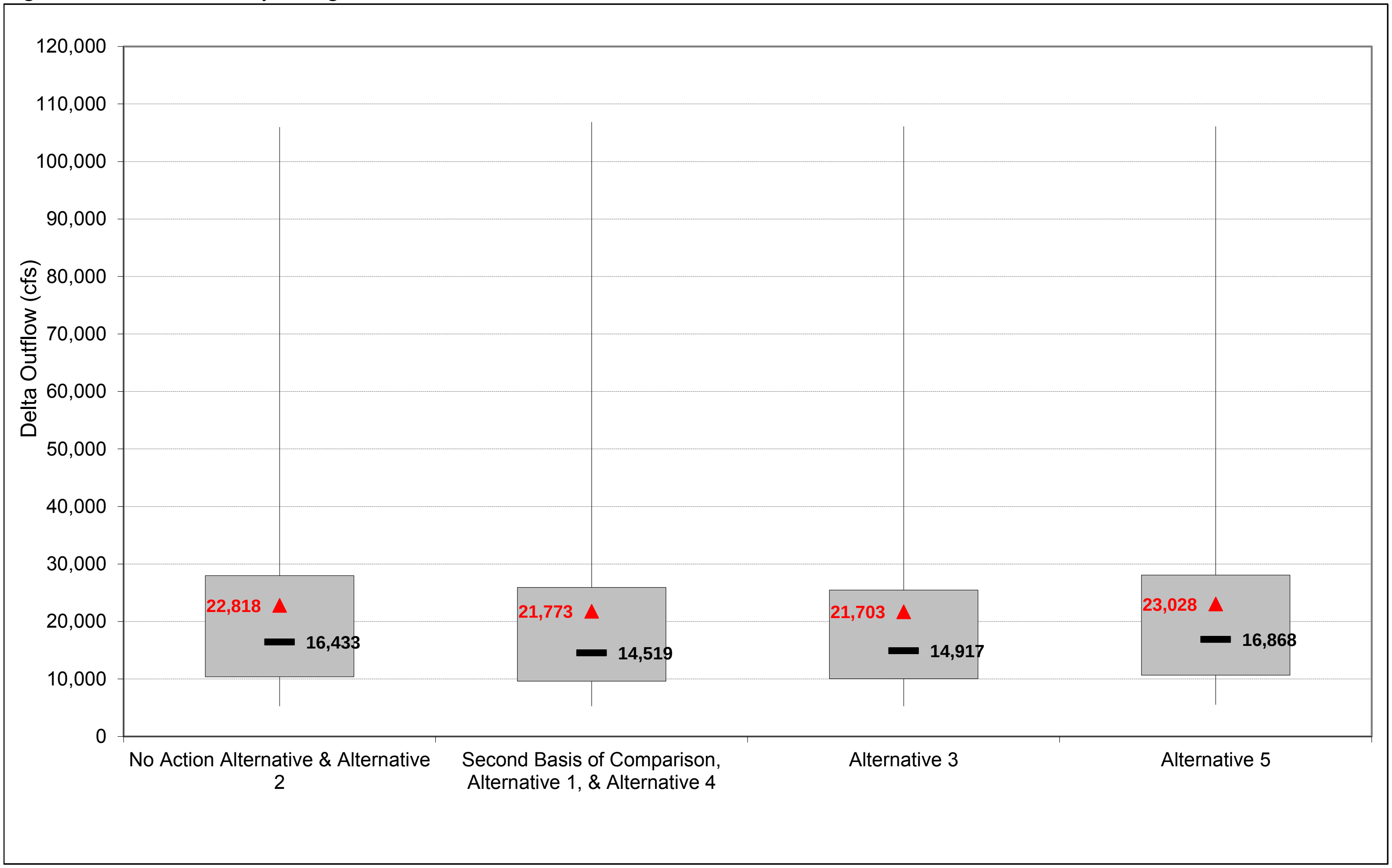
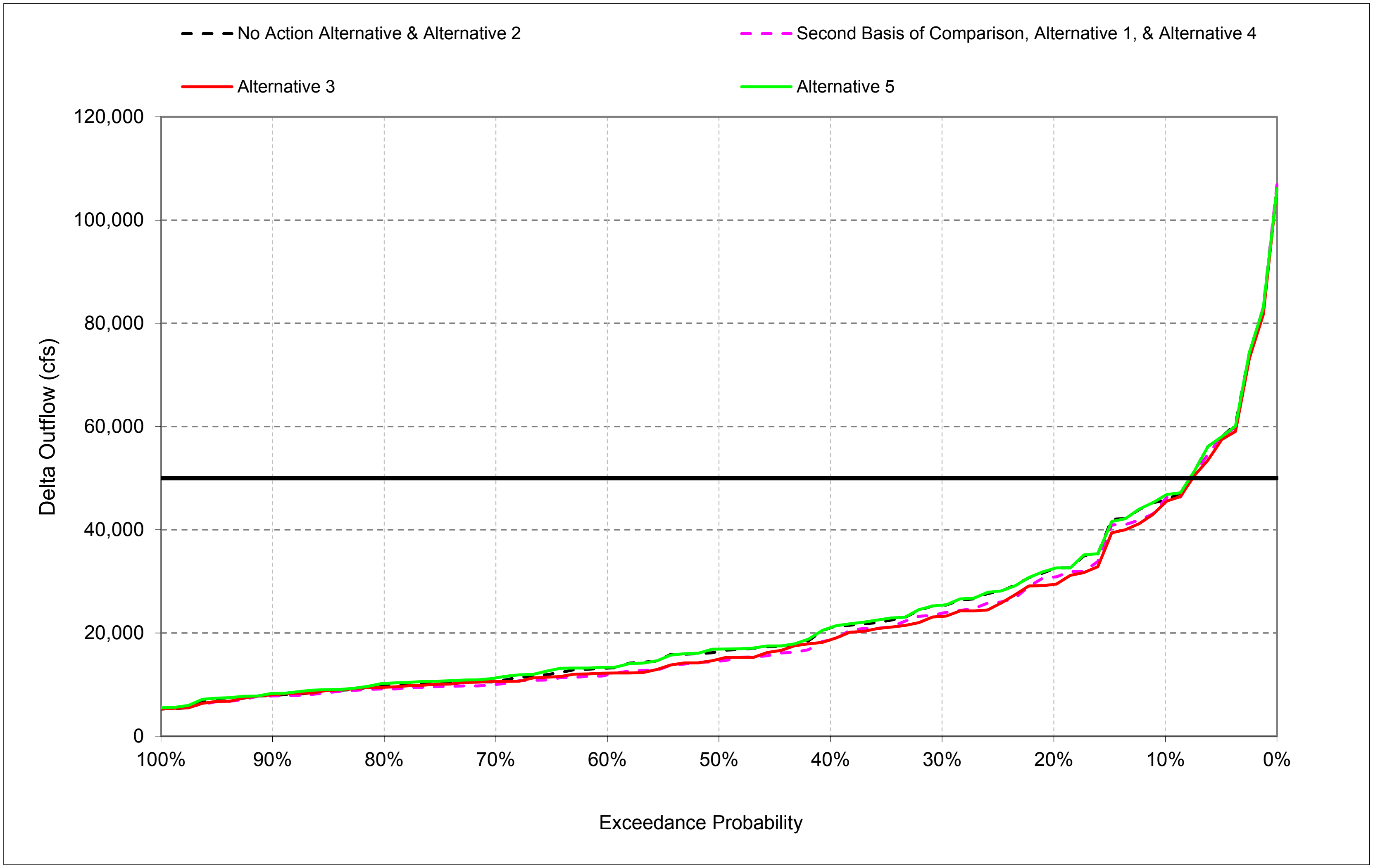
Figure 9.P.2.1. March to July Average Delta Outflow



(Box=25th to 75th percentile range, whiskers=min and max, dash=median, triangle=mean)

Notes: 1) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 2) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 3) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Figure 9.P.2.2. March to July Average Delta Outflow



Notes: 1) Exceedance probability is defined as the probability a given value will be exceeded in any one year. 2) All alternatives are simulated with projected hydrology and sea level at Year 2030 conditions. 3) Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternatives 1 and 4 results are not presented. Qualitative differences, if applicable, are discussed in the text. 4) Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented. Qualitative differences, if applicable, are discussed in the text.

Table 9.P.2.1. March to July Average Delta Outflow

	Delta Outflow	Difference from No Action Alternative	Difference from Second Basis of Comparison	% Difference from No Action Alternative	% Difference from Second Basis of Comparison
	cfs	cfs	cfs	Percentage	Percentage
No Action Alternative					
Median	16,433	---	1,914	---	13%
Long-term Average	22,818	---	1,045	---	5%
Wet	40,999	---	1,238	---	3%
Above Normal	24,745	---	1,364	---	6%
Below Normal	12,755	---	961	---	8%
Dry	12,584	---	1,011	---	9%
Critical	7,620	---	418	---	6%
Second Basis of Comparison					
Median	14,519	-1,914	---	-12%	---
Long-term Average	21,773	-1,045	---	-5%	---
Wet	39,761	-1,238	---	-3%	---
Above Normal	23,382	-1,364	---	-6%	---
Below Normal	11,794	-961	---	-8%	---
Dry	11,573	-1,011	---	-8%	---
Critical	7,202	-418	---	-5%	---
Alternative 3					
Median	14,917	-1,516	398	-9%	3%
Long-term Average	21,703	-1,115	-70	-5%	0%
Wet	39,126	-1,873	-635	-5%	-2%
Above Normal	23,150	-1,595	-231	-6%	-1%
Below Normal	11,975	-780	182	-6%	2%
Dry	11,997	-586	425	-5%	4%
Critical	7,475	-144	274	-2%	4%
Alternative 5					
Median	16,868	435	2,350	3%	16%
Long-term Average	23,028	210	1,255	1%	6%
Wet	41,065	66	1,304	0%	3%
Above Normal	24,826	81	1,445	0%	6%
Below Normal	12,977	221	1,183	2%	10%
Dry	12,962	379	1,389	3%	12%
Critical	7,989	370	788	5%	11%

Notes: All results are based on the 82-year simulation period. The water year types are defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999); projected to Year 2030.

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Appendix 10A

Special-Status Terrestrial Species

Tables 10A.1 and 10A.2 list special-status wildlife and plant species that occur within the study area and could be affected by changes under Alternatives 1 through 5 as compared to the No Action Alternative and Second Basis of Comparison. These changes could occur with the Central Valley Project and State Water Project operations or ecosystem restoration activities, and the potential for impacts is based on the likelihood of operational changes or restoration actions affecting suitable habitat for the listed species in the defined area of analysis.

The area of analysis for operational changes includes open water areas of reservoirs, rivers, and creeks; adjacent riparian vegetation; wetlands supported by these water bodies; potential restoration areas in Yolo Bypass and Suisun Marsh.

Species are presented in alphabetical order based on scientific name.

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Table 10A.1 Special-Status Wildlife Species

Common Name	Scientific Name	Status Federal/State/ CDFW*	Habitat/Distribution	Areas with Potential for Occurrence	Impact Potential
Burrowing Owl (nesting and wintering sites)	*Athene cunicularia*	--/--/SSC	Nests and forages in grasslands, shrub lands, deserts, and agricultural fields, especially where ground squirrel burrows are present. Occurs near New Melones Reservoir. Unlikely to occur along the Sacramento River corridor due to a lack of suitable nesting habitat. Known to occur in suitable habitat in the Yolo Bypass, in the Chowchilla Bypass, on the San Luis NWR complex, and at Mendota Pool.	Sacramento, Feather, American, Yolo, Stanislaus, San Joaquin, Delta, San Luis	Low potential to be affected by restoration in Yolo Bypass.
Swainson's Hawk (nesting)	*Buteo swainsoni*	BCC/T/--	Nests in riparian woodlands, roadside trees, tree rows, isolated trees, woodlots, and trees in farmyards and rural residences. Forages in grasslands and agricultural fields in Central Valley. Occurs near New Melones Reservoir. Known to nest in suitable habitat on the San Luis NWR complex and Great Valley Grasslands State Park and other areas along the San Joaquin River. Suitable nesting and foraging habitat is present along Sacramento River.	Sacramento, Feather, American, Yolo, San Joaquin, Stanislaus, Delta, San Luis	Low potential to be affected by changes in foraging habitat in agricultural areas influenced by operations; low potential for nesting habitat to be affected by operational changes in flow.
Western Yellow-billed Cuckoo (nesting)	*Coccyzus americanus occidentalis*	T/E/--	Densely foliaged, deciduous trees and shrubs, especially willows, required for roosting sites. An uncommon to rare summer resident of valley foothill and desert riparian habitats in scattered locations in California. Breeding pairs known from Sacramento Valley. Reclamation (2010) concluded this species could potentially occur near New Melones Reservoir. Detected by BDCP surveys in 2009 near Walnut Grove. Likely to nest and forage in the upper Sacramento River area.	Trinity, Clear Creek, Sacramento, Feather, Delta, New Melones, San Joaquin	Low potential for operations to affect riparian vegetation used for nesting by this species.
Valley Elderberry Longhorn Beetle	*Desmocerus californicus dimorphus*	T/--/--	Found only in association with its host plant, blue elderberry (*Sambucus mexicana*). In the Central Valley, the elderberry shrub is found primarily in riparian vegetation. Known to occur in elderberry shrubs present in the riparian woodland and expected to occur in suitable habitat in other locations along the San Joaquin River. Recorded at Caswell Memorial State Park and other locations along the Stanislaus River.	Trinity, Sacramento, Feather, American, San Joaquin, Stanislaus, Delta, San Luis	Low potential to be affected by changes in flow that influence riparian vegetation.
Greater Sandhill Crane (nesting and wintering)	*Grus canadensis tabida*	FS/T/FP	Eight distinct wintering locations in the Central Valley from Chico/Butte Sink on the north to Pixley National Wildlife Refuge near Delano on the south, with more than 95 percent occurring within the Sacramento Valley between Butte Sink and the Delta. Unlikely to breed in the upper Sacramento River area. Known to occur during winter in suitable habitat on the San Luis NWR complex, along the San Joaquin River, and in the Delta.	Sacramento, Feather, Yolo, San Joaquin	Low potential to be affected by restoration in the Yolo Bypass and changes in operations that influence crop patterns.
Bald Eagle (nesting and wintering)	*Haliaeetus leucocephalus*	--/E/FP	Requires large bodies of water or free-flowing rivers with abundant fish and adjacent snags or other perches for foraging. Occurs near New Melones Reservoir, Whiskeytown Lake, Trinity Lake, and Lewiston Reservoir. Known to nest in suitable habitat around Lake Millerton and in the Chowchilla Bypass.	Trinity, Clear Creek, Shasta, Sacramento, Feather, American, Yolo, Stanislaus, San Joaquin, Delta, San Luis	Low potential to be affected by changes in elevation at reservoirs.
California Black Rail	*Laterallus jamaicensis coturniculus*	BCC/T/FP	Tidal marshes in the northern San Francisco Bay estuary, Tomales Bay, Bolinas Lagoon, the Delta, Morro Bay, the Salton Sea, and the lower Colorado River. Found recently at several inland freshwater sites in the Sierra Nevada foothills in Butte, Yuba, and Nevada counties, the Cosumnes River Preserve in south Sacramento County, and Bidwell Park in Chico, Butte County.	Delta	Low potential to be affected by tidal marsh restoration.
California Ridgeway's Rail	*Rallus longirostris obsoletus*	E/E/FP	Dense marshy areas of the Bay-Delta region and Suisun Marsh.	Delta, Suisun	Low potential to be affected by tidal marsh restoration.
Salt Marsh Harvest Mouse	*Reithrodontomys raviventris*	E/E/FP	Found only in saline emergent wetlands of San Francisco Bay and its tributaries. Pickleweed saline emergent wetland is preferred habitat, where it may be locally common. Grasslands adjacent to pickleweed marsh are used, but only when new grass growth affords suitable cover in spring and summer. Reported occurrences of the salt marsh harvest mouse from within the Delta are restricted to salt and brackish tidal marshes along the northern edge of the Sacramento River and the southern edge of the San Joaquin River as far east as the vicinity of Collinsville and Antioch, west of Sherman Island	Delta, Suisun	Low potential to be affected by tidal marsh restoration and changes in water quality that influence habitat suitability.

Common Name	Scientific Name	Status Federal/State/ CDFW*	Habitat/Distribution	Areas with Potential for Occurrence	Impact Potential
Bank Swallow (nesting)	*Riparia riparia*	--/T/--	Neotropical migrant found primarily in riparian and other lowland habitats in California west of the deserts during the spring-fall period. In summer, restricted to riparian, lacustrine, and coastal areas with vertical banks, bluffs, and cliffs with fine-textured or sandy soils, into which it digs nesting holes. Approx. 75% of the current breeding population in California occurs along banks of the Sacramento and Feather rivers in the northern Central Valley.	Trinity, Clear Creek, Sacramento, Feather, American, Yolo, New Melones, San Joaquin, Delta	Low potential to be affected by operational changes that influence flows adjacent to nesting sites.
Giant Garter Snake	*Thamnophis gigas*	T/T/--	Marshes, ponds, sloughs, small lakes, low-gradient streams, and other waterways, and in agricultural wetlands, including irrigation and drainage canals, rice fields, and adjacent uplands. Current distribution extends from near Chico in Butte County south to the Mendota Wildlife Area in Fresno County. Known from White Slough/Caldoni Marsh and Yolo Basin/Willow Slough. Known to occur in suitable habitat on the San Luis NWR complex and in the Mendota Wildlife Area; reported from Mendota Pool.	Sacramento, Feather, American, Yolo, Delta, San Joaquin	Low potential to be affected by restoration in Yolo Bypass and operational changes that influence the acreage in rice production.
Tricolored Blackbird (nesting colony)	*Agelaius tricolor*	BCC/--/SSC	Nests colonially in tules, cattails, willows, thistles, blackberries, and other dense vegetation. Forages in grasslands and agricultural fields. Reclamation (2010) concluded this species occurs near New Melones Reservoir. Suitable nesting and foraging habitat is present in the upper Sacramento River area. Known to occur in suitable habitat on the San Luis NWR complex and other sites in the Yolo Bypass.	Sacramento, Feather, Yolo, American, Delta, Stanislaus.	Low potential to be affected by restoration activities in the Yolo Bypass.
Tule Greater White-fronted Goose (wintering)	*Anser albifrons elgasi*	--/--/SSC	Winters in California. Associates with dense tule–cattail marsh habitat. Has been documented near Sherman Island and at various locations in the Suisun Marsh. Winters at Sacramento Valley wildlife refuges and surrounding rice fields, Suisun Marsh, and Grizzly Island Wildlife Area.	Sacramento, Delta, Suisun	Low potential to be affected by restoration activities that increase inundated floodplain or flooded agricultural fields (e.g., winter flooding of rice fields).
Short-eared Owl (nesting)	*Asio flammeus*	--/--/SSC	Widespread winter migrant, found primarily in the Central Valley, in the western Sierra Nevada foothills, and along the coastline. Usually found in open areas with few trees, such as annual and perennial grasslands, prairies, dunes, meadows, irrigated lands, and saline and fresh emergent wetlands. Occasionally still breeds in northern California. Known to occur in suitable habitat on the San Luis NWR complex, where it possibly also nests. Breeding range includes coastal areas in Del Norte and Humboldt counties, the San Francisco Bay Delta, northeastern Modoc plateau, the east side of the Sierra from Lake Tahoe south to Inyo County, and the San Joaquin Valley	Sacramento, Feather, Yolo, Delta, Suisun, San Joaquin	Low potential for changes in acreage of agricultural land and cropping patterns to affect this species.
Ringtail	*Bassariscus astutus*	--/--/FP	Wooded and brushy areas, especially near water courses. Species distribution not well known. Potentially suitable habitat is present along the Sacramento River corridor.	Shasta, Sacramento, Feather, Delta, San Joaquin	Low potential for operational changes to affect riparian vegetation used for habitat by this species.
Conservancy Fairy Shrimp	*Branchinecta conservatio*	E/--/--	Large vernal pools and seasonal wetlands, ~ 1 acre in size. Known to occur in suitable habitat on the San Luis NWR complex, Eastside Bypass, and along the San Joaquin River. Currently found in disjunct and fragmented habitats across the Central Valley of California from Tehama County to Merced County and at two Southern California locations on the Los Padres National Forest in Ventura County.	Sacramento, Feather, Yolo, San Joaquin, Delta	Low potential to be affected by restoration activities that influence vernal pools.
Longhorn Fairy Shrimp	*Branchinecta longiantenna*	E/--/--	Vernal pool/seasonal wetlands. Known distribution extends from Contra Costa and Alameda counties to San Luis Obispo County and also includes Merced County. Within this geographic range, it is extremely rare in vernal pools and swales. Known to occur in suitable habitat on the San Luis NWR complex.	Delta, San Joaquin	Low potential to be affected by restoration activities that influence vernal pools.
Vernal Pool Fairy Shrimp	*Branchinecta lynchi*	T/--/--	Typically inhabits vernal pools and seasonal wetlands less than 200 m^2 and less than 5 cm deep; may also occur in larger, deeper pools. Known to occur in suitable habitat on the San Luis NWR.	Sacramento, Feather, Yolo, American, Delta, San Joaquin	Low potential to be affected by restoration activities that influence vernal pools.
Black Tern	*Childonias niger*	--/--/SSC	Nests in freshwater marsh, forages for fish and insects in open water, rice fields, and marsh. Uncommon visitor in suitable habitat in the area of analysis; expected during the nonbreeding season along the San Joaquin River.	Sacramento, Feather, Yolo, San Joaquin, Delta	Low potential to be affected by restoration or changes in acreage of irrigated agriculture and cropping patterns.

Common Name	Scientific Name	Status Federal/State/ CDFW*	Habitat/Distribution	Areas with Potential for Occurrence	Impact Potential
Yellow Warbler (nesting)	*Dendroica petechia brewsteri*	BCC/--/SSC	Nests in riparian woodland and riparian scrub habitats. Forages in a variety of wooded and shrub habitats during migration. Reclamation (2010) concluded this species occurs near New Melones Reservoir. No recent nesting records, but potential nesting habitat present; known to occur during migration in suitable habitat on the San Luis NWR. Could nest and forage in the upper Sacramento River area. Likely to use riparian woodlands during migration.	Trinity, Clear Creek, Shasta, Sacramento, Feather, New Melones, San Joaquin	Low potential to be affected by operational flow changes that influence riparian vegetation.
White-tailed Kite (nesting)	*Elanus leucurus*	--/--/FP	Nests in woodlands and isolated trees; forages in grasslands, shrub lands and agricultural fields. Common to uncommon and a year-round resident in the Central Valley, in other lowland valleys, and along the entire length of the coast. Recent surveys in Yolo and Sacramento counties have documented active nest sites in riparian habitats in the Yolo Bypass and along Steamboat and Georgiana sloughs and along the Sacramento River. Suitable nesting and foraging habitat is present along the upper Sacramento River. Expected to occur in suitable habitat along San Joaquin River and in Yolo Bypass.	Shasta, Sacramento, Feather, Yolo, American, San Joaquin, Delta, San Luis	Low potential to be impacted by restoration actions in Yolo Bypass or operational changes that influence riparian vegetation.
Delta Green Ground Beetle	*Elaphrus viridis*	T/--/--	Associated with vernal pool habitats, seasonally wet pools that accumulate in low areas with poor drainage, which occur throughout the Central Valley. Presently known to occur only in Solano County northeast of the San Francisco Bay Area.	Delta	Low potential to be affected by restoration activities that influence vernal pools.
Western Pond Turtle	*Emmys marmorata*	--/--/SSC	Inhabits slow-moving streams, sloughs, ponds, irrigation and drainage ditches, and adjacent upland areas. Potentially occurs near New Melones Reservoir. Recorded within Whiskeytown Lake and Clear Creek and near Lewiston Reservoir. Known to occur in suitable habitat on the San Luis NWR complex, in the Mendota Wildlife Area, and at Mendota Pool; expected to occur in suitable habitat in other locations in the San Joaquin River Restoration Area.	Trinity, Shasta, Sacramento, Feather, American, San Joaquin, Stanislaus, Delta, San Luis	Low potential to be affected by operational changes at reservoirs or irrigation canals and storage facilities.
Saltmarsh Common Yellowthroat	*Geothlypis trichas sinuosa*	BCC/--/SSC	Primarily brackish marsh, but also brackish and fresh woody swamps and riparian areas. Ranges generally in the San Francisco Bay area.	Delta, Suisun	Low potential to be affected by tidal marsh restoration.
Least Bittern (nesting)	*Ixobrychus exilis*	BCC/--/SSC	Rare to uncommon April to September nester in large, fresh emergent wetlands of cattails and tules in the Sacramento and San Joaquin valleys. Occurs in fresh water marsh habitats in the Yolo Bypass, east of the Sacramento River, and in the western Delta. Uncommon but regular breeder in suitable habitat in the San Joaquin Valley.	Sacramento, Feather, Yolo, Delta, San Joaquin	Low potential to be affected by restoration.
Vernal Pool Tadpole Shrimp	*Lepidurus packardi*	E/--/--	Vernal pool/seasonal wetlands. Endemic to the Central Valley, with most populations located in the Sacramento Valley. This species has also been reported from the Delta to the east side of San Francisco Bay. Known to occur in suitable habitat on the San Luis NWR complex and at the Great Valley Grasslands State Park.	Sacramento, Feather, Yolo, Delta, San Joaquin	Low potential to be affected by restoration activities that influence vernal pools.
Suisun Song Sparrow	*Melospiza melodia maxillaris*	BCC/--/SSC	Brackish marshes around Suisun Bay.	Suisun, Delta	Low potential to be affected by tidal marsh restoration activities.
Riparian (= San Joaquin Valley) Woodrat	*Neotoma fuscipes riparia*	E/--/SSC	Historically found in riparian habitat along the San Joaquin, Stanislaus, and Tuolumne rivers. Now known only from Caswell Memorial State Park on the Stanislaus River near its confluence with the San Joaquin River in very low gradient portion of river. No actions proposed that could affect this species in this area. Last reported at Caswell Memorial State Park in 2002. Likely still extant.	Delta, Stanislaus, San Joaquin	Low potential to be affected by changes in operation that influence riparian vegetation.
Osprey (nesting)	*Pandion haliaetus*	--/--/WL	Nests on platform of sticks at the top of large snags, dead-topped trees, on cliffs, or on human-made structures. Requires open, clear waters for foraging. Uses rivers, lakes, reservoirs, bays, estuaries, and surf zones. Reclamation (2010) concluded this species occurs near New Melones Reservoir. Known to nest along the Sacramento River.	Trinity, Clear Creek, Shasta, Sacramento, Feather, Yolo, American, New Melones	Low potential for foraging behavior to be affected by changes in reservoir levels.
White-faced Ibis (nesting colony)	*Plegadis chihi*	--/--/WL	Forages in wetlands and irrigated or flooded croplands and pastures. Breeds colonially in dense freshwater marsh. Known to occur in suitable habitat on the San Luis NWR complex and other sites in the Restoration Area and Yolo Bypass.	Feather, Yolo, American, San Joaquin	Low potential for restoration actions to affect nesting colonies in the Yolo Bypass.

Common Name	Scientific Name	Status Federal/State/ CDFW*	Habitat/Distribution	Areas with Potential for Occurrence	Impact Potential
Suisun Shrew	*Sorex ornatus sinuosus*	--/--/SSC	Historically known from tidal wetlands of Solano, Napa, and eastern Sonoma counties. Currently limited to the northern borders of San Pablo and Suisun bays.	Suisun	Low potential to be affected by tidal wetland restoration activities.
Riparian Brush Rabbit	*Sylvilagus bachmani riparius*	E/E/--	Historical distribution may have extended along portions of the San Joaquin River and its tributaries on the valley floor from at least Stanislaus County to the Delta. Currently restricted to several populations at Caswell Memorial State Park, near Manteca in San Joaquin County, along the Stanislaus River, along Paradise Cut (a channel of the San Joaquin River in the southern part of the Delta), and a recent reintroduction on private lands adjacent to the San Joaquin River NWR.	Delta, Stanislaus, San Joaquin	Low potential to be affected by changes in flows that inundate suitable habitat along the San Joaquin River.
Least Bell's Vireo (nesting)	*Vireo bellii pusillus*	E/E/--	Nests in dense, low, shrubby vegetation, generally early successional stages in riparian areas, particularly cottonwood-willow forest, but also brushy fields, young second-growth forest or woodland, scrub oak, coastal chaparral, and mesquite brush lands, often near water in arid regions. Observed in Yolo Bypass Wildlife Area. Successfully nested at the San Joaquin River NWR in 2005 and 2006.	Sacramento, Yolo, Delta, San Joaquin	Low potential to be affected by changes in flow that influence adjacent riparian vegetation.

Notes:
***Status Codes:**
BCC = Bird Species of Conservation Concern
BLM = Bureau of Land Management Sensitive Species
C = Candidate
E = Endangered
FP = California Fully Protected
FS = Forest Service Sensitive Species
PT = Proposed Threatened
SSC = California Species of Special Concern
T = Threatened
WL = CDFW Watch List

BDCP = Bay Delta Conservation Plan
CDFW = California Department of Fish and Wildlife
cm = centimeters
m^2 = square meters
NWR = National Wildlife Refuge

Table 10A.2 Special-Status Plant Species

Common Name	Scientific Name	Status Federal/State/ CRPR*	Habitat/Distribution	Areas with Potential for Occurrence	Impact Potential
Bogg's Lake Hedge-hyssop	*Gratiola heterosepala*	--/E/1B.2	Marshy and swampy lake margins, vernal pools. Known from north Delta and from the Sacramento and San Joaquin valleys. CNDDB documents occurrences at Jepson Prairie, the Rio Linda area, and Mather County Park.	Sacramento, Yolo, Delta, San Joaquin	Low potential to be affected by restoration actions that influence vernal pools.
Bolander's Water Hemlock	*Cicuta maculata* var. *bolanderi*	--/--/2.1	Coastal fresh or brackish marshes and swamps in Contra Costa, Sacramento, Marin, and Solano counties. Present at north and central Delta and Suisun Marsh.	Sacramento, Delta, Suisun Marsh	Low potential to be affected by tidal marsh restoration actions.
Delta Button-celery	*Eryngium racemosum*	--/E/1B.1	Vernally mesic clay depressions in riparian scrub. Extant occurrences recorded along San Joaquin River in Merced County, and in south Delta. Reclamation (2010) concluded this species could potentially occur near New Melones Reservoir.	Delta, Stanislaus, New Melones, San Joaquin	Low potential to be affected by changes in flood inundation and reservoir elevation.
Delta Tule Pea	*Lathyrus jepsonii* var. *jepsonii*	--/--/1B.2	Freshwater and brackish marshes and swamps in the Delta region. Known from north, central, and west Delta, and Suisun Marsh. CNDDB documents occurrences at Snodgrass, Barker, Lindsey, Hass, and Cache sloughs, Delta Meadows Park, and Calhoun Cut.	Yolo, Delta	Low potential to be affected by restoration of tidal marsh.
Mason's Lilaeopsis	*Lilaeopsis masonii*	--/R/1B.1	Brackish or freshwater marshes and swamps, riparian scrub in Delta region. Known and locally common in certain regions of Delta and in Suisun Marsh. CNDDB documents occurrences of this species in Barker, Lindsey, Cache, and Snodgrass sloughs as well as in Calhoun Cut.	Delta, Suisun Marsh	Low potential to be affected by tidal restoration.
Suisun Marsh Aster	*Symphyotrichum lentum*	--/--/1B.2	Endemic to Delta, generally occurs in marshes and swamps, often along sloughs, from 0 to 3 meters in elevation. Brackish and freshwater marshes and swamps in Bay-Delta region. Known from many areas of Delta and from Suisun Marsh	Yolo, Delta, Suisun Marsh	Low potential to be affected by tidal marsh restoration.
Suisun Thistle	*Cirsium hydrophilum* var. *hydrophilum*	E/--/1B.1	Salt marshes and swamps. Two known occurrences in Grizzly Island Wildlife Area and Peytonia Slough Ecological Reserve. Present at Suisun Marsh.	Delta, Suisun Marsh	Low potential to be affected by tidal marsh restoration.
Soft Bird's-beak	*Chloropyron molle* ssp. *molle*	E/R/1B.2	Coastal salt marshes and swamps in Contra Costa, Napa, and Solano counties.	Delta	Low potential to be affected by tidal marsh restoration.

Notes:
*** Status Codes:**
E = Endangered
R = Rare
SC = Species of Concern
T = Threatened

CRPR Codes:
1A = Plants presumed to be extinct in California
1B = Plants that are rare, threatened, or endangered in California and elsewhere
2 = Plants that are rare, threatened, or endangered in California but more common elsewhere

CRPR Threat Ranks:
1 = Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
2 = Fairly threatened in California (20-80% occurrences threatened / moderate degree and immediacy of threat)
3 = Not very threatened in California (<20% of occurrences threatened / low degree and immediacy of threat or no current threats known)

CNDDB= California Natural Diversity Database
CRPR = California Rare Plant Ranks

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Appendix 12A

Statewide Agricultural Production Model (SWAP) Documentation

This appendix provides information about the Statewide Agricultural Production (SWAP) model methodology, assumptions, and results used for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS). More comprehensive SWAP model documentation can be found in the reference list, Section 12A.4.

This appendix is organized into three main sections:

- Section 12A.1: SWAP Model Methodology. The EIS uses SWAP to quantify effects of the alternatives on the long-term operations. This section provides information about the development history, methodology, and coverage.
- Section 12A.2: SWAP Model Assumptions. This section provides a brief description of the assumptions for the SWAP model simulations of the No Action Alternative, Second Basis of Comparison, and the other EIS alternatives.
- Section 12A.3: SWAP Model Results. This section provides model results used in the analysis and interpretation of modeling results for the alternatives impacts assessment. Also included is a discussion of model outputs used by other tools.

12A.1 SWAP Model Methodology

This section summarizes the SWAP development history, methodology, and coverage. It describes the overall analytical framework and contains descriptions of the key sources of input data used in the quantitative evaluation of the alternatives. The project alternatives include several major components that will have significant effects on CVP and SWP operations and the quantity of delivered water to agricultural contractors.

The SWAP model is a regional agricultural production and economic optimization model that simulates the decisions of farmers across 93 percent of agricultural land in California. It is the most current in a series of production models of California agriculture developed by researchers at the University of California at Davis under the direction of Professor Richard Howitt in collaboration with the California Department of Water Resources (DWR). The SWAP model has been subject to peer review and technical details can be found in “Calibrating Disaggregate Economic Models of Irrigated Production and Water Management” (Howitt et al. 2012).

12A.1.1 SWAP Model Development History

The SWAP model is an improvement and extension of the Central Valley Production Model (CVPM). The CVPM was developed in the early 1990s and was used to assess the impacts of the Central Valley Project Improvement Act (Reclamation and USFWS 1999). The SWAP model allows for greater flexibility in production technology and input substitution than CVPM does, and has been extended to allow for a range of analyses, including interregional water transfers and climate change effects. Its first application was to estimate the economic scarcity costs of water for agriculture in the statewide hydro-economic optimization model for water management in California, CALVIN (Draper et al. 2003). More recently, the SWAP model has been used to estimate the economic losses caused by salinity in the Central Valley (Howitt et al. 2009a), economic losses to agriculture in the Sacramento-San Joaquin Delta (Lund et al. 2007), and economic effects of water shortage to Central Valley agriculture (Howitt et al. 2009b). The model was updated and augmented for use by Bureau of Reclamation (Reclamation) in 2012 (Reclamation 2012). It is also being used in several ongoing studies of water projects and operations.

12A.1.1.1 Modeling Objectives

EIS modeling objectives accomplished with the SWAP model included the evaluation of the following potential impacts:

- Effects on irrigated agricultural acreage
- Effects on total production value
- Qualitative effects related to water transfers

12A.1.2 SWAP Model Methodology

The SWAP model assumes that growers select the crops, water supplies, and other inputs to maximize profit subject to resource constraints, technical production relationships, and market conditions. Growers face competitive markets, where no one grower can influence crop prices. The competitive market is simulated by maximizing the sum of consumer and producer surplus subject to the following characteristics of production, market conditions, and available resources:

- Constant Elasticity of Substitution (CES) production functions for every crop in every region. CES has four inputs: land, labor, water, and other supplies. CES production functions allow for limited substitution between inputs, which allows the model to estimate both total input use and input use intensity. Parameters are calculated using a combination of prior information and the method of Positive Mathematical Programming (PMP) (Howitt 1995a, Howitt 1995b).

- Marginal land cost functions are estimated using PMP. Additional land brought into production is assumed to be of lower value and thus requires a higher cost to cultivate. The PMP functions capture this cost by using acreage response elasticities, which relate change in acreage to changes in expected returns and other information.

- Groundwater pumping cost including depth to groundwater.
- Crop demand functions.
- Resource constraints on land, labor, water, and, if applicable, other input availability by region.
- Other agronomic and economic constraints. For example, a minimum regional silage production to meet dairy herd feeding requirements can be imposed if appropriate.

The model chooses the optimal amounts of land, water, labor, and other input use subject to these constraints and definitions. Profit is revenue minus costs, where revenue is price times yield per acre times total acres. Trade-offs among production inputs are described by the CES production functions. Costs are observable input costs plus the PMP cost function, which represents changes in marginal productivity of land. Downward-sloping crop demand curves guarantee that with all else constant, as production increases, crop price decreases (and vice-versa). Over time, crop demands may shift, driven by real income growth and population increases. External data and elasticities are used to estimate the magnitude of these shifts.

The SWAP model incorporates CVP and SWP agricultural water supplies, other local surface water supplies, and groundwater. As conditions change within a SWAP region (e.g., the quantity of available project water supply increases or the cost of groundwater pumping increases), the model optimizes production by adjusting the crop mix, water sources and quantities used, and other inputs. Land will be fallowed when that is the most cost-effective response to resource conditions.

The SWAP model is used to compare the long-run response of agriculture to potential changes in CVP and SWP agricultural water delivery, other surface or groundwater conditions, or other economic values or restrictions. Results from the CalSim II model are used as inputs into SWAP through a standardized data linkage tool, as described in Appendix 5A, CalSim II and DSM2 Modeling. Groundwater analysis conducted for the EIS with the Central Valley Hydrologic Model is used to develop assumptions and estimates on pumping lifts for use in the SWAP model. See Appendix 7A, Groundwater Model Documentation, for more information on the interfacing of the Central Valley Hydrologic Model and SWAP.

The model self-calibrates using PMP, which has been used in models since the 1980s (Vaux and Howitt 1984) and was formalized in 1995 (Howitt 1995a). PMP allows the modeler to infer the marginal cost and return conditions affecting decisions of farmers while only being able to observe limited average production cost and return data. PMP captures this information through a nonlinear cost or revenue function introduced to the model.

12A.1.3 SWAP Model Coverage

The SWAP model has 27 base regions in the Central Valley. The model is also able to include agricultural areas of the Central Coast, the Colorado River region that includes Coachella, Palo Verde and the Imperial Valley, and San Diego, Santa Ana, and Ventura and the South Coast; however, data for those regions have not been updated recently, so those regions were not analyzed for this report using SWAP. Figure 12A.1 shows the numbered California agricultural areas covered in SWAP. Table 12A.1 details the major water users in each of the regions.

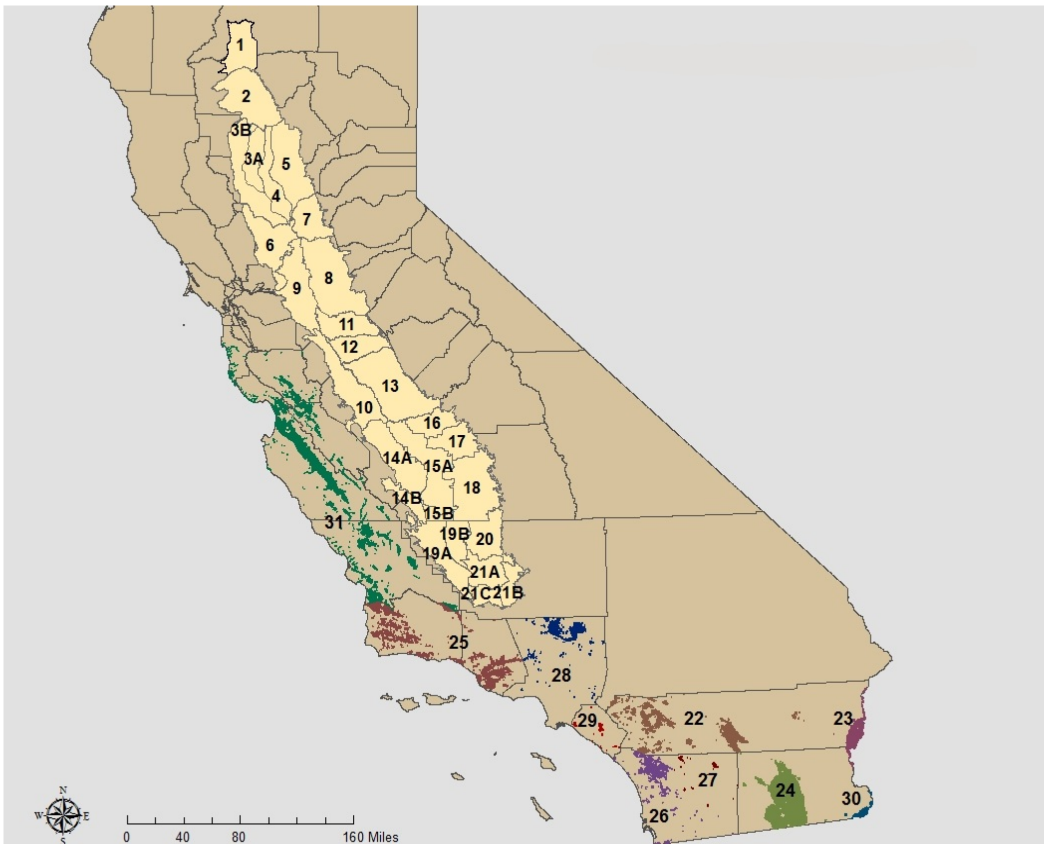

Figure 12A.1 SWAP Model Coverage of Agriculture in California

Table 12A.1 SWAP Model Region Summary

SWAP Region	Major Surface Water Users
1	CVP Users: Anderson Cottonwood I.D., Clear Creek C.S.D., Bella Vista W.D., and other Sacramento River Water Rights Settlement Contractors.
2	CVP Users: Corning Canal, Kirkwood W.D., Tehama, and other Sacramento River Water Rights Settlement Contractors.
3a	CVP Users: Glenn Colusa I.D., Provident I.D., Princeton-Codora I.D., Maxwell I.D., and Colusa Basin Drain M.W.C.
3b	Tehama Colusa Canal Service Area. CVP Users: Orland-Artois W.D., most of Colusa County, Davis W.D., Dunnigan W.D., Glide W.D., Kanawha W.D., La Grande W.D., and Westside W.D.
4	CVP Users: Princeton-Codora-Glenn I.D., Colusa I.C., Meridian Farm W.C., Pelger Mutual W.C., Reclamation District 1004, Reclamation District 108, Roberts Ditch I.C., Sartain M.D., Sutter M.W.C., Swinford Tract I.C., Tisdale Irrigation and Drainage Company, and other Sacramento River Water Rights Settlement Contractors.
5	Most Feather River Region riparian and appropriative users.
6	Yolo and Solano Counties. CVP Users: Conaway Ranch and other Sacramento River Water Rights Settlement Contractors.
7	Sacramento County north of American River. CVP Users: Natomas Central M.W.C., other Sacramento River Water Rights Settlement Contractors, Pleasant Grove-Verona W.M.C., and Placer County Water Agency.
8	Sacramento County south of American River and northern San Joaquin County.
9	Direct diverters within the Delta region. CVP Users: Banta Carbona I.D., West Side W.D., and Plainview W.D.
10	Delta Mendota service area. CVP Users: Panoche W.D., Pacheco W.D., Del Puerto W.D., Hospital W.D., Sunflower W.D., West Stanislaus W.D., Mustang W.D., Orestimba W.D., Patterson W.D., Foothill W.D., San Luis W.D., Broadview W.D., Eagle Field W.D., Mercy Springs W.D., San Joaquin River Exchange Contractors.
11	Stanislaus River water rights: Modesto I.D., Oakdale I.D., and South San Joaquin I.D.
12	Turlock I.D.
13	Merced I.D. CVP Users: Madera I.D., Chowchilla W.D., and Gravelly Ford W.D.
14a	CVP Users: Westlands W.D.
14b	Southwest corner of Kings County.
15a	Tulare Lake Bed. CVP Users: Fresno Slough W.D., James I.D., Tranquillity I.D., Traction Ranch, Laguna W.D., and Reclamation District 1606.
15b	Dudley Ridge W.D. and Devil’s Den W.D. (Castaic Lake).

SWAP Region	Major Surface Water Users
16	Eastern Fresno County. CVP Users: Friant-Kern Canal Water Authority, Fresno I.D., Garfield W.D., and International W.D.
17	CVP Users: Friant-Kern Canal, Hills Valley I.D., Tri-Valley W.D., and Orange Cove I.D.
18	CVP Users: Friant-Kern Canal, County of Fresno, Lower Tule River I.D., Pixley I.D., portion of Rag Gulch W.D., Ducor I.D., County of Tulare, most of Delano-Earlimart I.D., Exeter I.D., Ivanhoe I.D., Lewis Creek W.D., Lindmore I.D., Lindsay-Strathmore I.D., Porterville I.D., Sausalito I.D., Stone Corral I.D., Tea Pot Dome W.D., Terra Bella I.D., and Tulare I.D.
19a	SWP Service Area, including Belridge W.S.D., Berrenda Mesa W.D.
19b	SWP Service Area, including Semitropic W.S.D.
20	CVP Users: Friant-Kern Canal Water Authority, Shafter-Wasco I.D.
21a	CVP Users: Cross Valley Canal water users and Friant-Kern Canal Water Authority.
21b	Arvin Edison W.D.
21c	SWP service area: Wheeler Ridge-Maricopa W.S.D.
23-30	Central Coast, Desert, and Southern California.

Notes:

The list above does not include all water users. It is intended only to indicate the major users or categories of users. All regions in the Central Valley also include private groundwater pumpers.

C.S.D. = Community Service District
I.C. = Irrigation Company
I.D. = Irrigation District
M.W.C. = Mutual Water Company
W.D. = Water District
W.S.D. = Water Storage District

Crops are aggregated into 20 crop groups, which are the same across all regions. Each crop group may represent a number of individual crops, but many are dominated by a single crop. Irrigated acres represent acreage of all crops within the group, while production costs and returns are represented by a single proxy crop for each group. The current 20 crop groups were defined in collaboration with Reclamation and DWR and updated in March 2011. For each group, the representative (proxy) crop is chosen based on four criteria:

- A detailed production budget is available from the University of California Cooperative Extension (UCCE).
- It is the largest or one of the largest acreages within a group.
- Its water use (applied water) is representative of water use of the crops in the group.
- Its gross and net returns per acre are representative of the crops in the group.

The relative importance of these criteria varies by crop. Crop group definitions and the corresponding proxy crop are shown in Table 12A.2.

Table 12A.2 SWAP Model Crop Groups

SWAP Definition	Proxy Crop	Other Crops
Almonds and Pistachios	Almonds	Pistachios
Alfalfa	Alfalfa hay	–
Corn	Grain corn	Corn silage
Cotton	Pima cotton	Upland cotton
Cucurbits	Summer squash	Melons, cucumbers, pumpkins
Dry Beans	Dry beans	Lima beans
Fresh Tomatoes	Fresh tomatoes	–
Grain	Wheat	Oats, sorghum, barley
Onions and Garlic	Dry onions	Fresh onions, garlic
Other Deciduous	Walnuts	Peaches, plums, apples
Other Field	Sudan grass hay	Other silage
Other Truck	Broccoli	Carrots, peppers, lettuce, other vegetables
Pasture	Irrigated pasture	–
Potatoes	White potatoes	–
Processing Tomatoes	Processing tomatoes	–
Rice	Rice	–
Safflower	Safflower	–
Sugar Beet	Sugar beets	–
Subtropical	Oranges	Lemons, misc. citrus, olives
Vine	Wine grapes	Table grapes, raisins

12A.2 SWAP Model Assumptions

This section is a non-technical overview of the SWAP model. It is important to note that SWAP, like any model, is a representation of a complex system and requires assumptions and simplifications to be made. All analyses using SWAP should be explicit about the assumptions and provide sensitivity analysis where appropriate.

12A.2.1 Calibration Using Positive Mathematical Programming

The SWAP model self-calibrates using a three-step procedure based on PMP (Howitt 1995a) and the assumption that farmers behave as profit-maximizing agents within a competitive market. In a traditional optimization model, profit-maximizing farmers would simply allocate all land, up until resource constraints become binding, to the most valuable crop(s). In other words, a traditional model would have a tendency for overspecialization in production activities relative to what is observed empirically. PMP incorporates information on the marginal production conditions that farmers face, allowing the model to replicate a base year of observed input use and output. Farm- and field-specific conditions that are unobserved in aggregated data may include inter-temporal effects of crop rotation, proximity to processing facilities, management skills, farm-level effects such as risk and input smoothing, and heterogeneity in soil and other physical capital. In the SWAP model, PMP is used to translate these unobservable marginal conditions, in addition to observed average conditions, into an exponential "PMP" cost function. This cost function allows the model to calibrate to a base year of observed input use and output.

The SWAP model assumes additional land brought into production faces an increasing marginal cost of production. The most fertile or lowest cost land is cultivated first; additional land brought into production is of lower "quality" because of poorer soil quality, drainage or other water quality issues, or other factors that cause it to be more costly to farm. This is captured through an exponential land cost function (PMP cost function) for each crop and region. The exponential function is advantageous because it is always positive and strictly increasing, consistent with the hypothesis of increasing land costs. The PMP cost function is both region- and crop-specific, reflecting differences in production across crops and heterogeneity across regions. Functions are calibrated using information from acreage response elasticities and shadow values of calibration and resource constraints. The information is incorporated in such a way that the average cost conditions (the observed cost data) are unaffected.

12A.2.2 Constant Elasticity of Substitution Production Function

Crop production in the SWAP model is represented by a CES production function for each region and crop with positive acres. In general, a production function captures the relationship between inputs and output. For example, land, labor, water, and other inputs are combined to produce a crop. CES production functions in the SWAP model are specific to each region; thus, regional input use is combined to determine regional production for each crop. The calibration routine in SWAP guarantees that both input use and output match a base year of observed data.

The SWAP model considers four aggregate inputs to produce each crop in each region: land, labor, water, and other supplies. All units are converted into monetary terms, e.g., dollars of labor per acre instead of worker hours. Land is simply the number of acres of a crop in any region. Land costs represent basic land investment, cash overhead, and (when applicable) land rent. Labor costs represent both machinery labor and manual labor. "Other supplies" is a broad category that captures a range of inputs including fertilizer, pesticides, chemicals, capital recovery, and interest on operating capital. Water costs and use per acre vary by crop and region.

The generalized CES production function allows for limited substitution among inputs (Beattie and Taylor 1985). This is consistent with observed farmer production practices (farmers are able to substitute among inputs in order to achieve the same level of production). For example, farmers may substitute labor for chemicals by reducing herbicide application and increasing manual weed control. Or, farmers can substitute labor for water by managing an existing irrigation system more intensively in order to reduce water use. The CES function used in Version 6 of the SWAP model is non-nested; thus, the elasticity of substitution is the same between all inputs.

12A.2.3 Crop Demand Functions

The SWAP model is specified with downward-sloping, California-specific crop demand functions. The demand curve represents consumers' willingness-to-pay for a given level of crop production. With all else constant, as production of a crop increases, the price of that crop is expected to fall. The extent of the price decrease depends on the elasticity of demand or, equivalently, the price flexibility, which is the percentage change in crop price due to a percent change in production. Demand functions are specific to a crop but not to a region. Therefore, large changes in production in one set of regions can, through the demand-induced price changes, lead to changes in production in other regions.

The SWAP model is specified with linear demand functions. The nature of the demand function for specific commodities can change over time due to tastes and preferences, population growth, changes in income, and other factors. The SWAP model incorporates linear shifts in the demand functions over time due to growth in population and changes in real income per capita. Changes in the demand elasticity itself, resulting from changing tastes and preferences, are not considered in the model, though they can be evaluated by changing demand function parameters in the model's input data.

12A.2.4 Water Supply and Groundwater Pumping

Total available water for agriculture is specified on a regional basis in the SWAP model. Each region has six sources of supply, although not all sources are available in every region:

- CVP water service contracts (including Friant-Kern Class 1 water service contracts)
- CVP Sacramento River settlement contracts and San Joaquin River exchange contracts
- Friant Kern Class 2 water service contracts
- SWP entitlement contracts
- Other local surface water
- Groundwater

Data sources and associated calculations are described in Reclamation (2012). State and Federal project deliveries are estimated from delivery records of DWR and Reclamation. Local surface water supplies are based on DWR estimates and reports of individual water suppliers, and, where necessary, are drawn from earlier studies.

Costs for surface water supplies are compiled from information published by individual water supply agencies. There is no central data source for water prices in California. Agencies that prepared CVP water conservation plans or agricultural water management plans in most cases included water prices and related fees charged to growers. Other agencies publish and/or announce rates on an annual basis. Water prices used in SWAP are intended to be representative for each region, but vary in their level of detail.

Groundwater availability is specified by region-specific maximum pumping estimates. These are determined by consulting the individual districts' records and information compiled by DWR. DWR analysts provided estimates of the actual pumping in the base year and the existing pumping capacity by region. The model determines the optimal level of groundwater pumping for each region, up to the capacity limit specified. In some studies using SWAP or CVPM, the model has been used interactively with a groundwater model to evaluate short-term and long-term effects on aquifer conditions and pumping lifts.

Pumping costs vary by region depending on depth to groundwater and power rates. The SWAP model includes a routine to calculate the total costs of groundwater. The total cost of groundwater is the sum of fixed, operation and maintenance (O&M), and energy costs. Energy costs are based on a blend of agricultural power rates provided by Pacific Gas and Electric Company (PG&E).

12A.2.5 SWAP Model Inputs and Supporting Data

Land use data in the SWAP model correspond to the year 2010 and were prepared by DWR analysts. DWR is now developing more detailed annual time series data on agricultural land use, but the current version of the SWAP model calibrates to 2010 as a relatively normal base year. All prices and costs in SWAP are in constant 2010 dollars for consistency with the land use data. Table 12A.3 summarizes input data and sources used in the SWAP model.

Table 12A.3 SWAP Model Input Data Summary

Input	Source	Notes
Land Use	DWR	Base year 2010.
Crop Prices	County agricultural commissioners	By proxy crop using 2010-2012 average prices, indexed to 2010 price level.
Crop Yields	UCCE crop budgets	By proxy crop for various years (most recent available).
Interest Rates	UCCE crop budgets	Crop budget interest costs adjusted to year 2010.
Land Costs	UCCE crop budgets	By proxy crop for various years (most recent available). In 2010 dollars.
Other Supply Costs	UCCE crop budgets	By proxy crop for various years (most recent available). In 2010 dollars
Labor Costs	UCCE crop budgets	By proxy crop for various years (most recent available). In 2010 dollars
Surface Water Costs	Reclamation, DWR, individual districts	By SWAP model region. In 2010 dollars.
Groundwater Costs	PG&E, individual districts	Total cost per acre-foot includes fixed, O&M, and energy cost. In 2010 dollars.
Irrigation Water	DWR	Average crop irrigation water requirements in acre-feet per acre.
Available Water	CVPM, DWR, Reclamation, individual districts	By SWAP model region and water supply source.
Elasticities	Russo et al. 2008	California estimates.

12A.2.6 2030 Assumptions

Analysis of alternatives assumed 2030 conditions. Projected CVP and SWP water deliveries were provided by CalSim II results as described in Appendix 5A, CalSim II and DSM2 Modeling. Future crop demand functions are based on shifts over time due to growth in population and changes in real income per capita (see Section 12A.2.3).

12A.3 SWAP Model Results

12A.3.1 Acreage and Agricultural Production Results

Modeling results are summarized and discussed in Chapter 12, Agricultural Resources. More detailed results by individual crop type are shown in Tables 12A.4 through 12A.11. All values of production are in 2010 dollars.

Table 12A.4 Sacramento and San Joaquin Valley Irrigated Acreage by Crop under the No Action Alternative and Alternative 2 over the Long-term Average Conditions and for Dry and Critically Dry Years

Crops	Long-term Average, Sacramento Valley (1000s acres)	Long-term Average, San Joaquin Valley (1000s acres)	Dry and Critically Dry, Sacramento Valley (1000s acres)	Dry and Critically Dry, San Joaquin Valley (1000s acres)
Alfalfa	97.2	572.0	96.4	571.5
Almond, Pistachio	164.3	920.3	163.4	918.6
Corn	48.7	678.7	48.3	678.3
Cotton	3.3	281.2	3.3	281.0
Cucurbits	40.1	68.8	40.1	68.8
Drybeans	19.9	55.9	19.9	55.9
Fresh Tomato	1.7	35.1	1.7	35.1
Grain	86.6	289.0	86.8	275.8
Onion, Garlic	4.0	60.4	4.0	60.4
Other Deciduous	246.6	392.6	246.6	392.4
Other Field	44.8	519.5	44.7	519.3
Other Truck	7.4	199.1	7.4	199.1
Pasture, Irrigated	102.0	162.7	100.3	163.0
Potato	–	16.9	–	16.9
Process Tomato	65.5	252.9	65.4	252.9
Rice	548.0	16.6	544.2	16.6
Safflower	11.0	26.5	11.0	26.5
Sugarbeet	–	0.6	–	0.6
Subtropical	37.2	238.5	37.2	238.5
Vineyard	8.4	604.1	8.4	604.1
Total	**1,536.7**	**5,391.7**	**1,529.0**	**5,375.3**

Table 12A.5 Sacramento and San Joaquin Valley Production Value by Crop under the No Action Alternative and Alternative 2, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crops	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Alfalfa	$161.7	$1,256.0	$160.6	$1,255.9
Almond, Pistachio	$737.9	$4,826.8	$737.4	$4,823.5
Corn	$60.6	$979.9	$60.3	$979.1
Cotton	$8.2	$697.1	$8.2	$696.7
Cucurbits	$593.8	$1,018.3	$593.8	$1,018.2
Drybeans	$23.9	$63.5	$23.9	$63.5
Fresh Tomato	$16.5	$404.8	$16.5	$404.8
Grain	$59.6	$278.2	$59.8	$265.1
Onion, Garlic	$31.5	$445.7	$31.5	$445.6
Other Deciduous	$1,759.1	$3,237.2	$1,759.1	$3,236.1
Other Field	$58.0	$664.1	$58.0	$663.9
Other Truck	$51.0	$1,459.2	$51.0	$1,459.1
Pasture, Irrigated	$74.7	$116.2	$73.6	$116.7
Potato	$-	$122.2	$-	$122.2
Process Tomato	$237.9	$999.3	$237.9	$999.1
Rice	$1,072.2	$30.3	$1,065.1	$30.3
Safflower	$8.1	$19.6	$8.1	$19.6
Sugarbeet	$-	$1.6	$-	$1.6
Subtropical	$525.1	$3,618.9	$525.1	$3,618.8
Vineyard	$49.6	$4,243.2	$49.8	$4,243.0
Total	**$5,529.5**	**$24,482.1**	**$5,519.7**	**$24,462.8**

Table 12A.6 Sacramento and San Joaquin Valley Irrigated Acreage by Crop under the Second Basis of Comparison and Alternative 1, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crops	Long-term Average, Sacramento Valley (1000s acres)	Long-term Average, San Joaquin Valley (1000s acres)	Dry and Critically Dry, Sacramento Valley (1000s acres)	Dry and Critically Dry, San Joaquin Valley (1000s acres)
Alfalfa	97.3	572.2	97.2	572.2
Almond, Pistachio	164.4	920.3	164.4	920.3
Corn	48.6	679.0	48.8	678.9
Cotton	3.3	281.2	3.3	281.2
Cucurbits	40.1	68.8	40.1	68.8
Drybeans	19.9	55.9	19.9	55.9
Fresh Tomato	1.7	35.1	1.7	35.1
Grain	85.6	288.8	86.8	288.8
Onion, Garlic	4.0	60.4	4.0	60.4
Other Deciduous	246.6	392.6	246.6	392.6
Other Field	44.8	519.6	44.9	519.5
Other Truck	7.4	199.1	7.4	199.1
Pasture, Irrigated	102.5	162.7	100.8	163.2
Potato	–	16.9	–	16.9
Process Tomato	65.5	252.9	65.5	252.9
Rice	548.5	16.6	548.0	16.6
Safflower	11.0	26.5	11.0	26.5
Sugarbeet	–	0.6	–	0.6
Subtropical	37.2	238.5	37.2	238.5
Vineyard	8.4	604.1	8.4	604.1
Total	**1,536.7**	**5,392.2**	**1,535.8**	**5,392.2**

Table 12A.7 Sacramento and San Joaquin Valley Production Value by Crop under the Second Basis of Comparison and Alternative 1, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crops	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Alfalfa	$162.0	$1,256.1	$161.7	$1,256.2
Almond, Pistachio	$738.8	$4,826.5	$738.9	$4,826.4
Corn	$60.5	$980.3	$60.8	$980.1
Cotton	$8.2	$697.3	$8.2	$697.3
Cucurbits	$593.8	$1,018.2	$593.8	$1,018.2
Drybeans	$23.9	$63.5	$23.9	$63.5
Fresh Tomato	$16.5	$404.8	$16.5	$404.8
Grain	$58.9	$277.9	$59.8	$277.9
Onion, Garlic	$31.5	$445.7	$31.5	$445.7
Other Deciduous	$1,759.1	$3,237.3	$1,759.1	$3,237.3
Other Field	$58.0	$664.3	$58.1	$664.2
Other Truck	$51.0	$1,459.2	$51.0	$1,459.1
Pasture, Irrigated	$75.0	$116.2	$73.9	$116.7
Potato	$-	$122.2	$-	$122.2
Process Tomato	$238.0	$999.2	$238.1	$999.2
Rice	$1,073.1	$30.3	$1,072.1	$30.3
Safflower	$8.1	$19.6	$8.2	$19.6
Sugarbeet	$-	$1.6	$-	$1.6
Subtropical	$525.1	$3,619.0	$525.3	$3,618.8
Vineyard	$49.6	$4,243.3	$49.8	$4,243.1
Total	**$5,531.0**	**$24,482.6**	**$5,530.6**	**$24,482.3**

Table 12A.8 Sacramento and San Joaquin Valley Irrigated Acreage by Crop under Alternative 3, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crops	Long-term Average, Sacramento Valley (1000s acres)	Long-term Average, San Joaquin Valley (1000s acres)	Dry and Critically Dry, Sacramento Valley (1000s acres)	Dry and Critically Dry, San Joaquin Valley (1000s acres)
Alfalfa	97.3	572.2	96.8	571.6
Almond, Pistachio	164.4	920.3	163.9	918.9
Corn	48.6	679.0	48.6	678.5
Cotton	3.3	281.2	3.3	281.1
Cucurbits	40.1	68.8	40.1	68.8
Drybeans	19.9	55.9	19.9	55.9
Fresh Tomato	1.7	35.1	1.7	35.1
Grain	85.8	288.8	86.6	286.5
Onion, Garlic	4.0	60.4	4.0	60.4
Other Deciduous	246.6	392.6	246.6	392.5
Other Field	44.8	519.6	44.8	519.4
Other Truck	7.4	199.1	7.4	199.1
Pasture, Irrigated	102.5	162.7	100.3	163.1
Potato	–	16.9	–	16.9
Process Tomato	65.5	252.9	65.5	252.9
Rice	548.4	16.6	547.2	16.6
Safflower	11.0	26.5	11.0	26.5
Sugarbeet	–	0.6	–	0.6
Subtropical	37.2	238.5	37.2	238.5
Vineyard	8.4	604.1	8.4	604.1
Total	**1,536.7**	**5,392.0**	**1,533.2**	**5,386.9**

Table 12A.9 Sacramento and San Joaquin Valley Production Value by Crop under Alternative 3, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crops	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Alfalfa	$161.9	$1,256.1	$161.3	$1,255.7
Almond, Pistachio	$738.8	$4,826.5	$739.2	$4,823.1
Corn	$60.5	$980.2	$60.6	$979.4
Cotton	$8.2	$697.3	$8.2	$696.9
Cucurbits	$593.8	$1,018.2	$593.7	$1,018.2
Drybeans	$23.9	$63.5	$23.9	$63.5
Fresh Tomato	$16.5	$404.8	$16.5	$404.8
Grain	$59.1	$278.0	$59.7	$275.9
Onion, Garlic	$31.5	$445.7	$31.5	$445.6
Other Deciduous	$1,759.1	$3,237.3	$1,759.2	$3,236.4
Other Field	$57.9	$664.3	$58.1	$664.0
Other Truck	$51.0	$1,459.2	$51.0	$1,459.1
Pasture, Irrigated	$75.0	$116.2	$73.7	$116.8
Potato	$-	$122.2	$-	$122.2
Process Tomato	$238.0	$999.2	$238.0	$999.1
Rice	$1,072.8	$30.3	$1,070.7	$30.3
Safflower	$8.1	$19.6	$8.1	$19.6
Sugarbeet	$-	$1.6	$-	$1.6
Subtropical	$525.1	$3,618.9	$525.3	$3,618.7
Vineyard	$49.6	$4,243.3	$49.8	$4,243.0
Total	**$5,530.7**	**$24,482.4**	**$5,528.6**	**$24,473.7**

1 **Table 12A.10 Sacramento and San Joaquin Valley Irrigated Acreage by Crop under**
2 **Alternative 5, over the Long-term Average Conditions and for Dry and Critically**
3 **Dry Years**

Crops	Long-term Average, Sacramento Valley (1000s acres)	Long-term Average, San Joaquin Valley (1000s acres)	Dry and Critically Dry, Sacramento Valley (1000s acres)	Dry and Critically Dry, San Joaquin Valley (1000s acres)
Alfalfa	97.2	572.0	96.4	571.5
Almond, Pistachio	164.3	920.3	163.4	918.0
Corn	48.7	678.7	48.3	678.2
Cotton	3.3	281.2	3.3	280.9
Cucurbits	40.1	68.8	40.1	68.8
Drybeans	19.9	55.9	19.9	55.9
Fresh Tomato	1.7	35.1	1.7	35.1
Grain	86.6	289.0	86.6	275.7
Onion, Garlic	4.0	60.4	4.0	60.4
Other Deciduous	246.6	392.6	246.6	392.4
Other Field	44.8	519.5	44.7	519.3
Other Truck	7.4	199.1	7.3	199.1
Pasture, Irrigated	102.0	162.7	100.3	163.0
Potato	–	16.9	–	16.9
Process Tomato	65.5	252.9	65.4	252.9
Rice	548.1	16.6	544.3	16.6
Safflower	11.0	26.5	11.0	26.5
Sugarbeet	–	0.6	–	0.6
Subtropical	37.2	238.5	37.2	238.5
Vineyard	8.4	604.1	8.4	604.0
Total	**1,536.7**	**5,391.6**	**1,529.0**	**5,374.4**

Table 12A.11 Sacramento and San Joaquin Valley Production Value by Crop under Alternative 5, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crops	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Alfalfa	$161.7	$1,255.9	$160.6	$1,255.8
Almond, Pistachio	$738.0	$4,826.7	$737.9	$4,822.0
Corn	$60.6	$979.9	$60.3	$979.0
Cotton	$8.2	$697.1	$8.2	$696.5
Cucurbits	$593.8	$1,018.3	$593.7	$1,018.2
Drybeans	$23.9	$63.5	$23.9	$63.5
Fresh Tomato	$16.5	$404.8	$16.5	$404.8
Grain	$59.6	$278.2	$59.7	$265.1
Onion, Garlic	$31.5	$445.7	$31.5	$445.6
Other Deciduous	$1,759.1	$3,237.2	$1,759.1	$3,235.8
Other Field	$58.0	$664.1	$58.0	$663.8
Other Truck	$51.0	$1,459.2	$51.0	$1,459.0
Pasture, Irrigated	$74.7	$116.2	$73.7	$116.7
Potato	$-	$122.2	$-	$122.2
Process Tomato	$237.9	$999.3	$237.9	$999.1
Rice	$1,072.3	$30.3	$1,065.3	$30.3
Safflower	$8.1	$19.6	$8.1	$19.6
Sugarbeet	$-	$1.6	$-	$1.6
Subtropical	$525.1	$3,618.9	$525.2	$3,618.7
Vineyard	$49.6	$4,243.2	$49.8	$4,243.0
Total	**$5,529.6**	**$24,482.0**	**$5,520.4**	**$24,460.2**

12A.3.2 Cost of Groundwater Pumping for Irrigation

Table 12A.12 displays the cost of pumping groundwater in 2010 dollars, by region and alternative, for long-term average condition and for dry and critically dry years.

Table 12A.12 Groundwater Pumping Cost by Region and Alternative, over the Long-term Average Conditions and for Dry and Critically Dry Years

Alternative	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically, Sacramento Valley (Million $)	Dry and Critically, San Joaquin Valley (Million $)
No Action Alternative and Alternative 2	$58.3	$882.6	$66.3	$1,029.3
Second Basis of Comparison and Alternative 1	$57.6	$782.9	$66.3	$962.1
Alternative 3	$57.5	$813.0	$66.3	$990.2
Alternative 5	$58.3	$887.1	$66.3	$1,032.8

12A.3.3 Output Data for Use in IMPLAN Model

Production value estimates were summarized into more aggregated crop categories for use in regional economic impact analysis, as described in Chapter 19, Socioeconomics. All values below are in 2010 dollars. Tables 12A.13 through 12A.16 display the aggregated production values. It should be noted that for the IMPLAN analysis, the values were indexed for 2012 dollars.

Table 12A.13 Production Value by Aggregated Crop Category under the No Action Alternative and Alternative 2, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crop Category	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Grains	$1,348	$1,498	$1,340	$1,483
Field Crops	$82	$1,532	$82	$1,531
Forage Crops	$262	$1,521	$260	$1,521
Vegetable, Truck	$1,031	$4,931	$1,031	$4,930
Orchards, Vineyards	$3,404	$17,649	$3,404	$17,644
Total	**$6,128**	**$27,130**	**$6,117**	**$27,109**

Table 12A.14 Production Value by Aggregated Crop Category under Second Basis of Comparison and Alternative 1, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crop Category	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Grains	$1,348	$1,498	$1,348	$1,498
Field Crops	$82	$1,532	$83	$1,532
Forage Crops	$263	$1,521	$261	$1,521
Vegetable, Truck	$1,031	$4,931	$1,032	$4,931
Orchards, Vineyards	$3,405	$17,649	$3,405	$17,648
Total	**$6,129**	**$27,131**	**$6,129**	**$27,131**

Table 12A.15 Production Value by Aggregated Crop Category under Alternative 3, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crop Category	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Grains	$1,348	$1,498	$1,346	$1,495
Field Crops	$82	$1,532	$82	$1,532
Forage Crops	$263	$1,521	$260	$1,521
Vegetable, Truck	$1,031	$4,931	$1,031	$4,930
Orchards, Vineyards	$3,405	$17,649	$3,406	$17,643
Total	**$6,129**	**$27,131**	**$6,127**	**$27,121**

Table 12A.16 Production Value by Aggregated Crop Category under Alternative 5, over the Long-term Average Conditions and for Dry and Critically Dry Years

Crop Category	Long-term Average, Sacramento Valley (Million $)	Long-term Average, San Joaquin Valley (Million $)	Dry and Critically Dry, Sacramento Valley (Million $)	Dry and Critically Dry, San Joaquin Valley (Million $)
Grains	$1,281	$412	$1,273	$398
Field Crops	$150	$2,618	$149	$2,616
Forage Crops	$262	$1,521	$260	$1,521
Vegetable, Truck	$1,031	$4,931	$1,031	$4,930
Orchards, Vineyards	$3,404	$17,649	$3,404	$17,641
Total	**$6,128**	**$27,130**	**$6,118**	**$27,106**

12A.3.4 Model Limitations and Applicability

The SWAP model is an optimization model that makes the best (most profitable) adjustments to water supply and other changes. Constraints can be imposed to simulate restrictions on how much adjustment is possible or how fast the adjustment can realistically occur. Nevertheless, an optimization model can tend to over-adjust and minimize costs associated with detrimental changes or, similarly, maximize benefits associated with positive changes.

SWAP does not explicitly account for the dynamic nature of agricultural production; it provides a point in time comparison between two conditions. This is consistent with the way most economic and environmental impact analysis is conducted, but it can obscure sometimes important adjustment costs.

SWAP also does not explicitly incorporate risk or risk preferences (e.g., risk aversion) into its objective function. Risk and variability are handled in two ways. First, the calibration procedure for SWAP is designed to reproduce observed crop mix, so to the extent that crop mix incorporates farmers' risk spreading and risk aversion, the starting, calibrated SWAP base condition will also. Second, variability in water delivery, prices, yields, or other parameters can be evaluated by running the model over a sequence of conditions or over a set of conditions that characterize a distribution, such as a set of water year types.

Groundwater is an alternative source to augment local surface, SWP, and CVP water delivery in all SWAP regions. The cost and availability of groundwater therefore has an important effect on how SWAP responds to changes in delivery. However, SWAP is not a groundwater model and does not include any direct way to adjust pumping lifts and unit pumping cost in response to long-run changes in pumping quantities. Economic analysis using SWAP must rely on an accompanying groundwater analysis.

12A.4 References

Beattie, B. R., and C. R. Taylor. 1985. *The Economics of Production*. New York: Wiley and Sons.

Draper, A. J., M. W. Jenkins, K. W. Kirby, J. R. Lund, and R. E. Howitt. 2003. Economic-Engineering Optimization for California Water Management. *Journal of Water Resources Planning and Management* 129: 3.

DWR (California Department of Water Resources). 2011. Unpublished projections provided for the economic study.

Howitt, R. E. 1995a. Positive Mathematical Programming. *American Journal of Agricultural Economics* 77(2): 329-342.

Howitt, R. E. 1995b. A Calibration Method for Agricultural Economic Production Models. *Journal of Agricultural Economics* 46(2): 147-159.

Howitt, R. E., D. MacEwan, and J. Medellín-Azuara. 2009a. Economic Impacts of Reduction in Delta Exports on Central Valley Agriculture. *Agricultural and Resource Economics Update*. Pp. 1-4. Giannini Foundation of Agricultural Economics.

Howitt, R. E., J. Medellín-Azuara, and D. MacEwan. 2009b. *Estimating Economic Impacts of Agricultural Yield Related Changes.* Prepared for California Energy Commission, Public Interest Energy Research (PIER).

Howitt, R. E, J. Medellín-Azuara, D. MacEwan, and J. R. Lund. 2012. Calibrating Disaggregate Economic Models of Agricultural Production and Water Management. *Environmental Modeling and Software* 38: 244-258.

Lund, J., E. Hanak, W. Fleenor, R. Howitt, J. Mount, and P. Moyle. 2007. *Envisioning Futures for the Sacramento-San Joaquin Delta.* Public Policy Institute of California.

Reclamation (Bureau of Reclamation). 1997. *Central Valley Production Model, Central Valley Project Improvement Act Draft Programmatic EIS.* Technical Appendix Volume 8.

Reclamation (Bureau of Reclamation). 2012. *Statewide Agricultural Production (SWAP) Model Update and Application to Federal Feasibility Analysis*.

Reclamation and USFWS (Bureau of Reclamation and U.S. Fish and Wildlife Service). 1999. *Central Valley Project Improvement Act Programmatic Environmental Impact Statement*.

Russo C., R. Green, and R. Howitt. 2008. *Estimation of Supply and Demand Elasticities of California Commodities*. Working Paper No. 08-001. Davis, California: Department of Agricultural and Resource Economics, University of California at Davis. June.

Vaux, H. J., and R. E. Howitt. 1984. Managing Water Scarcity: An Evaluation of Interregional Transfers. *Water Resources Research* 20: 785-792.

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Appendix 19A

California Water Economics Spreadsheet Tool (CWEST) Documentation

This appendix provides information about the California Water Economics Spreadsheet Tool (CWEST) methodology, assumptions, and results used for the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) Environmental Consequences analysis. The EIS uses CWEST to quantify effects of the alternatives on the economic benefits of deliveries to CVP and SWP Municipal and Industrial (M&I) water users. CWEST was developed for the EIS and this is the first official documentation of the tool.

This appendix is organized into three main sections as follows:

- Section 19A.1: CWEST Methodology
  - This section provides information about the development history, methodology, and coverage.
- Section 19A.2: CWEST Assumptions
  - This section provides information about the overall analytical framework, assumptions, and the input data obtained from publicly available sources. A description of how the No Action Alternative water supplies was formulated is also included.
- Section 19A.3: CWEST Results
  - This section provides a detailed description of the model simulation output format used in the analysis and interpretation of modeling results for the alternatives impacts assessment. Also included is a description of the model outputs used by other model analyses.

19A.1 CWEST Methodology

This section summarizes the CWEST development history, methodology, and coverage. It describes the overall analytical framework and the geographical extent of the economic evaluation of the alternatives. The EIS alternatives include several major components that may have significant effects on CVP and SWP operations and the quantity of delivered water to CVP and SWP M&I water users. CWEST was developed to provide consistent and transparent analysis of economic benefits of CVP and SWP M&I water supplies for CVP contractors and SWP Table A contract holders under 2030 conditions using publicly available information. Most demand data and data on local supply levels are from 2010 Urban Water Management Plans (UWMPs).

CWEST is an economic simulation and optimization tool that represents each individual CVP and SWP M&I water user's decision making. It provides estimates of water supply costs for each water user. The logic and methods are built on those used by other California M&I water economics tools. Similar to the existing California M&I water economics tools, CWEST minimizes the total costs of meeting annual M&I water demands that are subject to constraints. These costs include: conveyance and operations costs, costs of existing and new permanent supplies, transfer or other option costs, costs of local surface and groundwater operations, lost water sales revenues, and end-user shortage costs. The level of demand, quantity and type of local water supplies, and costs represent a 2030 development condition. The assumptions, sources of information, and description of the tool are discussed in the following sections.

19A.1.1 CWEST Development History

CWEST was developed in response to the requirements of the EIS quantitative analyses. CWEST provides a transparent, easy to use, and flexible tool that is applicable to many future studies. Table 19A.1 lists how CWEST fulfils the needs of the EIS quantitative analyses.

Table 19A.1 Comparison of CWEST to LCPSIM and OMWEM

Need for EIS	CWEST
Accurately represent each CVP and SWP M&I water user's individual behavior.	CWEST evaluates each CVP and SWP M&I water user separately.
Consistently evaluate across all CVP and SWP M&I water users.	All CVP and SWP M&I water users are in one spreadsheet. The same data structure and optimization routines apply to all.
Able to track and view model assumptions.	CWEST is an Excel tool designed to easily locate model assumptions.
Easily follow model logic and use of tool is simple.	CWEST optimization routine is traceable and the Excel tool is easy to use.
Need to estimate change in retail water sales revenues and groundwater pumping costs.	Includes water sales based on retail price and groundwater cost savings.

19A.1.1.1 Modeling Objectives

Modeling objectives accomplished with CWEST for this EIS included the evaluation of the following potential impacts:

- Effects on CVP and SWP M&I water user costs and revenues
- Effects on end users from experiencing shortage costs
- Annual quantities of transferred water to CVP and SWP M&I water users

19A.1.2 CWEST Methodology

CWEST represents how CVP and SWP M&I water users will meet 2030 water demand levels at the lowest economic cost that are subject to constraints. The model assumes that each CVP and SWP M&I water user uses its contract delivery (modeled in CalSim II), local supplies, and imported water (if applicable) to meet annual demand. CWEST operates on an annual time step for the hydrologic period. The current application uses CVP and SWP delivery results modeled by CalSim II for the 1922 to 2003 period, but CWEST can easily be adapted to other input data and period of record. In years where available supplies are lower than demand, the CVP and SWP M&I water user will use local stored supplies, purchase or transfer water on a market, or short its customers—all of which results in an economic cost. If shortage and transfer costs occur frequently, the model could select to purchase additional fixed-yield supplies, such as additional desalination water treatment. Additional fixed-yield supplies will be purchased when the annual cost of the supply is less than the average annual costs of shortage. The model optimizes the additional supply decisions with perfect foresight to provide the lowest-cost water supply portfolio to meet 2030 demands throughout the 82-year hydrologic period.

CWEST uses water supply costs that represent the specific situation and supply conditions for each CVP and SWP M&I water user. Transfer and groundwater pumping costs vary by water-year type or by the region. All of these shortage costs are based on linear cost functions except for the end-user shortage costs. This cost function for retail water is non-linear; therefore, CWEST uses Excel Solver to find the optimal level of additional fixed-yield supply. CWEST uses the same cost function for each CVP and SWP M&I contractor and only has one function to represent all of their water users. At least one fixed-yield supply is included for every agency to choose when optimizing. Types of projects include stormwater, conservation, recycling, groundwater capacity, or desalination. The Metropolitan Water District of Southern California (MWDSC) can choose from five different fixed-yield project supply types, each with a unique increasing marginal cost function. The quantity of fixed-yield supply is a choice when optimizing and the cost for the new supply must be paid each year.

When annual supplies are in excess of demand, CWEST allows CVP and SWP M&I water users to reduce groundwater pumping, put water into local or regional storage (if applicable), or turn back the water. Each CVP and SWP M&I water user deals with excess water differently. Reduction in groundwater pumping results in a benefit based on the variable costs of groundwater pumping. Turning back water provides a cost savings based on the avoided conveyance charges. Fixed local supplies such as recycled water or desalination are not reduced in response to annual supply in excess of demand.

19A.1.3 CWEST Coverage

Individual CVP and SWP M&I water users are grouped into regions which correspond to the regions reported in Chapter 19, Socioeconomics. Table 19A.2 displays the CVP and SWP M&I water users included in each region.

Table 19A.2 CVP and SWP M&I Water Users Included in the EIS

Central Valley Region – Sacramento Valley	Centerville CSD, El Dorado Irrigation District, City of Folsom, Mountain Gate CSD, Napa County Flood Control and Water Conservation District, Placer County Water Agency, City of Redding, City of Roseville, Sacramento County Water Agency, San Juan Water District, Shasta CSD, Shasta County Water Agency, City of Shasta Lake, Solano County Water Agency, City of West Sacramento
Central Valley Region – San Joaquin Valley	Arvin-Edison Water Storage District, City of Avenal, City of Coalinga, Delano-Earlimart Irrigation District, City of Fresno, City of Huron, Kern County Water Agency, City of Lindsay, Lindsay-Strathmore Irrigation District, City of Orange Cove, Stockton-East Water District, City of Tracy
San Francisco Bay Area Region	Alameda County Water District, Contra Costa Water District, San Benito County Water District, Zone 6, Santa Clara Valley Water District, Zone 7 Water Agency
Central Coast Region	San Luis Obispo County Flood Control and Water Conservation District, Santa Barbara County Flood Control and Water Conservation District
Southern California Region	Antelope Valley-East Kern Water Agency, Castaic Lake Water Agency, Coachella Valley Water District, Crestline-Lake Arrowhead Water Agency, Desert Water Agency, Metropolitan Water District of Southern California, Mojave Water Agency, Palmdale Water District and Littlerock Creek Irrigation District, San Bernardino Valley Municipal Water District, San Gorgonio Pass Water Agency

Note:
CSD = Community Service District

Table 19A.3 displays why certain CVP and SWP M&I water users are not included in the EIS. Placeholders for San Gabriel Valley Municipal Water District, East Bay Municipal Utilities District, and Ventura County Watershed Protection District are included in CWEST, but are not modeled for the EIS.

Table 19A.3 CVP and SWP M&I Water Users excluded from EIS Analysis

CVP and SWP Water User	Reason
Bella Vista Water District	No discernible differences in deliveries in CalSim II model output.
Clear Creek CSD	No discernible differences in deliveries in CalSim II model output.
East Bay Municipal Utilities District	There is a lack of public information on major water supplies (Mokelumne Aqueduct).
El Dorado County Water Agency	Water user does not have conveyance.
Sacramento, City of	No discernible differences in deliveries in CalSim II model output.
San Gabriel Valley Municipal Water District	SWP water is solely for regional groundwater recharge.
Ventura County Watershed Protection District	No discernible differences in deliveries in CalSim II model output.

19A.2 CWEST Assumptions

The following CalSim II model simulations were performed as the basis of evaluating the impacts of No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5:

- No Action Alternative
- Second Basis of Comparison
- Alternative 1 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 2 – for simulation purposes, considered the same as No Action Alternative
- Alternative 3
- Alternative 4 – for simulation purposes, considered the same as Second Basis of Comparison
- Alternative 5

Assumptions for each of these alternatives were developed with the surface water modeling tools described in Appendix 5A, CalSim II and DSM2 Modeling.

Because Alternative 1 modeling assumptions are the same as the Second Basis of Comparison and Alternative 2 modeling assumptions are the same as the No Action Alternative, the assumptions for those alternatives are not discussed separately in this document.

The No Action Alternative, Second Basis of Comparison, and Alternatives 1 through 5 were evaluated under the same set of local supply, demand, and cost assumptions for 2030 conditions. The only model input that varied across alternatives is the CalSim II CVP and SWP M&I water user delivery data.

19A.2.1 CVP and SWP M&I Water User Demand and Supply

19A.2.1.1 2030 CVP and SWP M&I Water User Demand

CVP and SWP M&I water user demands developed for CWEST are sourced from publicly available data. The majority of 2030 demands are reported in each CVP and SWP M&I water user's 2010 UWMP, with exceptions for those that did not create one (see Appendix 5D, CVP and SWP M&I Water User Supplies, for more information on 2030 demand levels and UWMP sources). The 2030 demand levels for CVP and SWP M&I water users without published UMWPs are provided by the CVP M&I Water Shortage Policy (WSP) Draft Environmental Impact Statement (Reclamation 2014). The UWMP demands presented for 2030 are assumed to be compliant with the "20% by 2020" legislation. In some cases, additional conservation is presented as part of 2030 supply in the UWMP. If so, this is counted as a demand reduction, not as a new supply in CWEST.

Table 19A.4 displays the 2030 contract quantities and demand levels included in the model.

Table 19A.4 CWEST Modeled Demands in 2030

CVP and SWP M&I Water User	2030 CVP and SWP Contract Quantities (acre-feet)	2030 Demands from UWMP (acre-feet)
Alameda County Water District	42,000	71,800
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	2,926	6,000
Antelope Valley-East Kern Water Agency	141,400	96,558
Avenal, City of	3,500	3,500
Castaic Lake Water Agency	95,200	105,313
Coachella Valley Water District	133,100	212,000
Coalinga, City of	10,000	10,000
Contra Costa Water District	195,000	215,471
Crestline-Lake Arrowhead Water Agency	5,800	2,250
Desert Water Agency	54,000	69,400
El Dorado Irrigation District	7,550	57,039
Folsom, City of	34,000	36,259
Fresno, City of	60,000	201,100
Huron, City of	3,000	3,000

CVP and SWP M&I Water User	2030 CVP and SWP Contract Quantities (acre-feet)	2030 Demands from UWMP (acre-feet)
Kern County Water Agency	134,600	51,750
Lindsay, City of	2,500	2,689
MWDSC	2,185,600	4,455,000
Mojave Water Agency	75,800	192,969
Napa County Flood Control and Water Conservation District	29,025	21,572
Orange Cove, City of	1,400	2,790
Palmdale Water District and Littlerock Creek Irrigation District	21,300	45,700
Placer County Water Agency	100,000	156,333
Redding, City of	27,140	27,852
Roseville, City of	62,000	49,334
Sacramento County Water Agency	81,438	77,535
San Benito County Water District, Zone 6	8,250	11,583
San Bernardino Valley Municipal Water District	102,600	305,447
San Gorgonio Pass Water Agency	17,300	66,420
San Juan Water District	82,200	57,265
San Luis Obispo County Flood Control and Water Conservation District	8,447	8,150
Santa Barbara County Flood Control and Water Conservation District	62,039	75,935
Santa Clara Valley Water District	219,400	409,370
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	10,672	10,942
Solano County Water Agency	47,756	82,250
Stockton-East Water District	75,000	64,960
Tracy, City of	20,000	31,000
West Sacramento, City of	23,600	19,273
Yuba City, City of	9,600	29,041
Zone 7 Water Agency	80,619	75,500

19A.2.1.2 Development of 2030 CVP and SWP M&I Water User Water Supplies

CWEST used the UWMP to report local supplies expected to be available in 2030. In some cases, UWMP supplies were adjusted for projects that may not be implemented by 2030. CWEST uses the 2030 UWMP "normal" year supplies to represent 2030 supplies in wet, above normal, and below normal years, and "multiple-year drought" supplies are used to represent 2030 supplies in dry and critical years. The Sacramento index is used for CVP and SWP M&I water users in the Sacramento Valley and the San Francisco Bay Area Region. The San Joaquin index is used for CVP and SWP M&I water users in the San Joaquin Valley, the Central Coast Region, and the Southern California Region.

Local, non-project supply amounts are as summarized in Table 19A.5. More information on normal year 2030 supply is described in Appendix 5D, CVP and SWP M&I Water User Supplies.

Table 19A.5 CWEST Assumed 2030 Non-Project Supplies

CVP and SWP M&I Water User	Non-Project Supplies in Below Normal or Better Water Year Type (acre-feet)	Non-Project Supplies in Dry or Critical Water Year Type (acre-feet)
Alameda County Water District	50,800	35,600
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District*	3,000	0
Antelope Valley-East Kern Water Agency	40,000	20,000
Avenal, City of*	0	0
Castaic Lake Water Agency	77,787	77,787
Coachella Valley Water District	238,840	238,850
Coalinga, City of*	0	0
Contra Costa Water District	64,000	51,600
Crestline-Lake Arrowhead Water Agency	481	481
Desert Water Agency	69,900	89,000
El Dorado Irrigation District	54,789	54,789
Folsom, City of	3,250	11,250
Fresno, City of	228,800	232,400
Huron, City of*	0	0
Kern County Water Agency	68,126	40,130
Lindsay, City of*	1,210	1,210
MWDSC	3,040,100	3,142,300
Mojave Water Agency	152,921	176,785

CVP and SWP M&I Water User	Non-Project Supplies in Below Normal or Better Water Year Type (acre-feet)	Non-Project Supplies in Dry or Critical Water Year Type (acre-feet)
Napa County Flood Control and Water Conservation District	19,082	21,565
Orange Cove, City of*	0	0
Palmdale Water District and Littlerock Creek Irrigation District	39,600	42,059
Placer County Water Agency	68,119	103,119
Redding, City of	13,424	13,424
Roseville, City of	3,397	3,397
Sacramento County Water Agency	74,898	74,898
San Benito County Water District, Zone 6	5,174	5,174
San Bernardino Valley Municipal Water District	314,225	314,225
San Gorgonio Pass Water Agency	43,952	43,952
San Juan Water District	0	0
San Luis Obispo County Flood Control and Water Conservation District	8,288	8,288
Santa Barbara County Flood Control and Water Conservation District	79,490	79,490
Santa Clara Valley Water District	246,830	179,980
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD*	1,064	1,064
Solano County Water Agency	75,276	75,276
Stockton-East Water District	28,000	50,000
Tracy, City of	15,250	16,050
West Sacramento, City of	5,000	5,000
Yuba City, City of	22,748	22,748
Zone 7 Water Agency	11,600	2,620

Note:
*CVP and SWP M&I Water User without 2010 UWMP and supply and 2030 supply conditions are from CVP M&I WSP (Reclamation 2014)

19A.2.1.3 CalSim II Linkage Information

CalSim II node identification for each CVP and SWP M&I water user in the EIS analysis is displayed in Table 19A.6.

1 **Table 19A.6 CWEST and CalSim II Linkage**

CVP and SWP M&I Water User	CalSim II Equivalent Nodes
Alameda County Water District	D814_PCO + D814_PMI + D814_PIN
All other Friant-Kern M&I water users (Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District)	2.926*(D910_C1/60)
Antelope Valley-East Kern Water Agency	D877_PMI + D877_PCO + D877_PIN
Avenal, City of	D844_PMI*0.35
Castaic Lake Water Agency	D896_PMI + D896_PCO
Coachella Valley Water District	D883_PMI + D883_PCO + D883_PIN
Coalinga, City of	D844_PMI*0.5
Contra Costa Water District	D420
Crestline-Lake Arrowhead Water Agency	D25_PMI + D25_PCO
Desert Water Agency	D884_PMI + D884_PCO + D884_PIN
El Dorado Irrigation District	D8F_NP + D8F_PMI
Folsom, City of	D8B_NP + D8B_PMI
Fresno, City of	MAX(0.25*60, D910_C1*(60/64.802))
Huron, City of	D844_PMI*0.15
Kern County Water Agency	D851A_PMI
Lindsay, City of	2.5*(D910_C1/60)
MWDSC	D895_PMI + D895_PMI+ D895_PIN+ D899_PCO + D899_PCO + D899_PIN + D27_PMI +D27_PIN + D27_PCO +D885_PMI + D885_PCO + D885_PIN
Mojave Water Agency	D881_PMI + D881_PCO
Napa County Flood Control and Water Conservation District	D403B_PMI + D403B_PCO + D403B_PIN
Orange Cove, City of	1.4*(D910_C1/60)
Palmdale Water District and Littlerock Creek Irrigation District	D878_PMI + D878_PCO
Placer County Water Agency	D8H_PMI+D300_NP
Redding, City of	D104_PSC*0.13779 + D104_PMI*0.5
Roseville, City of	D8G_NP + D8G_PMI
Sacramento County Water Agency	D168C+D167B
San Benito County Water District, Zone 6	0.065*D711_PMI+0.518*D710_PAG
San Bernardino Valley Municipal Water District	D886_PMI + D886_PCO
San Gorgonio Pass Water Agency	D888_PMI + D888_PCO

CVP and SWP M&I Water User	CalSim II Equivalent Nodes
San Juan Water Agency	D8D_NP + D8E_NP + D8E_PMI
San Luis Obispo County Flood Control and Water Conservation District	[MIN(D869_PMI + D869_PCO,8.447)]
Santa Barbara County Flood Control and Water Conservation District	[((D870_PMI + D870_PCO) + ((D870_PMI + D870_PCO)—8.4)) * (0.852 if WY is W,AN,BN, 0.522 if WY is D,C)]
Santa Clara Valley Water District	D710_PAG * 0.442 + D711_PMI * 0.935 + D815_PCO + D815_PMI +D815_PIN
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	D104_PMI*0.5 + D104_PMI*0.35
Solano County Water Agency	D403C_PMI + D403C_PCO
Stockton-East Water District	D520_SEWD_PMI
Tracy, City of	0.2*[South of Delta % PMI Delivery]
West Sacramento, City of	D165_PSC
Yuba City, City of	D204_PMI
Zone 7 Water Agency	D810_PCO + D810_PMI + D813_PCO + D813_PMI + D810_PIN

19A.2.1.4 Development of Storage Operations

CWEST includes storage operations for the CVP and SWP M&I water users with published information on local storage operations, who participate in a regional groundwater bank, or who use significant local groundwater banking to store water. CVP and SWP M&I water users that participate in Semitropic Water Storage District's groundwater banking program have their capacity share included. Most of MWDSC's portfolio of local storage projects are modeled. Table 19A.7 presents the list of storage operations included in CWEST.

Table 19A.7 Storage Operations Assumptions

Water User with Storage	Modeled Storage Capacities
Alameda County Water District	150,000 acre-foot Semitropic Water Storage District Share[a]
MWDSC	1,600,000 acre-foot Regional Groundwater Banks[b] 980,000 acre-foot Local Surface Storage[c]
Santa Clara Valley Water District	350,000 acre-foot Semitropic Water Storage District Share[a] 530,000 acre-foot Local Groundwater[d]
Stockton-East Water District	100,000 acre-foot Local Groundwater[e]
Zone 7 Water Agency	78,000 acre-foot Semitropic Water Storage District Share[a] 126,000 acre-foot Local Groundwater[f] 120,000 acre-foot Cawelo Water District[f]

Source:

a. SWSD 2015

b. Includes: Arvin Edison Water Storage District, Semitropic Water Storage District, Kern Delta Water District, Mojave Water Agency Storage Program, Conjunctive Use programs (MWDSC 2011)

c. Includes: Castaic Lake, Diamond Valley, Lake Mathews, Lake Skinner, and Cyclic Storage (MWDSC 2011)

d. SCVWD 2011

e. Stockton-East UWMP (SEWD 2011)

f. ACWD 2011

19A.2.2 Water Costs

Water costs include delivery, groundwater pumping, additional fixed-yield supply, storage operations, and shortage costs. Shortage costs include retail revenue losses, transfer and annual option, and end-user shortage costs. Increases in M&I deliveries raise total delivery costs, but may decrease shortage costs. Real increases in water and energy costs are used to escalate costs to the 2030 levels needed for the EIS analysis.

19A.2.2.1 Delivery Costs and Water Prices

CVP and SWP M&I deliveries are assigned a delivery cost based on Reclamation CVP M&I (Reclamation 2009) rates and Bulletin 132-10 (DWR 2013), respectively. In years when supply is in excess of demand, even after reductions in groundwater pumping are placed into storage, the quantity of excess water is credited the delivery costs. This represents a CVP and SWP M&I water user “turning back” water.

The delivery cost for SWP M&I water users is the variable OMP&R component plus the Off-Aqueduct charge, which is also charged based on the amount of deliveries (CCWA 2007). As an example, DWR calculates the Off-Aqueduct charges based on the requested deliveries submitted by the Central Coast Water

Authority on a calendar-year basis. The resulting total is paid by the Authority in 12 equal payments throughout the calendar year. Additionally, in May of each year, DWR provides an amended Off-Aqueduct bill based on the actual water deliveries and power costs for the first six months of the year. The delivery cost of CVP water is the "O&M rate" (Reclamation 2009).

Real energy costs are expected to increase in real terms leading up to 2030. The California Energy Commission (CEC) mid-demand scenario predicts that real electricity rates will increase 1.7 percent annually, over the 2014 to 2024 period (CEC 2013). This rate of increase is applied to water delivery costs up to 2030. Table 19A.8 provides the 2030 delivery costs for CVP and SWP M&I water users.

Table 19A.8 also shows representative retail water prices for each CVP and SWP M&I water user. MWDSC projects their water rates will have a 1.364 percent real rate of increase annually between 2014 and 2024. Other CVP and SWP M&I water users have not made long-range projections of real retail prices, so CWEST applies MWDSC's real rate of increase to all CVP and SWP M&I water user retail water prices to estimate 2030 levels. Retail water prices are used to estimate revenue losses to CVP and SWP M&I water users from a shortage.

Table 19A.8 Conveyance and Retail Water Price Assumptions

CVP and SWP M&I Water User	CVP and SWP Delivery Costs in 2030 ($/acre-foot)[a]	Retail Water Price in 2030 ($/acre-foot)[b]
Alameda County Water District	$30	$1,528
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	$16	$228
Antelope Valley-East Kern Water Agency	$145	$580
Avenal, City of	$16	$1,130
Castaic Lake Water Agency	$99	$1,462
Coachella Valley Water District	$162	$472
Coalinga, City of	$24	$228
Contra Costa Water District	$26	$1,577
Crestline-Lake Arrowhead Water Agency	$173	$402
Desert Water Agency	$139	$527
El Dorado Irrigation District	$16	$475
Folsom, City of	$16	$235
Fresno, City of	$16	$228
Huron, City of	$16	$228
Kern County Water Agency	$18	$290
Lindsay, City of	$16	$228

CVP and SWP M&I Water User	CVP and SWP Delivery Costs in 2030 ($/acre-foot)[a]	Retail Water Price in 2030 ($/acre-foot)[b]
MWDSC	$122	$1,374
Mojave Water Agency	$232	$1,175
Napa County Flood Control and Water Conservation District	$33	$1,921
Orange Cove, City of	$16	$228
Palmdale Water District and Littlerock Creek Irrigation District	$192	$580
Placer County Water Agency	$16	$594
Redding, City of	$16	$514
Roseville, City of	$16	$197
Sacramento County Water Agency	$25	$454
San Benito County Water District, Zone 6	$32	$890
San Bernardino Valley Municipal Water District	$154	$402
San Gorgonio Pass Water Agency	$323	$624
San Juan Water Agency	$16	$235
San Luis Obispo County Flood Control and Water Conservation District	$156	$2,429
Santa Barbara County Flood Control and Water Conservation District	$157	$1,719
Santa Clara Valley Water District	$27	$1,204
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	$16	$596
Solano County Water Agency	$21	$1,198
Stockton-East Water District	$15	$507
Tracy, City of	$16	$582
West Sacramento, City of	$16	$454
Yuba City, City of	$0	$681
Zone 7 Water Agency	$42	$1,162

Source:

a. (Reclamation 2009) and (DWR 2013) escalated from 2010 to 2030 in proportion to the change in real energy prices (CEC 2013)

b. Published retail prices were chosen from representative locations (Black and Veatch 2006) and updated using MWDSC

19A.2.2.2 Additional Fixed-Yield Supply Costs

For each CVP and SWP M&I water user, at least one fixed-yield supply is available to choose in optimization. Examples include reclamation water projects, desalination, new groundwater development, and some types of conservation. Every year fixed-yield supplies provide the same amount of water and the annualized cost for operations and capital is paid. The model selects a level of fixed-yield supply that minimizes total cost over the hydrologic period. Table 19A.9 shows the fixed-yield supply included for each CVP and SWP M&I water user and its annualized cost except for those with multiple fixed-yield supplies to choose from.

A variety of data sources were used to obtain capital costs of representative projects including the UWMPs, integrated resource water management (IRWM) grant applications, water master plans, and other public information, as summarized in Appendix 5B, Municipal and Industrial Water Demands and Supplies.

For some CVP and SWP M&I water users in the Sacramento Valley, the model chooses an optimal increase in total groundwater pumping capacity when that is the additional fixed-yield supply to choose from. The model currently uses information from four representative urban well developments in Sonoma County (SCWA 2010). The annualized cost of well development for four wells was $358 per acre-foot. When a CVP and SWP M&I water user chooses to increase their groundwater pumping capacity, the annual pumping cost is added to obtain a total cost per acre-foot per year.

Table 19A.9 Information on Additional Fixed-Yield Supplies

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)[1]	Type or Name of Additional Fixed-Yield Supply
Alameda County Water District	Variable—See Table 19A.10	Variable—See Table 19A.10
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	$449	Develop groundwater[a]
Antelope Valley-East Kern Water Agency	$568	Regional aquifer project[b]
Avenal, City of	$266	Transfer/exchange[c]
Castaic Lake Water Agency	$400	None—assumed $400
Coachella Valley Water District	$258	Recycle golf course water[d]
Coalinga, City of	$274	Transfer/exchange[c]
Contra Costa Water District	$1,070	Bay Area Regional Desalination[e]
Crestline-Lake Arrowhead Water Agency	$423	Transfer/exchange[c]

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)[1]	Type or Name of Additional Fixed-Yield Supply
Desert Water Agency	$416	Additional Colorado River Aqueduct water[c]
El Dorado Irrigation District	$410	Develop groundwater[a]
Folsom, City of	$365	Willow Hill Pipeline Rehabilitation Project[f]
Fresno, City of	$449	Develop groundwater[a]
Huron, City of	$266	Transfer exchange[c]
Kern County Water Agency	$314	None—assumed $314
Lindsay, City of	$449	Develop groundwater[a]
MWDSC	Variable—See Table 19A.10	Variable—See Table 19A.10
Mojave Water Agency	$482	Transfer/exchange[c]
Napa County Flood Control and Water Conservation District	$233	Transfer/exchange[c]
Orange Cove, City of	$449	Develop groundwater[a]
Palmdale Water District and Littlerock Creek Irrigation District	$615	Regional Aquifer Project[g]
Placer County Water Agency	$410	Develop groundwater[a]
Redding, City of	$432	Develop groundwater[a]
Roseville, City of	$502	Develop groundwater[a]
Sacramento County Water Agency	$410	Develop groundwater[a]
San Benito County Water District, Zone 6	$384	Transfer/exchange[c]
San Bernardino Valley Municipal Water District	$366	Beaumont Avenue Recharge Facility[h]
San Gorgonio Pass Water Agency	$366	Beaumont Avenue Recharge Facility[h]
San Juan Water Agency	$138	Regional Indoor and Outdoor Efficiency[f]
San Luis Obispo County Flood Control and Water Conservation District	$475	Raise Lopez Dam 3-5 feet[i]
Santa Barbara County Flood Control and Water Conservation District	$804	Expand conjunctive use and groundwater[a]
Santa Clara Valley Water District	$1,795	Bay Area Regional Desalination[e]

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)[1]	Type or Name of Additional Fixed-Yield Supply
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	$216	Transfer/exchange[c]
Solano County Water Agency	$221	Expand exchange with Mojave Water Agency[c]
Stockton-East Water District	$338	Delta Water Supply Project[j]
Tracy, City of	$266	Transfer/exchange[c]
West Sacramento, City of	$410	Develop groundwater[a]
Yuba City, City of	$432	Develop groundwater[a]
Zone 7 Water Agency	Variable—See Table 19A.10	Variable—See Table 19A.10

Source:
a. SCWA 2010 for cost of well development plus pumping cost from Table 19A.13
b. AVEK 2011
c. Transfer cost from Table 19A.11 plus delivery cost from Table 19A.8
d. CVWD 2013
e. BARDP 2011
f. RWA 2011
g. PRWA 2014
h. SGPWA 2013
i. Zone 3 2015
j. ESJGB 2014

Zone 7 Water Agency, Alameda County Water District, and MWDSC have multiple additional fixed-yield supplies modeled in CWEST. For MWDSC, five fixed yield options are provided: reclamation, desalination, groundwater recovery, conservation, and stormwater. Cost functions are included that express the average cost of supply as an increasing function of the amount used. Table 19A.10 displays the range of average cost for each supply type.

Table 19A.10 CVP and SWP M&I Water Users with Multiple Additional Fixed-Yield Supply Options

CVP and SWP M&I Water User	Additional Fixed-Yield Supply Costs ($/acre-foot)	Type or Name of Additional Fixed-Yield Supply	Maximum Quantity Available (acre-foot)
Alameda County Water District	$410	Conservation	3,600[a]
	$500	Expansion of Newark Facility	5,100[a]
MWDSC	$500 to $1,500[b]	Groundwater Recovery	92,000[c]
	$600 to $1,500[b]	Recycling	360,000[c]
	$192 to $1,300[d]	Conservation	346,000[c]
	$300 to $1,500[e]	Stormwater Capture	75,000[c]
	$1,300 to $2,000[b]	Desalination	84,000[c]
Zone 7 Water Agency	$20	Arroyo Valle—Perfection of Existing Permit	3,800[f]
	$30	Reduction of Demineralization Losses	260[f]
	$100	Reduction of Unaccounted for Water	1,300[f]
	$110	Enhance Existing In-lieu Recharge	500 – 830[f]
	$200	Arroyo Las Positas Water Rights	750[f]
	$285	Confirm Byron-Bethany Irrigation District Yield	3,000[f]
	$1,400	Intertie Supply: Long-term Lease	10,900[f]
	$1,500	Recycled Water—Direct	3,700[f]
	$1,600	Groundwater Injection: Recycled Water	2,800[f]
	$2,000	Intertie Supply: Regional Desalination	9,300[f]
	$2,400	Recycled Water—Storage	17,300[f]

Source:
a. ACWD 2014
b. MWDSC 2010
c. LADWP 2011
d. Mitchell 2005
e. LADWP 2014
f. Zone 7 WA 2011

19A.2.2.3 Transfer Costs and Annual Options

Annual options are supplies that can be made available to meet demands annually. The model allows for separate costs of these supplies in dry and critical years, and a separate cost in below normal or wetter years. In below normal or wetter years, these supplies are generally transfers or groundwater. In dry or critical years, these supplies are generally transfers; providers are not allowed to pump groundwater in excess of their UWMP levels.

Costs of water transfers are based on publications summarizing observed market prices. Water transfer prices in California ranged from $50 to $550 per acre-foot from 1992 to 2004 (Hanak and Stryjewski 2012). From 2008 to 2012, transfers originating from north of the Delta (NOD) cost $47 to $200 per acre-foot while transfers originating south of the Delta (SOD) cost $237 to $436 per acre-foot (Mann and Hatchett 2012). Drought conditions in 2013 led to an estimated increase of up to 40 percent from 2012 prices (WestWater Research 2013). Transfer prices were created for multiple regions, based on historical transfer prices detailed earlier, in the same area of origin. Colorado River transfer prices are included as a supply option for agencies receiving their SWP Table A water by exchange. Prices are based on planned prices for the water transfer between Imperial Irrigation District and San Diego County Water Authority. The dry/critical year price is calculated as the weighted average of historical dry and critical year prices, where the weights are the frequency of the two year types in the historical hydrology (18 dry years and 12 critical years). The Gross National Product Implicit Price Deflator was used to bring historical transfer prices to equivalent years.

These prices are intended to represent the analysis, and are not predictions. Also, prices provided in Table 19A.11 are at the source (location of purchase) and do not include delivery costs or losses. A conveyance loss of 18 percent is assumed for cross-Delta transfers. Water delivery costs presented in Table 19A.8 are included for all transfers.

Table 19A.11 Assumed Water Transfer Prices in CWEST, 2030 Conditions*

Condition	North of Delta Origin	South of Delta Origin	North of Delta with Conveyance Loss	Colorado River Transfers
Below Normal or Wetter	$200	$250	$244	$416
Dry or Critical	$378	$480	$461	$416

Note:
* See 19A.2.2.3, Transfer Costs and Annual Options for source information

19A.2.2.4 Storage Operations and Groundwater Costs

19A.2.2.4.1 Storage Operations Costs

Storage operations are included for MWDSC, some CVP and SWP M&I water users in the San Francisco Bay Area Region, and Stockton-East Water District. The San Francisco Bay Area Region includes local groundwater storage and Semitropic Water Bank storage for Santa Clara Valley Water District, Zone 7 and Alameda County Water District. Storage operation costs for MWDSC are based on information provided in its Water Surplus and Demand Management Plan (MWDSC, 2011). Semitropic Water Storage District's published put and take costs for banking operations are used in CWEST in addition to the delivery cost to each banking partner (SWSD 2014). Local groundwater storage operation costs used by San Francisco Bay Area Region CVP and SWP M&I contractors and Stockton-East Water District are based on the groundwater costs detailed in Table 19A.12.

19A.2.2.4.2 Groundwater Costs

CWEST includes an estimate of cost savings for groundwater not pumped when excess CVP and SWP water is available. Data on groundwater costs are from CVP and SWP M&I water user UWMPs, where possible. When this information is not available in UWMPs, groundwater pumping costs are based on estimates of regional depth to groundwater and electricity price. Depths to groundwater are from DWR's Bulletin 118—Groundwater Basin Maps and Descriptions (DWR, 2004). The amount of groundwater available in below normal or wetter, and dry or critical conditions is based on individual CVP and SWP M&I water user UWMPs.

Groundwater pumping costs were estimated for each region based on a representative value from published information. CVP and SWP M&I water users in the Southern California Region have a groundwater pumping cost based on an estimate published in a Groundwater Basin Assessment (MWDSC 2007). Representative groundwater pumping costs in the Central Coast Region are based on recent estimates from the City of Santa Barbara (City of Santa Barbara 2015). Groundwater pumping costs in the San Francisco Bay Area Region are based on published estimates from San Benito County (SBCWD 2014). San Joaquin Valley groundwater pumping costs are based on published estimates from James Irrigation District and Fresno Irrigation District (KBWA 2013). Sacramento Valley had no readily available information on groundwater pumping estimates. Groundwater depth estimates and published estimates of groundwater pumping from the previous sources were used to interpolate groundwater pumping costs in the Sacramento Valley. This method was used to adjust groundwater pumping prices in other regions.

Additional costs associated with groundwater use include lower groundwater tables, subsidence, streamflow depletion, depreciation, and well replacement that should be included. In some locations, groundwater must be treated for water quality, which adds additional cost. No consistent source of information is available to assess these other costs, so cost per acre-foot is conservatively increased by 10 percent to account for some of these costs. Real increases in energy costs were applied to groundwater pumping costs (CEC 2013). Table 9A.12 displays groundwater variable costs used in the model.

Table 19A.12 Groundwater Variable Pumping Costs

CVP and SWP M&I Water User	Estimated Groundwater Pumping Cost in 2030 ($/acre-foot)*
Alameda County Water District	$52
Arvin-Edison Water Storage District, Delano-Earlimart Irrigation District, Lindsay-Strathmore Irrigation District	$91
Antelope Valley-East Kern Water Agency	$171
Avenal, City of	$91
Castaic Lake Water Agency	$94
Coachella Valley Water District	$171
Coalinga, City of	$91
Contra Costa Water District	$52
Crestline-Lake Arrowhead Water Agency	$171
Desert Water Agency	$171
El Dorado Irrigation District	$52
Folsom, City of	$52
Fresno, City of	$91
Huron, City of	$91
Kern County Water Agency	$168
Lindsay, City of	$91
MWDSC	$94
Mojave Water Agency	$171
Napa County Flood Control and Water Conservation District	$108
Orange Cove, City of	$91
Palmdale Water District and Littlerock Creek Irrigation District	$171
Placer County Water Agency	$52
Redding, City of	$74
Roseville, City of	$52
Sacramento County Water Agency	$52
San Benito County Water District, Zone 6	$52
San Bernardino Valley Municipal Water District	$171
San Gorgonio Pass Water Agency	$171
San Juan Water Agency	$52
San Luis Obispo County Flood Control and Water Conservation District	$298

CVP and SWP M&I Water User	Estimated Groundwater Pumping Cost in 2030 ($/acre-foot)*
Santa Barbara County Flood Control and Water Conservation District	$298
Santa Clara Valley Water District	$52
Shasta Lake, City of, Shasta County Water Agency, Centerville CSD, Mountain Gate CSD, and Shasta CSD	$74
Solano County Water Agency	$108
Stockton-East Water District	$91
Tracy, City of	$91
West Sacramento, City of	$52
Yuba City, City of	$74
Zone 7 Water Agency	$52

Note:
* See 19A.2.2.4 Storage Operations and Groundwater Costs – *Groundwater Costs* for source information

19A.2.2.5 Shortage Costs

Shortages in critical years are represented in the common behavior of CVP and SWP M&I water users. CWEST requires that a 5 percent end-use drought conservation shortage is implemented before any annual supply is purchased in a critical year. A provider can then eliminate a shortfall using an annual option supply such as a transfer. There is no limit currently programmed in CWEST to limit annual option supplies; therefore, end-user shortages only occur during critical years.

Shortage costs are lost retail water revenue plus end-user shortage costs. Revenue losses are based on the water prices presented in Table 19A.8. The model calculates shortage costs based on a constant elasticity of demand function. This form of shortage loss function is standard practice in California water economics studies and has been documented (M. Cubed 2007). The 2030 retail water price presented in Table 19A.8 defines one point on the demand function, and the slope is defined by the price elasticity.

The short-run demand price elasticity assumed for all providers is -0.1. This elasticity represents a demand elasticity appropriate for drought conditions. A variety of studies have found short-run price elasticities in the range of -0.1 to -0.3 (Thomas and Syme 1988; A&N Technical Services 1996). California urban price elasticity is believed to be even more inelastic because of demand hardening. This means people’s actions to reduce water use in response to shortages will already have been implemented by 2030. To evaluate 2030 conditions, -0.1 is used because it is the more inelastic estimate reported in the published information.

19A.3 CWEST Results

CWEST generates results for each CVP and SWP M&I water user, which can be aggregated into regions or a statewide total. Descriptions and interpretations of results for each region and EIS alternative are provided in Chapter 19, Socioeconomics. Table 19A.1 defines the report results and Tables 19A.14 through 19A.45 present the results for the EIS alternatives. CWEST results presented in this appendix are in 2014 dollars. Results provided in Chapter 19 have been translated to 2012 dollars to allow for comparison with SWAP and IMPLAN results.

Table 19A.13 Interpretation of Reported Results

Reported Results	Interpretation
Average Annual CVP and SWP Deliveries (TAF)	Average Annual CVP and SWP delivery quantity for the reported alternative
Delivery Cost ($1,000)	Delivery cost to deliver SWP/ CVP water
New Supply (TAF)	Additional 2030 fixed-yield supply above stated 2030 supplies. This is the cost-minimizing decision variable in the model.
Annualized New Supply Costs ($1,000)	Cost of optimal quantity of additional 2030 fixed-yield supply. Varies across water users by type of new supply listed in their UWMPs as likely new supply (e.g., desalination, recycling, conservation)
Surface/GW Storage Costs ($1,000)	Cost of annual puts/takes into local surface storage, local groundwater storage, or regional groundwater banks (e.g., Semitropic Water Storage District)
Lost Water Sales Revenues ($1,000)	Loss of retail water sales revenue due to shortage
Transfer Costs ($1,000)	Cost to purchase and deliver transfer water purchases on annual spot market, or other annual options if applicable
Shortage Costs ($1,000)	Estimated consumer surplus loss to water shortages
GW pumping savings ($1,000)	Savings from resulting reduction in groundwater pumping relative to UWMP levels
Excess Water Savings ($1,000)	Cost savings from contract water not used to meet demand or reduce groundwater pumping
Average Annual Cost ($1,000)	Lost water sales revenue plus change in delivery, new supply, storage, transfers, options, and groundwater costs

Notes:
GW = groundwater
TAF = thousand acre-feet

Table 19A.14 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	447	463	-16
Delivery Cost ($1,000)	$8,271	$8,566	$295
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$219	$213	$6
Transfer Costs ($1,000)	$761	$532	$229
Shortage Costs ($1,000)	$71	$70	$1
Reduction in Groundwater Pumping Costs (-$1,000)	-$3,973	-$4,033	$60
Savings from Excess Water (-$1,000)	-$2,344	-$2,640	$296
Average Annual Cost ($1,000)	**$3,006**	**$2,709**	**$297**

Note: In 2014 dollars

Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

Table 19A.15 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	214	237	-23
Delivery Cost ($1,000)	$3,563	$3,969	$-406
New Supply (TAF)	2	0	2
Annualized New Supply Costs ($1,000)	$442	$16	$426
Surface/GW Storage Costs ($1,000)	$970	$845	$125
Lost Water Sales Revenues ($1,000)	$372	$332	$40
Transfer Costs ($1,000)	$2,753	$2,701	$51
Shortage Costs ($1,000)	$119	$105	$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$15,837	-$16,490	$653
Excess Water Savings ($1,000)	-$1,060	-$1,358	$298
Average Annual Cost ($1,000)	**-$8,679**	**-$9,880**	**$1,201**

Note: In 2014 dollars

Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

Table 19A.16 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	396	445	-48
Delivery Cost ($1,000)	$11,374	$12,889	-$1,515
New Supply (TAF)	8	6	2
Annualized New Supply Costs ($1,000)	$617	$241	$376
Surface/GW Storage Costs ($1,000)	$1,624	$2,021	-$398
Lost Water Sales Revenues ($1,000)	$4,415	$1,643	$2,772
Transfer Costs ($1,000)	$5,893	$1,189	$4,704
Shortage Costs ($1,000)	$1,452	$538	$914
Reduction in Groundwater Pumping Costs (-$1,000)	-$508	-$815	$307
Excess Water Savings ($1,000)	-$232	-$565	$333
Average Annual Cost ($1,000)	**$24,635**	**$17,141**	**$7,494**

Note: In 2014 dollars

Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

Table 19A.17 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	44	54	-10
Delivery Cost ($1,000)	$6,863	8,418	-1,556
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,309	-$8,901	$593
Excess Water Savings ($1,000)	-$3,058	-$4,301	$1,242
Average Annual Cost ($1,000)	**-$4,505**	**-$4,784**	**$279**

Note: In 2014 dollars

Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

Table 19A.18 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the No Action Alternative as Compared to the Second Basis of Comparison

Differences in Total	No Action Alternative	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	1,932	2,394	-461
Delivery Cost ($1,000)	$246,862	$305,673	-$58,811
New Supply (TAF)	47	11	35
Annualized New Supply Costs ($1,000)	$13,067	$4,153	$8,915
Surface/GW Storage Costs ($1,000)	$7,825	$2,909	$4,916
Lost Water Sales Revenues ($1,000)	$15,051	$1,153	$13,899
Transfer Costs ($1,000)	$11,827	$3,816	$8,011
Shortage Costs ($1,000)	$17,837	$363	$17,474
Reduction in Groundwater Pumping Costs (-$1,000)	-$59,193	-$94,244	$35,051
Excess Water Savings ($1,000)	-$4,768	-$10,889	$6,121
Average Annual Cost ($1,000)	**$248,509**	**$212,933**	**$35,576**

Note: In 2014 dollars

Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

Table 19A.19 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	463	447	16
Delivery Cost ($1,000)	$8,566	$8,271	$295
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$213	$219	-$6
Transfer Costs ($1,000)	$532	$761	-$229
Shortage Costs ($1,000)	$70	$71	-$1
Reduction in Groundwater Pumping Costs (-$1,000)	-$4,033	-$3,973	-$60
Excess Water Savings ($1,000)	-$2,640	-$2,344	-$296
Average Annual Cost ($1,000)	**$2,709**	**$3,006**	**-$297**

Note: In 2014 dollars

Model results for Alternatives 1 and 4 are the same, therefore Alternative 4 results are not presented separately.

Table 19A.20 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	237	214	23
Delivery Cost ($1,000)	$3,969	$3,563	$406
New Supply (TAF)	0	2	-2
Annualized New Supply Costs ($1,000)	$16	$442	-$426
Surface/GW Storage Costs ($1,000)	$845	$970	-$125
Lost Water Sales Revenues ($1,000)	$332	$372	-$40
Transfer Costs ($1,000)	$2,701	$2,753	-$51
Shortage Costs ($1,000)	$105	$119	-$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$16,490	-$15,837	-$653
Excess Water Savings ($1,000)	-$1,358	-$1,060	-$298
Average Annual Cost ($1,000)	**-$9,880**	**-$8,679**	**-$1,201**

Note: In 2014 dollars

Model results for Alternatives 1 and 4 are the same, therefore Alternative 4 results are not presented separately.

Table 19A.21 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	445	396	48
Delivery Cost ($1,000)	$12,889	$11,374	$1,515
New Supply (TAF)	6	8	-2
Annualized New Supply Costs ($1,000)	$241	$617	-$376
Surface/GW Storage Costs ($1,000)	$2,021	$1,624	$398
Lost Water Sales Revenues ($1,000)	$1,643	$4,415	-$2,772
Transfer Costs ($1,000)	$1,189	$5,893	-$4,704
Shortage Costs ($1,000)	$538	$1,452	-$914
Reduction in Groundwater Pumping Costs (-$1,000)	-$815	-$508	-$307
Excess Water Savings ($1,000)	-$565	-$232	-$333
Average Annual Cost ($1,000)	**$17,141**	**$24,635**	**-$7,494**

Note: In 2014 dollars

Model results for Alternatives 1 and 4 are the same, therefore Alternative 4 results are not presented separately.

Table 19A.22 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	54	44	10
Delivery Cost ($1,000)	$8,418	$6,863	$1,556
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,901	-$8,309	-$593
Excess Water Savings ($1,000)	-$4,301	-$3,058	-$1,242
Average Annual Cost ($1,000)	**-$4,784**	**-$4,505**	**-$279**

Note: In 2014 dollars

Model results for Alternatives 1 and 4 are the same, therefore Alternative 4 results are not presented separately.

Table 19A.23 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under Alternative 1 as Compared to the No Action Alternative

Differences in Total	Alternative 1	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	2,394	1,932	461
Delivery Cost ($1,000)	$305,673	$246,862	$58,811
New Supply (TAF)	11	47	-35
Annualized New Supply Costs ($1,000)	$4,153	$13,067	-$8,915
Surface/GW Storage Costs ($1,000)	$2,909	$7,825	-$4,916
Lost Water Sales Revenues ($1,000)	$1,153	$15,051	-$13,899
Transfer Costs ($1,000)	$3,816	$11,827	-$8,011
Shortage Costs ($1,000)	$363	$17,837	-$17,474
Reduction in Groundwater Pumping Costs (-$1,000)	-$94,244	-$59,193	-$35,051
Excess Water Savings ($1,000)	-$10,889	-$4,768	-$6,121
Average Annual Cost ($1,000)	**$212,933**	**$248,509**	**-$35,576**

Note: In 2014 dollars

Model results for Alternatives 1 and 4 are the same, therefore Alternative 4 results are not presented separately.

Table 19A.24 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	461	447	13
Delivery Cost ($1,000)	$8,533	$8,271	$262
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$250	$219	$31
Transfer Costs ($1,000)	$619	$761	-$143
Shortage Costs ($1,000)	$79	$71	$8
Reduction in Groundwater Pumping Costs (-$1,000)	-$4,056	-$3,973	-$83
Excess Water Savings ($1,000)	-$2,592	-$2,344	-$249
Average Annual Cost ($1,000)	**$2,832**	**$3,006**	**-$174**

Note: In 2014 dollars

Table 19A.25 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	241	214	27
Delivery Cost ($1,000)	$4,013	$3,563	$449
New Supply (TAF)	0	2	-2
Annualized New Supply Costs ($1,000)	$13	$442	-$429
Surface/GW Storage Costs ($1,000)	$478	$970	-$491
Lost Water Sales Revenues ($1,000)	$292	$372	-$80
Transfer Costs ($1,000)	$2,167	$2,753	-$585
Shortage Costs ($1,000)	$92	$119	-$27
Reduction in Groundwater Pumping Costs (-$1,000)	-$16,129	-$15,837	-$291
Excess Water Savings ($1,000)	-$1,419	-$1,060	-$359
Average Annual Cost ($1,000)	**-$10,492**	**-$8,679**	**-$1,813**

Note: In 2014 dollars

Table 19A.26 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	431	396	34
Delivery Cost ($1,000)	$12,458	$11,374	$1,083
New Supply (TAF)	$8	$8	$0
Annualized New Supply Costs ($1,000)	$593	$617	-$24
Surface/GW Storage Costs ($1,000)	$2,372	$1,624	$748
Lost Water Sales Revenues ($1,000)	$2,452	$4,415	-$1,962
Transfer Costs ($1,000)	$1,881	$5,893	-$4,012
Shortage Costs ($1,000)	$766	$1,452	-$687
Reduction in Groundwater Pumping Costs (-$1,000)	-$748	-$508	-$239
Excess Water Savings ($1,000)	-$404	-$232	-$172
Average Annual Cost ($1,000)	**$19,369**	**$24,635**	**-5,266**

Note: In 2014 dollars

Table 19A.27 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	51	44	8
Delivery Cost ($1,000)	$8,048	$6,863	$1,185
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,582	-$8,309	-$273
Excess Water Savings ($1,000)	-$4,099	-$3,058	-$1,041
Average Annual Cost ($1,000)	**-$4,633**	**-$4,505**	**-$129**

Note: In 2014 dollars

Table 19A.28 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the No Action Alternative

Differences in Total	Alternative 3	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	2,241	1,932	308
Delivery Cost ($1,000)	$286,403	$246,862	$39,541
New Supply (TAF)	40	47	-7
Annualized New Supply Costs ($1,000)	$10,901	$13,067	-$2,167
Surface/GW Storage Costs ($1,000)	$8,398	$7,825	$573
Lost Water Sales Revenues ($1,000)	$11,750	$15,051	-$3,301
Transfer Costs ($1,000)	$6,366	$11,827	-$5,461
Shortage Costs ($1,000)	$13,010	$17,837	-$4,827
Reduction in Groundwater Pumping Costs (-$1,000)	-$84,136	-$59,193	-$24,943
Excess Water Savings ($1,000)	-$9,275	-$4,768	-$4,507
Average Annual Cost ($1,000)	**$243,416**	**$248,509**	**-$5,092**

Note: In 2014 dollars

Table 19A.29 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	461	463	-2
Delivery Cost ($1,000)	$8,533	$8,566	-$33
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$250	$213	$36
Transfer Costs ($1,000)	$619	$532	$86
Shortage Costs ($1,000)	$79	$70	$9
Reduction in Groundwater Pumping Costs (-$1,000)	-$4,056	-$4,033	-$23
Excess Water Savings ($1,000)	-$2,592	-$2,640	$48
Average Annual Cost ($1,000)	**$2,832**	**$2,709**	**$123**

Note: In 2014 dollars

Table 19A.30 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	241	237	4
Delivery Cost ($1,000)	$4,013	$3,969	$44
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$13	$16	-$3
Surface/GW Storage Costs ($1,000)	$478	$845	-$366
Lost Water Sales Revenues ($1,000)	$292	$332	-$40
Transfer Costs ($1,000)	$2,167	$2,701	-$534
Shortage Costs ($1,000)	$92	$105	-$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$16,129	-$16,490	$361
Excess Water Savings ($1,000)	-$1,419	-$1,358	-$61
Average Annual Cost ($1,000)	**-$10,492**	**-$9,880**	**-$612**

Note: In 2014 dollars

Table 19A.31 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	431	445	-14
Delivery Cost ($1,000)	$12,458	$12,889	-$432
New Supply (TAF)	8	6	2
Annualized New Supply Costs ($1,000)	$593	$241	$352
Surface/GW Storage Costs ($1,000)	$2,372	$2,021	$350
Lost Water Sales Revenues ($1,000)	$2,452	$1,643	$810
Transfer Costs ($1,000)	$1,881	$1,189	$692
Shortage Costs ($1,000)	$766	$538	$227
Reduction in Groundwater Pumping Costs (-$1,000)	-$748	-$815	$68
Excess Water Savings ($1,000)	-$404	-$565	$161
Average Annual Cost ($1,000)	**$19,369**	**$17,141**	**$2,228**

Note: In 2014 dollars

Table 19A.32 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	51	54	-2
Delivery Cost ($1,000)	$8,048	$8,418	-$371
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,582	-$8,901	$320
Excess Water Savings ($1,000)	-$4,099	-$4,301	$202
Average Annual Cost ($1,000)	**-$4,633**	**-$4,784**	**$151**

Note: In 2014 dollars

Table 19A.33 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 3 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 3	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	2,241	2,394	-153
Delivery Cost ($1,000)	$286,403	$305,673	-$19,270
New Supply (TAF)	40	11	28
Annualized New Supply Costs ($1,000)	$10,901	$4,153	$6,748
Surface/GW Storage Costs ($1,000)	$8,398	$2,909	$5,489
Lost Water Sales Revenues ($1,000)	$11,750	$1,153	$10,597
Transfer Costs ($1,000)	$6,366	$3,816	$2,550
Shortage Costs ($1,000)	$13,010	$363	$12,646
Reduction in Groundwater Pumping Costs (-$1,000)	-$84,136	-$94,244	$10,108
Excess Water Savings ($1,000)	-$9,275	-$10,889	$1,615
Average Annual Cost ($1,000)	**$254,212**	**$218,820**	**$35,392**

Note: In 2014 dollars

Table 19A.34 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	447	447	-1
Delivery Cost ($1,000)	$8,262	$8,271	-$8
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$210	$219	-$9
Transfer Costs ($1,000)	$774	$761	$13
Shortage Costs ($1,000)	$70	$71	-$2
Reduction in Groundwater Pumping Costs (-$1,000)	-$3,972	-$3,973	$1
Excess Water Savings ($1,000)	-$2,333	-$2,344	$10
Average Annual Cost ($1,000)	**$3,011**	**$3,006**	**$5**

Note: In 2014 dollars

Table 19A.35 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	211	214	-3
Delivery Cost ($1,000)	$3,513	$3,563	-$51
New Supply (TAF)	$2	$2	$1
Annualized New Supply Costs ($1,000)	$619	$442	$177
Surface/GW Storage Costs ($1,000)	$994	$970	$25
Lost Water Sales Revenues ($1,000)	$372	$372	$0
Transfer Costs ($1,000)	$2,740	$2,753	-$12
Shortage Costs ($1,000)	$119	$119	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$15,787	-$15,837	$50
Excess Water Savings ($1,000)	-$1,026	-$1,060	$34
Average Annual Cost ($1,000)	**-$8,457**	**-$8,679**	**$222**

Note: In 2014 dollars

Table 19A.36 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	394	396	-3
Delivery Cost ($1,000)	$11,290	$11,374	-$84
New Supply (TAF)	8	8	0
Annualized New Supply Costs ($1,000)	$617	$617	$0
Surface/GW Storage Costs ($1,000)	$1,540	$1,624	-$84
Lost Water Sales Revenues ($1,000)	$4,491	$4,415	$76
Transfer Costs ($1,000)	$6,340	$5,893	$447
Shortage Costs ($1,000)	$1,493	$1,452	$41
Reduction in Groundwater Pumping Costs (-$1,000)	-$484	-$508	$25
Excess Water Savings ($1,000)	-$232	-$232	$0
Average Annual Cost ($1,000)	**$25,056**	**$24,635**	**$421**

Note: In 2014 dollars

Table 19A.37 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	43	44	-1
Delivery Cost ($1,000)	$6,763	$6,863	-$100
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,258	-$8,309	$51
Excess Water Savings ($1,000)	-$2,986	-$3,058	$73
Average Annual Cost ($1,000)	**-$4,481**	**-$4,505**	**$24**

Note: In 2014 dollars

Table 19A.38 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the No Action Alternative

Differences in Total	Alternative 5	No Action Alternative	Changes
Average Annual CVP and SWP Deliveries (TAF)	1,912	1,932	-20
Delivery Cost ($1,000)	$244,210	$246,862	-$2,652
New Supply (TAF)	81	47	34
Annualized New Supply Costs ($1,000)	$24,915	$13,067	$11,847
Surface/GW Storage Costs ($1,000)	$7,697	$7,825	-$128
Lost Water Sales Revenues ($1,000)	$14,631	$15,051	-$420
Transfer Costs ($1,000)	$10,820	$11,827	-$1,008
Shortage Costs ($1,000)	$17,160	$17,837	-$677
Reduction in Groundwater Pumping Costs (-$1,000)	-$60,068	-$59,193	-$875
Excess Water Savings ($1,000)	-$4,726	-$4,768	$42
Average Annual Cost ($1,000)	**$254,639**	**$248,509**	**$6,130**

Note: In 2014 dollars

Table 19A.39 Changes in Sacramento Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	447	463	-16
Delivery Cost ($1,000)	$8,262	$8,566	-$304
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$210	$213	-$3
Transfer Costs ($1,000)	$774	$532	$242
Shortage Costs ($1,000)	$70	$70	-$1
Reduction in Groundwater Pumping Costs (-$1,000)	-$3,972	-$4,033	$61
Excess Water Savings ($1,000)	-$2,333	-$2,640	$306
Average Annual Cost ($1,000)	**$3,011**	**$2,709**	**$302**

Note: In 2014 dollars

Table 19A.40 Changes in San Joaquin Valley CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	211	237	-26
Delivery Cost ($1,000)	$3,513	$3,969	-$457
New Supply (TAF)	2	0	2
Annualized New Supply Costs ($1,000)	$619	$16	$603
Surface/GW Storage Costs ($1,000)	$994	$845	$150
Lost Water Sales Revenues ($1,000)	$372	$332	$40
Transfer Costs ($1,000)	$2,740	$2,701	$39
Shortage Costs ($1,000)	$119	$105	$13
Reduction in Groundwater Pumping Costs (-$1,000)	-$15,787	-$16,490	$703
Excess Water Savings ($1,000)	-$1,026	-$1,358	$332
Average Annual Cost ($1,000)	**-$8,457**	**-$9,880**	**$1,423**

Note: In 2014 dollars

Table 19A.41 Changes in San Francisco Bay Area Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	394	445	-51
Delivery Cost ($1,000)	$11,290	$12,889	-$1,599
New Supply (TAF)	8	6	2
Annualized New Supply Costs ($1,000)	$617	$241	$376
Surface/GW Storage Costs ($1,000)	$1,540	$2,021	-$481
Lost Water Sales Revenues ($1,000)	$4,491	$1,643	$2,848
Transfer Costs ($1,000)	$6,340	$1,189	$5,152
Shortage Costs ($1,000)	$1,493	$538	$955
Reduction in Groundwater Pumping Costs (-$1,000)	-$484	-$815	$332
Excess Water Savings ($1,000)	-$232	-$565	$333
Average Annual Cost ($1,000)	**$25,056**	**$17,141**	**$7,915**

Note: In 2014 dollars

Table 19A.42 Changes in Central Coast Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	43	54	-11
Delivery Cost ($1,000)	$6,763	$8,418	-$1,655
New Supply (TAF)	0	0	0
Annualized New Supply Costs ($1,000)	$0	$0	$0
Surface/GW Storage Costs ($1,000)	$0	$0	$0
Lost Water Sales Revenues ($1,000)	$0	$0	$0
Transfer Costs ($1,000)	$0	$0	$0
Shortage Costs ($1,000)	$0	$0	$0
Reduction in Groundwater Pumping Costs (-$1,000)	-$8,258	-$8,901	$644
Excess Water Savings ($1,000)	-$2,986	-$4,301	$1,315
Average Annual Cost ($1,000)	**-$4,481**	**-$4,784**	**$304**

Note: In 2014 dollars

Table 19A.43 Changes in Southern California Region CVP and SWP M&I Water User Costs over the Long-term Average Conditions under the Alternative 5 as Compared to the Second Basis of Comparison

Differences in Total	Alternative 5	Second Basis of Comparison	Changes
Average Annual CVP and SWP Deliveries (TAF)	1,912	2,394	-482
Delivery Cost ($1,000)	$244,210	$305,673	-$61,462
New Supply (TAF)	81	11	70
Annualized New Supply Costs ($1,000)	$24,915	$4,153	$20,762
Surface/GW Storage Costs ($1,000)	$7,697	$2,909	$4,788
Lost Water Sales Revenues ($1,000)	$14,631	$1,153	$13,478
Transfer Costs ($1,000)	$10,820	$3,816	$7,003
Shortage Costs ($1,000)	$17,160	$363	$16,797
Reduction in Groundwater Pumping Costs (-$1,000)	-$60,068	-$94,244	$34,176
Excess Water Savings ($1,000)	-$4,726	-$10,889	$6,164
Average Annual Cost ($1,000)	**$254,639**	**$212,933**	**$41,706**

Note: In 2014 dollars

The maximum single-year transfers are listed in Table 19A.44. An analysis on available capacity to complete these transfers concluded that transfer quantities in each alternative will not be limited by delta pumping capacity. Conservative estimates of the quantity of transfers going south of the Delta were used with published information (USFWS 2008) on transfer quantities that did not show any capacity limitations.

Table 19A.44 Annual Transfer Analysis

Maximum Single-Year Transfers by Region Across Alternatives				
Alternative	**NAA**	**SBC and Alt 1**	**Alt 3**	**Alt 5**
Central Valley Region—Sacramento Valley	18	15	16	17
Central Valley Region—San Joaquin Region	10	11	11	9
San Francisco Bay Area Region	209	110	143	209
Central Coast Region	0	0	0	0
Southern California Region	442	62	184	405
Statewide Total	679	197	354	641

Notes:
NAA – No Action Alternative
SBC – Second Basis of Comparison
Alt 1 – Alternative 1
Alt 3 – Alternative 3
Alt 5 – Alternative 5

Model results for Alternatives 1, 4, and Second Basis of Comparison are the same, therefore Alternative 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

Table 19A.45 Alternatives Difference in Annual Transfers

Maximum Single-Year Transfers by Alternatives Comparison			
Alternative	**Alt 1 vs NAA**	**Alt 3 vs NAA**	**Alt 5 vs NAA**
Central Valley Region— Sacramento Valley	-4	-2	-1
Central Valley Region—San Joaquin Region	1	1	-1
San Francisco Bay Area Region	-100	-66	0
Central Coast Region	0	0	0
Southern California Region	-380	-258	-36
Statewide Total	-482	-324	-38

Notes:
Alt 1 vs NAA – Alternative 1 compared to No Action Alternative
Alt 3 vs NAA – Alternative 3 compared to No Action Alternative
Alt 5 vs NAA – Alternative 5 compared to No Action Alternative

Model results for Alternatives 1 and 4 are the same, therefore Alternative 4 results are not presented separately. Model results for Alternative 2 and No Action Alternative are the same, therefore Alternative 2 results are not presented separately.

SOD transfer limits: 600 TAF Dry/Critical years, 360 TAF all other years (USFWS 2008)

19A.3.1 Result Data for Other Models

CWEST results are used by the IMPLAN model, as described in Chapter 19, Socioeconomics. Because of the cost recovery requirements of public utilities, changes to CVP and SWP M&I water user costs are passed directly to the utilities' customers, and therefore affect customers' income available to spend on other purchases. Changes in CVP and SWP M&I deliveries can also affect water sales. These two categories of changes, to water sales net revenue and to local utilities' spending on imported water supplies and other imports, are used to assess regional economic impacts.

19A.3.2 Model Limitations and Applicability

Although it is impossible to represent precisely and in detail the economic costs and tradeoffs faced by each CVP and SWP M&I water user, CWEST provides representative cost estimates across EIS alternatives. Economic models are inherently inexact because mathematical descriptions are used to simulate complex human and organizational decisions. However, CWEST can provide realistic and representative estimates of changes in economic costs for the EIS alternatives.

Other challenges in modeling reduce the accuracy of CWEST's estimates of the economic benefits of CVP and SWP M&I water user water supplies. Conducting the analysis at an annual time step does not allow for in-season water supply decisions. Decisions involving large capital investments are not always based entirely on economic criteria. CWEST does not model political concerns and constraints or other local preferences.

19A.4 References

A&N Technical Services. 1996. *Handbook for the Design, Evaluation, and Implementation of Conservation Rate Structures*.

ACWD (Alameda County Water District). 2011. *Urban Water Management Plan 2010-2015*.

_____. 2014. *Reliability by Design: Integrated Resources Planning at the Alameda County Water District*.

Antelope Valley – East Kern Water Agency (AVEK). 2011. *Water Supply Stabilization Project No. 2. Implementation Grant Proposal, Attachment 7, Economic Analysis: Water Supply Costs and Benefits*.

BARDP (Bay Area Regional Desalination Project). 2011. *Institutional Analysis Technical Memorandum #2—Analysis of Feasible Scenarios. Project Partners: Contra Costa Water District, East Bay Municipal Utility District, Zone 7 Water Agency, San Francisco Public Utilities Commission, and Santa Clara Valley Water District*.

Black & Veatch. 2006. *California Water Rate Survey*.

CCWA (Central Coast Water Authority). 2007. *Fiscal Year 2008/2009 Budget*.

CEC (California Energy Commission, Electricity Supply Analysis Division). 2013. *California Energy Demand 2014-2024 Revised Forecast, Volume 1: Statewide Electricity Demand, End-User Natural Gas Demand, and Energy Efficiency*. Publication Number: CEC-200-2013-004-SD-V1-REV.

City of Santa Barbara. 2015. *Groundwater Cost Information*. Site accessed June 4, 2015. http://www.santabarbaraca.gov/gov/depts/pw/resources/system/sources/groundwater.asp.

CVWD (Coachella Valley Water District). 2013. *Coachella Valley IRWM Implementation Grant, Round 2, Attachment 7 Technical Justification of Projects*.

DWR (California Department of Water Resources). 2013. *Bulletin 132-10*.

_____. 2004. *Bulletin 118 – Groundwater Basin Descriptions*.

ESJGB (Eastern San Joaquin County Groundwater Basin Authority). 2014. *2014 Eastern San Joaquin Integrated Regional Water Management Plan Update*.

Hanak, E. and E. Stryjewski. 2012. *California's Water Market, By the Numbers: Update 2012*. Site accessed June 3, 2015. http://www.ppic.org/content/pubs/report/R_1112EHR.pdf.

KBWA (Kings Basin Water Authority). 2015. *Upper Kings Basin IRWM Authority IRWMP Grant Proposal. Attachment 8 – Benefits and Costs*. Site accessed June 3, 2015. http://www.water.ca.gov/irwm/grants/docs/Archives/Prop84/Submitted Applications/P84 Round2_Implementation/Upper Kings Basin IRWM Authority (201312340022)/KBWA IRWMP Implementation Projects.pdf

LADWP (Los Angeles Department of Water and Power). 2011. *2010 Urban Water Management Plan*.

_____. 2014. *Stormwater Capture Master Plan, Interim Report, Draft*.

M. Cubed. 2007. *Proposed Method for Calculating Customer Shortage Costs for Use in WSMP 2040 Portfolio Evaluations*. Site accessed June 3, 2015. https://www5.ebmud.com/sites/default/files/pdfs/Proposed Method for Calculating Customer Shortage Costs.pdf.

Mann, R. and S. Hatchett. 2012. *Methods for Valuing Agricultural Water in California and Some Recent Results*. For Bureau of Reclamation, Mid-Pacific Region.

MWDSC (Metropolitan Water District of Southern California). 2007. *Groundwater Assessment Study, Chapter IV – Groundwater Basin Reports, Los Angeles County Coastal Plains Basins – Central Basin*.

_____. 2010. *Regional Urban Water Management Plan*.

_____. 2011. *Water Surplus and Drought Management Plan. Report for Water Resource Management Board Meeting*. December 13.

_____. 2014. *Board of Directors Finance and Insurance Committee Board Meeting Letter, Attachment 10 Ten-Year Financial Forecast. Board Meeting on 8 April, 2014*.

Mitchell, D. 2005. Memo From: David Mitchell. To: Ray Hoagland. Cc: Roger Mann, Greg Young. Re: Urban Conservation Unit Costs and Savings Potential. March 9.

PRWA (Palmdale Recycled Water Authority). 2014. P*almdale Recycled Water Authority Recycled Water Facilities Plan, Initial Study/Mitigated Negative Declaration*.

Reclamation (Bureau of Reclamation). 2009. *Schedule of M&I Cost of Service Water Rates Per Acre-Foot by Contractor 2010 M&I Water Rates*.

_____ 2014. *Central Valley Project Municipal and Industrial Water Shortage Policy Draft Environmental Impact Statement*.

RWA (Regional Water Authority). 2011. American River Basin IRWM Implementation Program Grant Application, Attachment 7 Economic Analysis.

SBCWD (San Benito County Water District). 2014. Annual Groundwater Report.

SCVWD (Santa Clara Valley Water District). 2011. *Urban Water Management Plan 2010*.

SCWA (Sonoma County Water Agency). 2010. *Water Supply Strategies Action Plan*.

SEWD (Stockton-East Water District). 2011. *2010 Stockton-East Water District Urban Water Management Plan Update*.

SGPWA (San Gorgonio Pass Water Agency). 2013. *Draft EIR Beaumont Avenue Recharge Facility and Pipeline City of Beaumont, County of Riverside, California*.

SWSD (Semitropic Water Storage District). 2014. *Rate Structure for Customers*.

_____. 2015. *Banking Partners Allocation*. Site accessed June 3, 2015. http://www.semitropic.com/BankingPartners.htm.

Thomas, F. and G. Syme. 1988. *Estimating Residential Price Elasticity of Demand for Water; A Contingent Valuation Approach*. Water Resource Research, vol. 24, No II, pp 1847-1857.

WestWater Research. 2013. Water Market Insider: 2013 California Spot Market Price Forecast. April.

USFWS (United States Fish and Wildlife Service). 2008. *Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the CVP and SWP*. Page 129

Zone 3 (San Luis Obispo County Zone 3). 2015. *Spillway Raise July 2009 Project Cost Per Acre Foot Summary*. Site accessed June 3, 2015. http://www.slocountywater.org/site/Flood Control and Water Conservation District Zones/ZONE 3/Spillway Raise Feasibility Project/pdf/Spillway Raise Project Cost Per Acre Ft Summ.pdf.

Zone 7 WA (Zone 7 Water Agency). 2011. *2011 Water Supply Evaluation, A Risk-Based Approach to Evaluating Zone 7 Water Agency's Water Supply System*.

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Appendix 19B

IMPLAN Model Documentation

This appendix provides information about the analytical approach, assumptions, data sources and limitations of the IMpact Analysis for PLANning (IMPLAN) model used to evaluate the regional economic impacts under each of the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) alternatives. This appendix also provides specific assumptions used to link the results from the other economic models to the IMPLAN regional models.

This appendix is organized into three main sections:

- Section 19B.1: IMPLAN Model Analytical Approach
  - This section provides information about the overall analytical framework including the assumptions underlying the IMPLAN model, data sources and the limitations of the model.
- Section 19B.2: Regional Economic Modeling Assumptions
  - This section provides a brief description of the specific assumptions used to link output from the Statewide Agricultural Production (SWAP) model (see Appendix 12A) and California Water Economics Spreadsheet Tool (CWEST) model (see Appendix 19A) to specific IMPLAN regional models. These specific IMPLAN models are used to evaluate potential regional economic changes associated with alternatives with respect to both the No Action Alternative and the Second Basis of Comparison.
- Section 19B.3: IMPLAN Model Results
  - This section provides the results from the IMPLAN model runs.

19B.1 IMPLAN Model Analytical Approach

Regional economic impacts are concerned with the effects of changes in the economy of a region. The magnitudes of the economic impacts are determined by the interactions between linkages within the local/regional economy and the leakages from this economy to the larger economy. Economic linkages are the relationships between industries, businesses, factors of production (e.g., labor and capital) and government created by trade and other exchange, such as taxes, within and among regions. Economic linkages create multiplier effects in a regional economy as money is circulated by trade. The magnitudes of impacts resulting from economic linkages are limited by the amount of leakage that occurs within the region. Economic leakages are a measure of the income shares spent outside of the region. Thus, the more the economic leakage, the less the multiplier effect. Economic leakages are generally higher the smaller the regional economy. For example, the economic leakages for a county are larger than those for the state which are larger than those for the nation.

19B.1.1 Tools and Assumptions

A number of regional economic analysis modeling systems (consisting of data as well as analytical software) are available for use in regional economic analysis, such as Regional Economic Models Inc. (REMI), Regional Industrial Multiplier System II (RIMS II), and IMPLAN. IMPLAN is a computer database and modeling system used to create Input-Output (I-O) models for any combination of U.S. counties. IMPLAN was originally developed by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency and the U.S. Department of the Interior (DOI) Bureau of Land Management to assist in land and resource management planning. In 1984, the U.S. Forest Service partnered with the University of Minnesota to expand and update IMPLAN data products. The updated IMPLAN software remained with the U.S. Forest Service. Beginning in 1993 through 2013, development of the IMPLAN was under exclusive rights of the Minnesota Implan Group, Inc. (MIG, Inc.), located in Stillwater, Minnesota. MIG, Inc. licensed and distributed the software to users. In 2013 MIG Inc. was purchased by IMPLAN Group LLC, which relocated the offices to Huntersville, North Carolina.

The IMPLAN Model is the most widely used I-O impact model system in the United States. Much more than a set of multipliers, it provides users with the ability to define industries, economic relationships and projects to be analyzed. It can be customized for any county, region, or state, and used to assess the "ripple effects" or "multiplier effects" caused by increasing or decreasing spending in various parts of the economy. This is used primarily to assess the economic impacts of facilities or industries, or changes in their level of activity in a given area.

IMPLAN is a static model that estimates impacts for a snapshot in time when the impacts are expected to occur, based on the makeup of the economy at the time of the underlying IMPLAN data. IMPLAN measures the initial impact to the economy but does not consider long-term adjustments as labor and capital move into alternative uses. This approach is used to compare the alternatives. Realistically, the structure of the economy will adapt and change; therefore, the IMPLAN results can only be used to compare relative changes between alternatives and the No Action Alternative and Second Basis of Comparison and cannot be used to predict or forecast future employment, labor income, or output (sales).

Input-output models measure commodity flows from producers to intermediate and final consumers. Purchases for final use (final demand) drive the model. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the analysis area (imports and value added) stop the cycle. These indirect and induced effects (the effects of household spending) can be mathematically derived using a set of multipliers. The multipliers describe the change in output for each regional industry caused by a 1-dollar change in final demand. Figure 19B.1 illustrates the concept of I-O modeling.

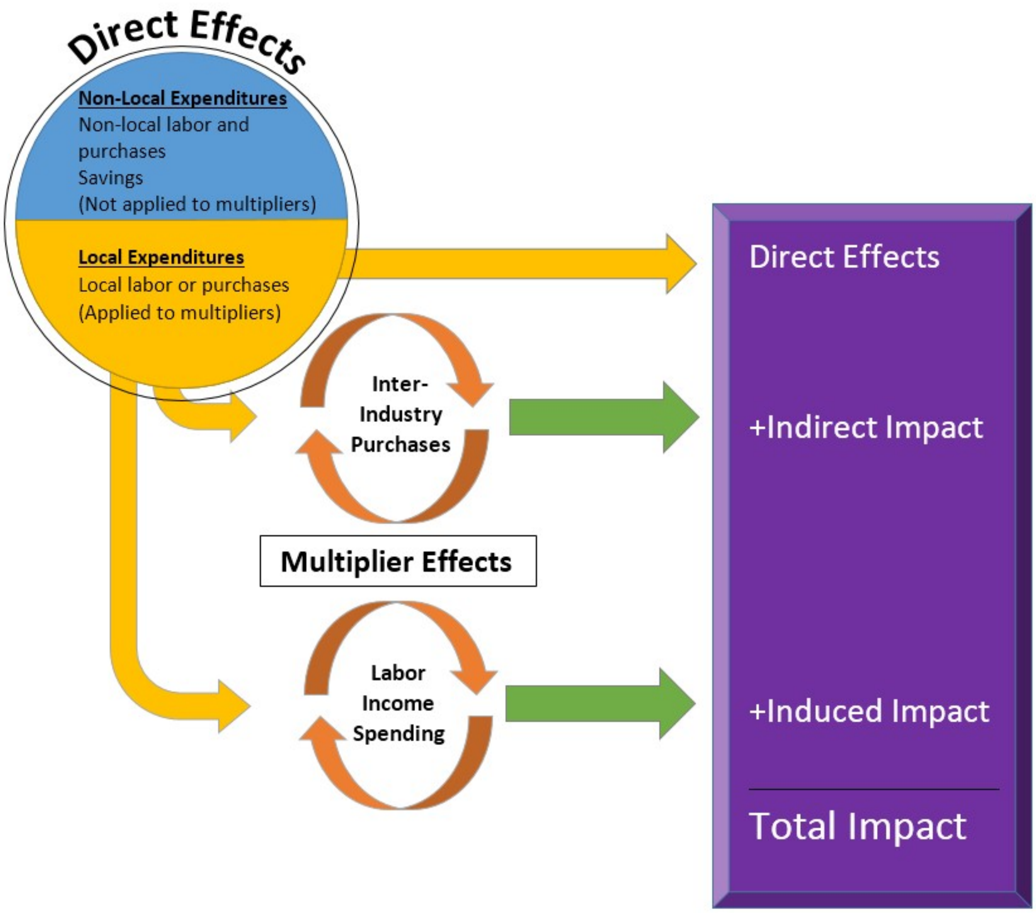

Figure 19B.1 Input-Output Modeling Concept

IMPLAN includes estimates of final demands and final payments for each county developed from government data, a national average matrix of technical coefficients, mathematical tools which help the user make the I-O model, and tools which allow the user to change data, conduct impact analysis, and generate reports.

19B.1.2 Limitations

One of the major limitations with the I-O methodology is the assumption of fixed proportions: for any good or service; all inputs are combined in fixed proportions that are invariant with the level of output. Hence, there is no substitution among production inputs and no economies of scale are possible. Additionally, each production function incorporates fixed, invariant technology.

I-O methodology does not model price effects that might be important to a region. The methodology also assumes that resources that become unemployed or employed due to a change in final demand have no alternative employment.

Finally, the IMPLAN database, even for a single county region, is very large, incorporating up to 440 sectors and more than 20 variables. It is constantly being updated as more data become available and it is virtually impossible to check every number for accuracy. For multi-county regions, the problem is even greater, since validation should begin at the county rather than the regional level. This limitation has been addressed in part in this study by validating the key numbers and coefficients for the IMPLAN sectors of most interest for this EIS.

19B.1.3 Data Sources

The economic data for the IMPLAN model come from the system of national accounts for the United States based on data collected by the U.S. Department of Commerce's Bureau of Economic Analysis, the U.S. Department of Labor's Bureau of Labor Statistics, and other federal and state government agencies. Data are collected for 440 distinct producing industry sectors of the national economy corresponding to the North American Industry Classification System (NAICS). Industry sectors are classified on the basis of the primary commodity or service produced. Corresponding data sets are also produced for each county in the United States, allowing analyses at the county level and for geographic aggregations such as clusters of contiguous counties, individual states, or groups of states. Initially, MIG Inc., and now the IMPLAN Group LLC provide annual IMPLAN I-O datasets representing the state of the economy for any region. Since these data rely on the release of federal economic data, the release of the IMPLAN I-O dataset typically lags by a year or two. For this EIS, the 2012 IMPLAN I-O data were used since this was the most recent dataset available at the time when preparation of this EIS commenced.

Data provided for each industry sector include outputs and inputs from other sectors, value added, employment, wages and business taxes paid, imports and exports, final demand by households and government, capital investment, business inventories, marketing margins, and inflation factors (deflators). These data are provided both for the 440 producing sectors at the national level and for the corresponding sectors at the county level. Data on the technological mix of inputs and levels of transactions between producing sectors are taken from detailed input-output tables of the national economy. National and county level data are the basis for IMPLAN calculations of input-output tables and multipliers for local areas.

19B.2 Regional IMPLAN Model Assumptions

The regional economic analysis was conducted using results from the agricultural production and municipal and industrial (M&I) water use impact analyses. The incremental impact results, estimated by the SWAP and CWEST economic models, were input into the regional IMPLAN models as the direct change caused by each of alternative as compared to the No Action Alternative and the Second Basis of Comparison. The IMPLAN models were then used to estimate the secondary (indirect and induced) regional employment, income, and output.

19B.2.1 Modeling Objectives

The regional economic impacts identified in Chapter 12, Agricultural Resources, and Chapter 19, Socioeconomics, were evaluated for each alternative. Modeling objectives included the evaluation of the following potential impacts:

- Effects on regional employment
- Effects on regional labor income
- Effects on regional total economic output

19B.2.2 Study Areas

Models of the multi-county regions identified in the Affected Environment of Chapter 19, Socioeconomics, were used to measure impacts in terms of total changes in employment, income and economic output in these regions. However, when the multi-county region identified in SWAP and CWEST differed from those identified in the Affected Environment section of Chapter 19, those identified in the other economic tools were used. For example, Plumas County is included in the Sacramento Valley subregion in the Affected Environment section but it is excluded from the CWEST model's Sacramento Valley region. Thus, Sacramento Valley's IMPLAN model excludes Plumas County. Table 19B.1 lists the counties included in the regions identified in the Affected Environment section of Chapter 19, Socioeconomics, the SWAP model, and the CWEST model.

Table 19B.1 Categorization of Counties within Regions

Region	Categorization in Affected Environment Section of Chapter 19, Socioeconomics	Categorization in the SWAP Model	Categorization in the CWEST Model
Central Valley Region – Sacramento	Shasta Plumas Tehama Glenn Colusa Butte Yuba Nevada Sutter Placer El Dorado	Shasta Tehama Glenn Colusa Butte Yuba Nevada Sutter Placer	El Dorado Napa Placer Sacramento Shasta Solano Sutter Yolo
Central Valley Region – San Joaquin	Stanislaus Madera Merced Fresno Tulare Kings Kern	Stanislaus Madera Merced Fresno Tulare Kings Kern	Fresno Kings Kern San Joaquin Tulare

Region	Categorization in Affected Environment Section of Chapter 19, Socioeconomics	Categorization in the SWAP Model	Categorization in the CWEST Model
San Francisco Bay Area	Alameda Santa Clara San Benito Napa	–	Alameda Contra Costa San Benito Santa Clara
Central Coast	San Luis Obispo Santa Barbara	–	San Luis Obispo Santa Barbara
Southern California	Ventura Los Angeles Orange San Diego Riverside San Bernardino	–	Kern Ventura Los Angeles Orange San Diego Riverside San Bernardino

IMPLAN models of each regions were used to estimate the secondary employment and income impacts associated with changes in irrigated agricultural production and M&I water costs. Each regional model follows county lines and incorporates, to the extent allowed by available data, the distinct sector characteristics of the region modeled.

19B.2.3 Assumptions

The primary assumption attributable to IMPLAN concerns linkages among regions. Each of the IMPLAN models is a single-region model. Other than assumptions on imports, exports, and regional purchases, the models do not explicitly recognize inter-regional interdependencies among sectors. It is believed that the regions defined for the IMPLAN models are sufficiently large so that each is relatively self-sufficient as an economic entity.

Incremental changes in agricultural production over the long-term condition (82-year simulation period analyzed in this EIS) were similar (within 5 percent) among Alternatives 1 through 5 as compared to the No Action Alternative, and among the No Action Alternative and Alternatives 1 through 5 as compared to the Second Basis of Comparison. Therefore, no IMPLAN analyses were conducted for regional economic impacts associated with the changes in irrigated agriculture production over the long-term condition. For the analyses of dry and critical dry year conditions, the direct inputs from the SWAP model were used as input into the relevant agricultural sector within each of the regions. Table 19B.2 shows the aggregated crop categories from the SWAP model and the IMPLAN sector to which each of these crop categories was assigned.

Table 19B.2 Mapping SWAP Model Results to IMPLAN Sectors

Crop Category	IMPLAN Sector
Grains	Sector 2 – Grain farming
Field Crops	Sector 10 – All other crop farming
Forage Crops	Sector 10 – All other crop farming
Vegetable, truck	Sector 3 – Vegetables and melon farming
Orchards and Vineyards	Sector 4 – Fruit farming

Because the SWAP model results were in 2010 dollars and the IMPLAN regional economic models were based on the 2012 IMPLAN I-O data, the agricultural revenue changes associated with each alternative as compared to the No Action Alternative and the Second Basis of Comparison were converted to 2012 dollars using the gross domestic product (GDP) deflator.

The long-term average year condition M&I cost estimates out of the CWEST model were used as input into the relevant IMPLAN sector and household category within each of the regions. Because the CWEST model results were in 2014 dollars and the IMPLAN regional economic models were based on the 2012 IMPLAN I-O data, the changes in M&I costs were converted to 2012 dollars using the GDP deflator.

19B.3 IMPLAN Results

This section presents the results of the IMPLAN model runs. Employment estimates out of IMPLAN, which are head counts and thus include both part-time and full-time jobs, were adjusted to full-time equivalents (FTEs) using IMPLAN’s ratios for each of the 440 sectors.

19B.3.1 No Action Alternative

As described in Chapter 4, Approach to Environmental Analysis, the No Action Alternative is compared to the Second Basis of Comparison.

Tables 19B.3 and 19B.4 summarize the regional economic impacts associated with the changes in irrigated agriculture production in the Central Valley Region in the dry and critical dry years. The income and output estimates are in 2012 dollars.

Tables 19B.5 and 19B.6 summarize the regional economic impacts associated with the changes in M&I water supply costs in the Central Valley Region. The income and output estimates are in 2012 dollars.

Table 19B.7 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the San Francisco Bay Area Region. The income and output estimates are in 2012 dollars.

Table 19B.8 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Central Coast Region. The income and output estimates are in 2012 dollars.

Table 19B.9 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Southern California Region. The income and output estimates are in 2012 dollars.

19B.3.2 Alternative 1 Compared to No Action Alternative

Tables 19B.10 and 19B.11 summarize the regional economic impacts associated with the changes in irrigated agriculture production in the Central Valley Region. The income and output estimates are in 2012 dollars.

Tables 19B.12 and 19B.13 summarize the regional economic impacts associated with the changes in M&I water supply costs in the Central Valley Region. The income and output estimates are in 2012 dollars.

Table 19B.14 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the San Francisco Bay Area Region. The income and output estimates are in 2012 dollars.

Table 19B.15 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Central Coast Region. The income and output estimates are in 2012 dollars.

Table 19B.16 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Southern California Region. The income and output estimates are in 2012 dollars.

19B.3.3 Alternative 3 Compared to No Action Alternative

Tables 19B.17 and 19B.18 summarize the regional economic impacts associated with the changes in irrigated agriculture production in the Central Valley Region. The income and output estimates are in 2012 dollars.

Tables 19B.19 and 19B.20 summarize the regional economic impacts associated with the changes in M&I water supply costs in the Central Valley Region. The income and output estimates are in 2012 dollars.

Table 19B.21 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the San Francisco Bay Area Region. The income and output estimates are in 2012 dollars.

Table 19B.22 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Central Coast Region. The income and output estimates are in 2012 dollars.

Table 19B.23 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Southern California Region. The income and output estimates are in 2012 dollars.

19B.3.4 Alternative 3 Compared to Second Basis of Comparison

Tables 19B.24 and 19B.25 summarize the regional economic impacts associated with the changes in irrigated agriculture production in the Central Valley Region. The income and output estimates are in 2012 dollars.

Tables 19B.26 and 19B.27 summarize the regional economic impacts associated with the changes in M&I water supply costs in the Central Valley Region. The income and output estimates are in 2012 dollars.

Table 19B.28 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the San Francisco Bay Area Region. The income and output estimates are in 2012 dollars.

Table 19B.29 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Central Coast Region. The income and output estimates are in 2012 dollars.

Table 19B.30 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Southern California Region. The income and output estimates are in 2012 dollars.

19B.3.5 Alternative 5 Compared to No Action Alternative

Tables 19B.31 and 19B.32 summarize the regional economic impacts associated with the changes in irrigated agriculture production in the Central Valley Region. The income and output estimates are in 2012 dollars.

Tables 19B.33 and 19B.34 summarize the regional economic impacts associated with the changes in M&I water supply costs in the Central Valley Region. The income and output estimates are in 2012 dollars.

Table 19B.35 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the San Francisco Bay Area Region. The income and output estimates are in 2012 dollars.

Table 19B.36 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Central Coast Region. The income and output estimates are in 2012 dollars.

Table 19B.37 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Southern California Region. The income and output estimates are in 2012 dollars.

19B.3.6 Alternative 5 Compared to Second Basis of Comparison

Tables 19B.38 and 19B.39 summarize the regional economic impacts associated with the changes in irrigated agriculture production in the Central Valley Region. The income and output estimates are in 2012 dollars.

Tables 19B.40 and 19B.41 summarize the regional economic impacts associated with the changes in M&I water supply costs in the Central Valley Region. The income and output estimates are in 2012 dollars.

Table 19B.42 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the San Francisco Bay Area Region. The income and output estimates are in 2012 dollars.

Table 19B.43 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Central Coast Region. The income and output estimates are in 2012 dollars.

Table 19B.44 summarizes the regional economic impacts associated with the changes in M&I water supply costs in the Southern California Region. The income and output estimates are in 2012 dollars.

19B.4 References

IMPLAN Group, LLC, IMPLAN System (data and software), 16740 Birkdale Commons Parkway, Suite 206, Huntersville, NC 28078 www.IMPLAN.com.

Table 19B.3 Changes in Agricultural-related Regional Economic Impacts for the Sacramento Valley under the No Action Alternative as Compared to the Second Basis of Comparison in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	-87	-21	0	-108	-2.7	-0.8	0.0	-3.5	-11.3	-1.3	0.0	-12.7
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	-1	0	-1	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	-0.2
Manufacturing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Transportation, Warehousing & Utilities	0	-1	0	-2	0.0	-0.1	0.0	-0.1	0.0	-0.4	-0.1	-0.5
Wholesale Trade	0	-1	-1	-2	0.0	-0.1	0.0	-0.1	0.0	-0.2	-0.1	-0.3
Retail Trade	0	0	-4	-4	0.0	0.0	-0.2	-0.2	0.0	0.0	-0.3	-0.3
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Financial Activities	0	-7	-2	-9	0.0	-0.2	-0.1	-0.3	0.0	-1.6	-0.8	-2.5
Services	0	-3	-12	-15	0.0	-0.1	-0.5	-0.7	0.0	-0.3	-1.0	-1.3
Government	0	0	0	0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1
Total	**-87**	**-36**	**-19**	**-142**	**-2.7**	**-1.5**	**-0.9**	**-5.1**	**-11.3**	**-4.2**	**-2.5**	**-18.1**

Note:
* In 2012 dollars.

Table 19B.4 Changes in Agricultural-related Regional Economic Impacts for the San Joaquin Valley under the No Action Alternative as Compared to the Second Basis of Comparison in Dry and Critical Dry Years

	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
Economic Sectors	**Direct**	**Indirect**	**Induced**	**Total**	**Direct**	**Indirect**	**Induced**	**Total**	**Direct**	**Indirect**	**Induced**	**Total**
Agriculture	-139	-53	0	-192	-5.2	-1.9	0.0	-7.1	-20.3	-2.3	-0.1	-22.7
Mining & Logging	0	-1	0	-1	0.0	-0.1	0.0	-0.1	0.0	-0.3	0.0	-0.3
Construction	0	-2	0	-2	0.0	-0.1	0.0	-0.1	0.0	-0.2	0.0	-0.2
Manufacturing	0	-1	0	-2	0.0	-0.1	0.0	-0.1	0.0	-1.8	-0.3	-2.1
Transportation, Warehousing & Utilities	0	-3	-1	-4	0.0	-0.2	-0.1	-0.3	0.0	-0.8	-0.2	-1.0
Wholesale Trade	0	-2	-1	-3	0.0	-0.1	-0.1	-0.2	0.0	-0.4	-0.2	-0.5
Retail Trade	0	0	-7	-8	0.0	0.0	-0.3	-0.3	0.0	0.0	-0.6	-0.6
Information	0	0	0	-1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2
Financial Activities	0	-12	-3	-15	0.0	-0.3	-0.1	-0.4	0.0	-2.7	-1.5	-4.1
Services	0	-5	-21	-26	0.0	-0.2	-0.9	-1.2	0.0	-0.5	-1.7	-2.2
Government	0	-1	0	-1	0.0	-0.1	0.0	-0.1	0.0	-0.2	-0.1	-0.3
Total	**-139**	**-79**	**-35**	**-254**	**-5.2**	**-3.1**	**-1.6**	**-9.9**	**-20.3**	**-9.2**	**-4.9**	**-34.4**

Note:
* In 2012 dollars.

Table 19B.5 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Sacramento Valley under the No Action Alternative as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	-0.7	-0.7	0.0	0.1	-1.7	-1.6
Mining & Logging	0	0	0	0	0.0	0.1	0.0	0.1	0.0	0.4	-0.3	0.1
Construction	0	0	0	0	0.0	15.6	-1.4	14.2	0.0	29.0	-2.5	26.5
Manufacturing	0	0	0	0	0.0	0.4	-2.3	-1.9	0.0	3.1	-22.2	-19.1
Transportation, Warehousing & Utilities	1	0	0	1	68.2	0.8	-5.5	63.5	286.4	2.8	-18.0	271.2
Wholesale Trade	0	0	0	0	0.0	0.4	-9.5	-9.1	0.0	1.0	-27.1	-26.1
Retail Trade	0	0	-1	-1	0.0	0.5	-23.3	-22.9	0.0	0.9	-46.6	-45.6
Information	0	0	0	0	0.0	0.5	-3.4	-2.9	0.0	3.4	-20.6	-17.2
Financial Activities	0	0	0	0	0.0	2.2	-16.9	-14.7	0.0	13.0	-147.7	-134.6
Services	0	0	-2	-1	0.0	16.8	-86.7	-69.9	0.0	30.8	-154.7	-123.9
Government	0	0	0	0	0.0	0.1	-1.9	-1.8	0.0	0.2	-3.8	-3.7
Total	**1**	**1**	**-3**	**-1**	**68.2**	**37.4**	**-151.8**	**-46.2**	**286.4**	**84.8**	**-445.2**	**-74.0**

Note:
* In 2012 dollars.

Table 19B.6 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Joaquin Valley under the No Action Alternative as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	-2.2	-2.2	0.0	0.0	-6.7	-6.7
Mining & Logging	0	0	0	0	0.0	-0.1	-2.1	-2.2	0.0	-0.4	-6.4	-6.8
Construction	0	0	0	0	0.0	-7.1	-3.1	-10.1	0.0	-13.3	-5.6	-18.9
Manufacturing	0	0	0	0	0.0	-0.1	-3.8	-3.9	0.0	-1.4	-46.4	-47.8
Transportation, Warehousing & Utilities	-1	0	0	-1	-39.9	-0.3	-11.8	-52.0	-140.8	-1.4	-44.7	-186.9
Wholesale Trade	0	0	0	0	0.0	-0.1	-13.3	-13.4	0.0	-0.4	-39.0	-39.3
Retail Trade	0	0	-1	-1	0.0	-0.2	-48.4	-48.6	0.0	-0.4	-97.4	-97.8
Information	0	0	0	0	0.0	-0.2	-4.9	-5.1	0.0	-1.0	-27.0	-28.0
Financial Activities	0	0	-1	-1	0.0	-0.6	-17.8	-18.4	0.0	-4.3	-263.7	-268.0
Services	0	0	-3	-3	0.0	-6.1	-155.3	-161.4	0.0	-11.7	-292.3	-303.9
Government	0	0	0	0	0.0	-0.1	-6.2	-6.3	0.0	-0.1	-12.9	-13.0
Total	**-1**	**0**	**-6**	**-7**	**-39.9**	**-15.0**	**-268.8**	**-323.6**	**-140.8**	**-34.3**	**-842.0**	**-1,017.2**

Note:
* In 2012 dollars.

Table 19B.7 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Francisco under the No Action Alternative as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	-4.1	-4.0	0.0	0.1	-7.9	-7.8
Mining & Logging	0	0	0	0	0.0	0.7	-1.8	-1.1	0.0	1.6	-5.0	-3.4
Construction	0	1	0	1	0.0	96.2	-22.8	73.3	0.0	158.8	-37.1	121.7
Manufacturing	0	0	0	0	0.0	3.1	-51.8	-48.8	0.0	28.8	-478.0	-449.1
Transportation, Warehousing & Utilities	5	0	-1	4	592.5	3.4	-65.0	530.9	1,492.4	11.2	-183.5	1,320.1
Wholesale Trade	0	0	-1	-1	0.0	2.2	-157.8	-155.6	0.0	5.0	-350.6	-345.7
Retail Trade	0	0	-6	-6	0.0	2.3	-306.5	-304.2	0.0	4.2	-567.2	-563.0
Information	0	0	-1	-1	0.0	4.4	-91.6	-87.2	0.0	16.8	-306.6	-289.8
Financial Activities	0	0	-5	-4	0.0	11.9	-218.8	-206.8	0.0	55.8	-1,740.5	-1,684.7
Services	0	1	-20	-19	0.0	84.3	-1,321.5	-1,237.2	0.0	133.7	-2,162.8	-2,029.1
Government	0	0	0	0	0.0	0.4	-30.5	-30.1	0.0	0.7	-55.1	-54.4
Total	**5**	**3**	**-35**	**-27**	**592.5**	**208.9**	**-2,272.2**	**-1,470.8**	**1,492.4**	**416.7**	**-5,894.3**	**-3,985.2**

Note:
* In 2012 dollars.

Table 19B.8 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Central Coast Region under the No Action Alternative as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.2	-2.2	-2.0	0.0	0.6	-4.0	-3.4
Mining & Logging	0	0	0	0	0.0	1.8	-2.1	-0.3	0.0	6.4	-9.3	-2.9
Construction	0	2	0	2	0.0	106.3	-5.4	100.8	0.0	201.9	-9.7	192.2
Manufacturing	0	0	0	0	0.0	1.6	-2.7	-1.1	0.0	26.8	-51.8	-25.0
Transportation, Warehousing & Utilities	6	0	0	6	371.2	3.8	-13.4	361.6	1,510.8	17.0	-56.2	1,471.6
Wholesale Trade	0	0	0	0	0.0	1.7	-20.2	-18.5	0.0	4.8	-58.6	-53.8
Retail Trade	0	0	-1	-1	0.0	3.2	-61.0	-57.8	0.0	6.1	-118.5	-112.4
Information	0	0	0	0	0.0	2.3	-9.0	-6.7	0.0	12.0	-39.0	-27.0
Financial Activities	0	0	-1	-1	0.0	11.8	-29.8	-18.0	0.0	68.9	-352.0	-283.2
Services	0	2	-5	-3	0.0	88.9	-243.3	-154.5	0.0	167.1	-447.4	-280.3
Government	0	0	0	0	0.0	0.5	-6.7	-6.2	0.0	0.9	-13.2	-12.3
Total	**6**	**4**	**-8**	**2**	**371.2**	**222.1**	**-395.9**	**197.4**	**1,510.8**	**512.7**	**-1,159.9**	**863.6**

Note:
* In 2012 dollars.

Table 19B.9 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Southern California Region under the No Action Alternative as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	2	1	0.0	-4.5	126.9	122.4	0.0	-12.5	272.7	260.2
Mining & Logging	0	-1	1	1	0.0	-49.2	98.7	49.5	0.0	-164.2	369.0	204.8
Construction	0	-43	3	-40	0.0	-2,828.3	222.0	-2,606.3	0.0	-5,205.5	395.5	-4,810.0
Manufacturing	0	-2	10	8	0.0	-180.9	803.4	622.5	0.0	-1,452.6	6,814.5	5,361.9
Transportation, Warehousing & Utilities	-175	-2	12	-166	-12,868.2	-164.5	820.7	-12,212.1	-43,673.4	-592.0	2,602.9	-41,662.5
Wholesale Trade	0	-1	20	19	0.0	-102.7	1,618.8	1,516.1	0.0	-275.3	4,339.0	4,063.8
Retail Trade	0	-2	58	56	0.0	-89.5	2,588.4	2,498.8	0.0	-170.6	5,106.3	4,935.7
Information	0	-1	6	5	0.0	-140.2	752.3	612.1	0.0	-637.5	2,962.1	2,324.6
Financial Activities	0	-9	52	43	0.0	-573.3	2,853.6	2,280.3	0.0	-2,528.7	17,797.9	15,269.1
Services	0	-46	212	166	0.0	-3,269.1	11,460.9	8,191.7	0.0	-5,542.2	20,430.6	14,888.4
Government	0	0	3	3	0.0	-17.1	306.1	289.0	0.0	-29.8	587.3	557.5
Total	**-175**	**-108**	**378**	**95**	**-12,868.2**	**-7,419.5**	**21,651.7**	**1,364.0**	**-43,673.4**	**-16,611.0**	**61,677.8**	**1,393.5**

Note:
* In 2012 dollars.

1 **Table 19B.10 Changes in Agricultural-related Regional Economic Impacts for the Sacramento Valley under Alternative 1 as Compared to**
2 **No Action Alternative in Dry and Critical Dry Years**

Economic Sectors	Employment				Labor Income ($ millions) *				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	87	21	0	108	2.7	0.8	0.0	3.5	11.3	1.3	0.0	12.7
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.2
Manufacturing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Transportation, Warehousing & Utilities	0	1	0	2	0.0	0.1	0.0	0.1	0.0	0.4	0.1	0.5
Wholesale Trade	0	1	1	2	0.0	0.1	0.0	0.1	0.0	0.2	0.1	0.3
Retail Trade	0	0	4	4	0.0	0.0	0.2	0.2	0.0	0.0	0.3	0.3
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Financial Activities	0	7	2	9	0.0	0.2	0.1	0.3	0.0	1.6	0.8	2.5
Services	0	3	12	15	0.0	0.1	0.5	0.7	0.0	0.3	1.0	1.3
Government	0	0	0	0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1
Total	**87**	**36**	**19**	**142**	**2.7**	**1.5**	**0.9**	**5.1**	**11.3**	**4.2**	**2.5**	**18.1**

3 Note:
4 * In 2012 dollars.

Table 19B.11 Changes in Agricultural-related Regional Economic Impacts for the San Joaquin Valley under Alternative 1 as Compared to No Action Alternative in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	139	53	0	192	5.2	1.9	0.0	7.1	20.3	2.3	0.1	22.7
Mining & Logging	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.3	0.0	0.3
Construction	0	2	0	2	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.2
Manufacturing	0	1	0	2	0.0	0.1	0.0	0.1	0.0	1.8	0.3	2.1
Transportation, Warehousing & Utilities	0	3	1	4	0.0	0.2	0.1	0.3	0.0	0.8	0.2	1.0
Wholesale Trade	0	2	1	3	0.0	0.1	0.1	0.2	0.0	0.4	0.2	0.5
Retail Trade	0	0	7	8	0.0	0.0	0.3	0.3	0.0	0.0	0.6	0.6
Information	0	0	0	1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2
Financial Activities	0	12	3	15	0.0	0.3	0.1	0.4	0.0	2.7	1.5	4.1
Services	0	5	21	26	0.0	0.2	0.9	1.2	0.0	0.5	1.7	2.2
Government	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.2	0.1	0.3
Total	**139**	**79**	**35**	**254**	**5.2**	**3.1**	**1.6**	**9.9**	**20.3**	**9.2**	**4.9**	**34.4**

Note:
* In 2012 dollars.

Table 19B.12 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Sacramento Valley under Alternative 1 as Compared to No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	0.7	0.7	0.0	-0.1	1.7	1.6
Mining & Logging	0	0	0	0	0.0	-0.1	0.0	-0.1	0.0	-0.4	0.3	-0.1
Construction	0	0	0	0	0.0	-15.6	1.4	-14.2	0.0	-29.0	2.5	-26.5
Manufacturing	0	0	0	0	0.0	-0.4	2.3	1.9	0.0	-3.1	22.2	19.1
Transportation, Warehousing & Utilities	-1	0	0	-1	-68.2	-0.8	5.5	-63.5	-286.4	-2.8	18.0	-271.2
Wholesale Trade	0	0	0	0	0.0	-0.4	9.5	9.1	0.0	-1.0	27.1	26.1
Retail Trade	0	0	1	1	0.0	-0.5	23.3	22.9	0.0	-0.9	46.6	45.6
Information	0	0	0	0	0.0	-0.5	3.4	2.9	0.0	-3.4	20.6	17.2
Financial Activities	0	0	0	0	0.0	-2.2	16.9	14.7	0.0	-13.0	147.7	134.6
Services	0	0	2	1	0.0	-16.8	86.7	69.9	0.0	-30.8	154.7	123.9
Government	0	0	0	0	0.0	-0.1	1.9	1.8	0.0	-0.2	3.8	3.7
Total	**-1**	**-1**	**3**	**1**	**-68.2**	**-37.4**	**151.8**	**46.2**	**-286.4**	**-84.8**	**445.2**	**74.0**

Note:
* In 2012 dollars.

Table 19B.13 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Joaquin Valley under Alternative 1 as Compared to No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	2.2	2.2	0.0	0.0	6.7	6.7
Mining & Logging	0	0	0	0	0.0	0.1	2.1	2.2	0.0	0.4	6.4	6.8
Construction	0	0	0	0	0.0	7.1	3.1	10.1	0.0	13.3	5.6	18.9
Manufacturing	0	0	0	0	0.0	0.1	3.8	3.9	0.0	1.4	46.4	47.8
Transportation, Warehousing & Utilities	1	0	0	1	39.9	0.3	11.8	52.0	140.8	1.4	44.7	186.9
Wholesale Trade	0	0	0	0	0.0	0.1	13.3	13.4	0.0	0.4	39.0	39.3
Retail Trade	0	0	1	1	0.0	0.2	48.4	48.6	0.0	0.4	97.4	97.8
Information	0	0	0	0	0.0	0.2	4.9	5.1	0.0	1.0	27.0	28.0
Financial Activities	0	0	1	1	0.0	0.6	17.8	18.4	0.0	4.3	263.7	268.0
Services	0	0	3	3	0.0	6.1	155.3	161.4	0.0	11.7	292.3	303.9
Government	0	0	0	0	0.0	0.1	6.2	6.3	0.0	0.1	12.9	13.0
Total	**1**	**0**	**6**	**7**	**39.9**	**15.0**	**268.8**	**323.6**	**140.8**	**34.3**	**842.0**	**1,017.2**

Note:
* In 2012 dollars.

Table 19B.14 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Francisco under Alternative 1 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	4.1	4.0	0.0	-0.1	7.9	7.8
Mining & Logging	0	0	0	0	0.0	-0.7	1.8	1.1	0.0	-1.6	5.0	3.4
Construction	0	-1	0	-1	0.0	-96.2	22.8	-73.3	0.0	-158.8	37.1	-121.7
Manufacturing	0	0	0	0	0.0	-3.1	51.8	48.8	0.0	-28.8	478.0	449.1
Transportation, Warehousing & Utilities	-5	0	1	-4	-592.5	-3.4	65.0	-530.9	-1,492.4	-11.2	183.5	-1,320.1
Wholesale Trade	0	0	1	1	0.0	-2.2	157.8	155.6	0.0	-5.0	350.6	345.7
Retail Trade	0	0	6	6	0.0	-2.3	306.5	304.2	0.0	-4.2	567.2	563.0
Information	0	0	1	1	0.0	-4.4	91.6	87.2	0.0	-16.8	306.6	289.8
Financial Activities	0	0	5	4	0.0	-11.9	218.8	206.8	0.0	-55.8	1,740.5	1,684.7
Services	0	-1	20	19	0.0	-84.3	1,321.5	1,237.2	0.0	-133.7	2,162.8	2,029.1
Government	0	0	0	0	0.0	-0.4	30.5	30.1	0.0	-0.7	55.1	54.4
Total	**-5**	**-3**	**35**	**27**	**-592.5**	**-208.9**	**2,272.2**	**1,470.8**	**-1,492.4**	**-416.7**	**5,894.3**	**3,985.2**

Note:
* In 2012 dollars.

Table 19B.15 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Central Coast Region under Alternative 1 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	-0.2	2.2	2.0	0.0	-0.6	4.0	3.4
Mining & Logging	0	0	0	0	0.0	-1.8	2.1	0.3	0.0	-6.4	9.3	2.9
Construction	0	-2	0	-2	0.0	-106.3	5.4	-100.8	0.0	-201.9	9.7	-192.2
Manufacturing	0	0	0	0	0.0	-1.6	2.7	1.1	0.0	-26.8	51.8	25.0
Transportation, Warehousing & Utilities	-6	0	0	-6	-371.2	-3.8	13.4	-361.6	-1,510.8	-17.0	56.2	-1,471.6
Wholesale Trade	0	0	0	0	0.0	-1.7	20.2	18.5	0.0	-4.8	58.6	53.8
Retail Trade	0	0	1	1	0.0	-3.2	61.0	57.8	0.0	-6.1	118.5	112.4
Information	0	0	0	0	0.0	-2.3	9.0	6.7	0.0	-12.0	39.0	27.0
Financial Activities	0	0	1	1	0.0	-11.8	29.8	18.0	0.0	-68.9	352.0	283.2
Services	0	-2	5	3	0.0	-88.9	243.3	154.5	0.0	-167.1	447.4	280.3
Government	0	0	0	0	0.0	-0.5	6.7	6.2	0.0	-0.9	13.2	12.3
Total	**-6**	**-4**	**8**	**-2**	**-371.2**	**-222.1**	**395.9**	**-197.4**	**-1,510.8**	**-512.7**	**1,159.9**	**-863.6**

Note:
* In 2012 dollars.

Table 19B.16 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Southern California Region under Alternative 1 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	-2	-1	0.0	4.5	-126.9	-122.4	0.0	12.5	-272.7	-260.2
Mining & Logging	0	1	-1	-1	0.0	49.2	-98.7	-49.5	0.0	164.2	-369.0	-204.8
Construction	0	43	-3	40	0.0	2,828.3	-222.0	2,606.3	0.0	5,205.5	-395.5	4,810.0
Manufacturing	0	2	-10	-8	0.0	180.9	-803.4	-622.5	0.0	1,452.6	-6,814.5	-5,361.9
Transportation, Warehousing & Utilities	175	2	-12	166	12,868.2	164.5	-820.7	12,212.1	43,673.4	592.0	-2,602.9	41,662.5
Wholesale Trade	0	1	-20	-19	0.0	102.7	-1,618.8	-1,516.1	0.0	275.3	-4,339.0	-4,063.8
Retail Trade	0	2	-58	-56	0.0	89.5	-2,588.4	-2,498.8	0.0	170.6	-5,106.3	-4,935.7
Information	0	1	-6	-5	0.0	140.2	-752.3	-612.1	0.0	637.5	-2,962.1	-2,324.6
Financial Activities	0	9	-52	-43	0.0	573.3	-2,853.6	-2,280.3	0.0	2,528.7	-17,797.9	-15,269.1
Services	0	46	-212	-166	0.0	3,269.1	-11,460.9	-8,191.7	0.0	5,542.2	-20,430.6	-14,888.4
Government	0	0	-3	-3	0.0	17.1	-306.1	-289.0	0.0	29.8	-587.3	-557.5
Total	**175**	**108**	**-378**	**-95**	**12,868.2**	**7,419.5**	**-21,651.7**	**-1,364.0**	**43,673.4**	**16,611.0**	**-61,677.8**	**-1,393.5**

Note:
* In 2012 dollars.

Table 19B.17 Changes in Agricultural-related Regional Economic Impacts for the Sacramento Valley under Alternative 3 as Compared to the No Action Alternative in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	69	18	0	86	2.4	0.7	0.0	3.1	9.2	1.1	0.0	10.3
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
Manufacturing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Transportation, Warehousing & Utilities	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.3	0.1	0.4
Wholesale Trade	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.2	0.1	0.3
Retail Trade	0	0	3	3	0.0	0.0	0.1	0.1	0.0	0.0	0.3	0.3
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Financial Activities	0	5	2	7	0.0	0.2	0.1	0.3	0.0	1.3	0.7	2.0
Services	0	3	10	13	0.0	0.1	0.5	0.6	0.0	0.2	0.9	1.1
Government	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Total	**69**	**29**	**17**	**115**	**2.4**	**1.2**	**0.8**	**4.4**	**9.2**	**3.4**	**2.2**	**14.8**

Note:
* In 2012 dollars.

Table 19B.18 Changes in Agricultural-related Regional Economic Impacts for the San Joaquin Valley under Alternative 3 as Compared to the No Action Alternative in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	103	26	0	130	1.8	0.9	0.0	2.7	11.4	1.2	0.0	12.7
Mining & Logging	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.2
Construction	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1
Manufacturing	0	1	0	1	0.0	0.1	0.0	0.1	0.0	1.2	0.1	1.3
Transportation, Warehousing & Utilities	0	2	0	2	0.0	0.1	0.0	0.2	0.0	0.5	0.1	0.6
Wholesale Trade	0	1	0	1	0.0	0.1	0.0	0.1	0.0	0.2	0.1	0.3
Retail Trade	0	0	3	3	0.0	0.0	0.1	0.1	0.0	0.0	0.3	0.3
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Financial Activities	0	8	1	10	0.0	0.2	0.0	0.2	0.0	1.8	0.6	2.5
Services	0	3	9	12	0.0	0.1	0.4	0.5	0.0	0.3	0.7	1.0
Government	0	0	0	1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1
Total	**103**	**44**	**15**	**161**	**1.8**	**1.7**	**0.7**	**4.2**	**11.4**	**5.7**	**2.1**	**19.1**

Note:
* In 2012 dollars.

Table 19B.19 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Sacramento Valley under Alternative 3 as Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	-0.5	-0.5	0.0	0.1	-1.2	-1.1
Mining & Logging	0	0	0	0	0.0	0.1	0.0	0.1	0.0	0.4	-0.2	0.2
Construction	0	0	0	0	0.0	13.9	-1.0	12.8	0.0	25.8	-1.8	23.9
Manufacturing	0	0	0	0	0.0	0.4	-1.7	-1.4	0.0	2.8	-16.2	-13.5
Transportation, Warehousing & Utilities	1	0	0	1	60.6	0.7	-4.0	57.2	254.4	2.5	-13.1	243.7
Wholesale Trade	0	0	0	0	0.0	0.3	-7.0	-6.6	0.0	0.9	-20.0	-19.1
Retail Trade	0	0	0	0	0.0	0.4	-17.0	-16.5	0.0	0.8	-33.8	-33.0
Information	0	0	0	0	0.0	0.5	-2.5	-2.0	0.0	3.0	-15.1	-12.1
Financial Activities	0	0	0	0	0.0	2.0	-12.3	-10.3	0.0	11.6	-107.7	-96.1
Services	0	0	-1	-1	0.0	14.9	-63.3	-48.3	0.0	27.4	-112.8	-85.4
Government	0	0	0	0	0.0	0.1	-1.4	-1.3	0.0	0.1	-2.8	-2.7
Total	**1**	**1**	**-2**	**0**	**60.6**	**33.3**	**-110.7**	**-16.9**	**254.4**	**75.3**	**-324.8**	**4.9**

Note:
* In 2012 dollars.

Table 19B.20 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Joaquin Valley under Alternative 3 as Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	-0.1	-3.0	-3.0	0.0	-0.2	-8.9	-9.1
Mining & Logging	0	0	0	0	0.0	-0.4	-2.7	-3.1	0.0	-1.2	-8.5	-9.7
Construction	0	0	0	0	0.0	-23.0	-4.1	-27.1	0.0	-43.3	-7.4	-50.7
Manufacturing	0	0	0	0	0.0	-0.4	-5.0	-5.4	0.0	-4.4	-62.0	-66.3
Transportation, Warehousing & Utilities	-2	0	0	-2	-129.6	-1.1	-15.7	-146.4	-457.3	-4.4	-59.6	-521.3
Wholesale Trade	0	0	0	0	0.0	-0.4	-17.6	-18.0	0.0	-1.2	-51.6	-52.8
Retail Trade	0	0	-2	-2	0.0	-0.7	-64.9	-65.6	0.0	-1.3	-130.7	-132.0
Information	0	0	0	0	0.0	-0.5	-6.6	-7.1	0.0	-3.2	-36.0	-39.2
Financial Activities	0	0	-1	-1	0.0	-2.1	-23.7	-25.8	0.0	-14.1	-352.2	-366.3
Services	0	0	-5	-5	0.0	-19.9	-207.7	-227.6	0.0	-38.0	-391.1	-429.1
Government	0	0	0	0	0.0	-0.2	-8.3	-8.5	0.0	-0.3	-17.2	-17.5
Total	**-2**	**-1**	**-8**	**-11**	**-129.6**	**-48.6**	**-359.4**	**-537.5**	**-457.3**	**-111.6**	**-1,125.2**	**-1,694.1**

Note:
* In 2012 dollars.

Table 19B.21 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Francisco under Alternative 3 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	-3.1	-3.1	0.0	0.1	-6.0	-5.9
Mining & Logging	0	0	0	0	0.0	0.8	-1.3	-0.5	0.0	1.9	-3.8	-1.9
Construction	0	1	0	1	0.0	113.1	-17.3	95.7	0.0	186.7	-28.2	158.6
Manufacturing	0	0	0	0	0.0	3.6	-39.4	-35.8	0.0	33.9	-363.5	-329.6
Transportation, Warehousing & Utilities	6	0	-1	5	696.6	3.9	-49.2	651.3	1,754.5	13.2	-139.1	1,628.6
Wholesale Trade	0	0	-1	-1	0.0	2.6	-120.9	-118.3	0.0	5.8	-268.7	-262.9
Retail Trade	0	0	-5	-5	0.0	2.7	-231.6	-228.9	0.0	4.9	-428.6	-423.7
Information	0	0	0	0	0.0	5.2	-69.6	-64.4	0.0	19.8	-233.1	-213.4
Financial Activities	0	0	-3	-3	0.0	14.0	-165.9	-151.8	0.0	65.6	-1,320.3	-1,254.7
Services	0	1	-15	-14	0.0	99.2	-1,001.8	-902.7	0.0	157.2	-1,639.6	-1,482.4
Government	0	0	0	0	0.0	0.5	-23.1	-22.6	0.0	0.8	-41.8	-41.0
Total	**6**	**3**	**-26**	**-17**	**696.6**	**245.6**	**-1,723.3**	**-781.1**	**1,754.5**	**489.9**	**-4,472.7**	**-2,228.3**

Note:
* In 2012 dollars.

Table 19B.22 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Central Coast Region under Alternative 3 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.2	-1.6	-1.4	0.0	0.4	-2.8	-2.4
Mining & Logging	0	0	0	0	0.0	1.4	-1.5	-0.1	0.0	4.9	-6.5	-1.7
Construction	0	1	0	1	0.0	80.9	-3.8	77.1	0.0	153.8	-6.8	147.0
Manufacturing	0	0	0	0	0.0	1.2	-1.9	-0.6	0.0	20.4	-36.5	-16.0
Transportation, Warehousing & Utilities	5	0	0	5	282.7	2.9	-9.4	276.2	1,150.6	13.0	-39.5	1,124.0
Wholesale Trade	0	0	0	0	0.0	1.3	-14.3	-13.0	0.0	3.7	-41.4	-37.8
Retail Trade	0	0	-1	-1	0.0	2.5	-42.8	-40.3	0.0	4.7	-83.0	-78.4
Information	0	0	0	0	0.0	1.8	-6.3	-4.6	0.0	9.1	-27.4	-18.3
Financial Activities	0	0	-1	0	0.0	9.0	-20.9	-11.9	0.0	52.5	-247.3	-194.8
Services	0	1	-3	-2	0.0	67.7	-170.9	-103.2	0.0	127.3	-314.2	-186.9
Government	0	0	0	0	0.0	0.4	-4.7	-4.3	0.0	0.7	-9.3	-8.6
Total	**5**	**3**	**-6**	**2**	**282.7**	**169.1**	**-278.0**	**173.8**	**1,150.6**	**390.4**	**-814.8**	**726.2**

Note:
* In 2012 dollars.

Table 19B.23 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Southern California Region under Alternative 3 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	-1	-1	0.0	3.8	-68.1	-64.3	0.0	10.5	-146.4	-135.8
Mining & Logging	0	1	-1	0	0.0	41.5	-53.4	-12.0	0.0	138.6	-199.8	-61.2
Construction	0	37	-2	35	0.0	2,386.1	-118.9	2,267.2	0.0	4,391.6	-211.9	4,179.8
Manufacturing	0	2	-6	-3	0.0	152.6	-430.4	-277.8	0.0	1,225.5	-3,662.5	-2,437.0
Transportation, Warehousing & Utilities	148	2	-6	143	10,856.3	138.8	-437.2	10,557.9	36,845.0	499.5	-1,389.7	35,954.8
Wholesale Trade	0	1	-11	-10	0.0	86.6	-897.5	-810.8	0.0	232.2	-2,405.6	-2,173.3
Retail Trade	0	2	-31	-29	0.0	75.5	-1,362.6	-1,287.1	0.0	143.9	-2,688.1	-2,544.2
Information	0	1	-3	-2	0.0	118.3	-403.7	-285.4	0.0	537.8	-1,595.7	-1,057.9
Financial Activities	0	7	-28	-20	0.0	483.7	-1,519.6	-1,035.9	0.0	2,133.4	-9,496.1	-7,362.8
Services	0	39	-113	-74	0.0	2,758.0	-6,109.8	-3,351.8	0.0	4,675.7	-10,892.2	-6,216.5
Government	0	0	-2	-1	0.0	14.4	-163.2	-148.8	0.0	25.1	-314.7	-289.6
Total	**148**	**91**	**-202**	**37**	**10,856.3**	**6,259.4**	**-11,564.4**	**5,551.3**	**36,845.0**	**14,013.9**	**-33,002.7**	**17,856.2**

Note:
* In 2012 dollars.

Table 19B.24 Changes in Agricultural-related Regional Economic Impacts for the Sacramento Valley under Alternative 3 as Compared to Second Basis of the Comparison in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	-18	-4	0	-22	-0.3	-0.1	0.0	-0.4	-2.1	-0.2	0.0	-2.3
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation, Warehousing & Utilities	0	0	0	0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Wholesale Trade	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Retail Trade	0	0	0	-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Financial Activities	0	-2	0	-2	0.0	-0.1	0.0	-0.1	0.0	-0.4	-0.1	-0.5
Services	0	-1	-1	-2	0.0	0.0	-0.1	-0.1	0.0	-0.1	-0.1	-0.2
Government	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**-18**	**-7**	**-2**	**-27**	**-0.3**	**-0.3**	**-0.1**	**-0.6**	**-2.1**	**-0.9**	**-0.3**	**-3.3**

Note:
* In 2012 dollars.

Table 19B.25 Changes in Agricultural-related Regional Economic Impacts for the San Joaquin Valley under Alternative 3 as Compared to Second Basis of the Comparison in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	-36	-26	0	-63	-3.4	-0.9	0.0	-4.4	-8.9	-1.1	0.0	-10.0
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Construction	0	-1	0	-1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Manufacturing	0	0	0	-1	0.0	0.0	0.0	-0.1	0.0	-0.7	-0.2	-0.8
Transportation, Warehousing & Utilities	0	-1	-1	-2	0.0	-0.1	0.0	-0.1	0.0	-0.3	-0.1	-0.5
Wholesale Trade	0	-1	-1	-1	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.2
Retail Trade	0	0	-4	-4	0.0	0.0	-0.2	-0.2	0.0	0.0	-0.4	-0.4
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Financial Activities	0	-4	-2	-5	0.0	-0.1	-0.1	-0.2	0.0	-0.8	-0.9	-1.7
Services	0	-2	-12	-14	0.0	-0.1	-0.5	-0.6	0.0	-0.2	-1.0	-1.2
Government	0	0	0	0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1
Total	**-36**	**-36**	**-20**	**-92**	**-3.4**	**-1.4**	**-0.9**	**-5.8**	**-8.9**	**-3.5**	**-2.8**	**-15.3**

Note:
* In 2012 dollars.

Table 19B.26 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Sacramento Valley under Alternative 3 as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	0.2	0.2	0.0	0.0	0.5	0.5
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Construction	0	0	0	0	0.0	-1.9	0.4	-1.5	0.0	-3.5	0.7	-2.8
Manufacturing	0	0	0	0	0.0	0.0	0.7	0.6	0.0	-0.4	6.4	6.0
Transportation, Warehousing & Utilities	0	0	0	0	-8.2	-0.1	1.6	-6.7	-34.6	-0.3	5.2	-29.7
Wholesale Trade	0	0	0	0	0.0	0.0	2.7	2.6	0.0	-0.1	7.7	7.6
Retail Trade	0	0	0	0	0.0	-0.1	6.8	6.8	0.0	-0.1	13.6	13.5
Information	0	0	0	0	0.0	-0.1	1.0	0.9	0.0	-0.4	6.0	5.5
Financial Activities	0	0	0	0	0.0	-0.3	4.9	4.6	0.0	-1.6	42.9	41.3
Services	0	0	0	0	0.0	-2.0	25.2	23.2	0.0	-3.7	45.0	41.2
Government	0	0	0	0	0.0	0.0	0.6	0.6	0.0	0.0	1.1	1.1
Total	**0**	**0**	**1**	**1**	**-8.2**	**-4.5**	**44.1**	**31.4**	**-34.6**	**-10.2**	**129.2**	**84.4**

Note:
* In 2012 dollars.

Table 19B.27 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Joaquin Valley under Alternative 3 as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	-0.7	-0.8	0.0	-0.1	-2.3	-2.4
Mining & Logging	0	0	0	0	0.0	-0.3	-0.7	-1.0	0.0	-0.8	-2.1	-3.0
Construction	0	0	0	0	0.0	-15.9	-1.0	-16.9	0.0	-29.9	-1.9	-31.8
Manufacturing	0	0	0	0	0.0	-0.3	-1.3	-1.5	0.0	-3.0	-15.5	-18.6
Transportation, Warehousing & Utilities	-1	0	0	-1	-89.5	-0.8	-4.0	-94.2	-315.8	-3.0	-14.9	-333.7
Wholesale Trade	0	0	0	0	0.0	-0.3	-4.3	-4.6	0.0	-0.8	-12.7	-13.5
Retail Trade	0	0	0	0	0.0	-0.5	-16.6	-17.0	0.0	-0.9	-33.4	-34.3
Information	0	0	0	0	0.0	-0.4	-1.6	-2.0	0.0	-2.2	-9.0	-11.2
Financial Activities	0	0	0	0	0.0	-1.4	-5.9	-7.4	0.0	-9.7	-88.6	-98.4
Services	0	0	-1	-1	0.0	-13.7	-52.5	-66.2	0.0	-26.2	-99.0	-125.2
Government	0	0	0	0	0.0	-0.1	-2.1	-2.2	0.0	-0.2	-4.3	-4.5
Total	**-1**	**-1**	**-2**	**-4**	**-89.5**	**-33.5**	**-90.7**	**-213.7**	**-315.8**	**-77.0**	**-283.5**	**-676.3**

Note:
* In 2012 dollars.

Table 19B.28 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Francisco under Alternative 3 Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	1.0	1.0	0.0	0.0	1.9	1.9
Mining & Logging	0	0	0	0	0.0	0.1	0.4	0.5	0.0	0.3	1.2	1.5
Construction	0	0	0	0	0.0	16.9	5.5	22.4	0.0	28.0	9.0	36.9
Manufacturing	0	0	0	0	0.0	0.5	12.5	13.0	0.0	5.1	114.4	119.5
Transportation, Warehousing & Utilities	1	0	0	1	104.3	0.6	15.7	120.6	262.6	2.0	44.3	308.9
Wholesale Trade	0	0	0	0	0.0	0.4	36.9	37.3	0.0	0.9	81.9	82.8
Retail Trade	0	0	2	2	0.0	0.4	74.9	75.3	0.0	0.7	138.5	139.3
Information	0	0	0	0	0.0	0.8	22.0	22.8	0.0	3.0	73.5	76.4
Financial Activities	0	0	1	1	0.0	2.1	52.9	55.0	0.0	9.8	420.2	430.0
Services	0	0	5	5	0.0	14.8	319.7	334.5	0.0	23.5	523.1	546.7
Government	0	0	0	0	0.0	0.1	7.4	7.4	0.0	0.1	13.3	13.4
Total	**1**	**0**	**8**	**10**	**104.3**	**36.8**	**548.8**	**689.8**	**262.6**	**73.3**	**1,421.3**	**1,757.2**

Note:
* In 2012 dollars.

Table 19B.29 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Central Coast Region under Alternative 3 Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	-0.1	0.7	0.6	0.0	-0.1	1.2	1.0
Mining & Logging	0	0	0	0	0.0	-0.4	0.6	0.2	0.0	-1.5	2.8	1.2
Construction	0	0	0	0	0.0	-25.3	1.6	-23.7	0.0	-48.1	2.9	-45.2
Manufacturing	0	0	0	0	0.0	-0.4	0.8	0.4	0.0	-6.4	15.4	9.0
Transportation, Warehousing & Utilities	-2	0	0	-2	-88.4	-0.9	4.0	-85.3	-359.9	-4.1	16.7	-347.2
Wholesale Trade	0	0	0	0	0.0	-0.4	5.9	5.5	0.0	-1.2	17.2	16.1
Retail Trade	0	0	0	0	0.0	-0.8	18.3	17.5	0.0	-1.5	35.5	34.1
Information	0	0	0	0	0.0	-0.6	2.7	2.1	0.0	-2.9	11.6	8.8
Financial Activities	0	0	0	0	0.0	-2.8	8.9	6.1	0.0	-16.4	104.9	88.5
Services	0	0	1	1	0.0	-21.2	72.5	51.4	0.0	-39.8	133.4	93.6
Government	0	0	0	0	0.0	-0.1	2.0	1.9	0.0	-0.2	3.9	3.7
Total	**-2**	**-1**	**2**	**0**	**-88.4**	**-52.9**	**118.0**	**-23.3**	**-359.9**	**-122.1**	**345.5**	**-136.5**

Note:
* In 2012 dollars.

Table 19B.30 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Southern California Region under Alternative 3 Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	1	1	0.0	-0.7	58.8	58.1	0.0	-2.0	126.3	124.4
Mining & Logging	0	0	1	0	0.0	-7.7	45.3	37.6	0.0	-25.7	169.2	143.5
Construction	0	-7	1	-5	0.0	-442.2	103.1	-339.1	0.0	-813.9	183.7	-630.2
Manufacturing	0	0	5	4	0.0	-28.3	373.0	344.7	0.0	-227.1	3,152.0	2,924.9
Transportation, Warehousing & Utilities	-27	0	5	-22	-2,011.9	-25.7	383.5	-1,654.2	-6,828.3	-92.6	1,213.1	-5,707.8
Wholesale Trade	0	0	9	9	0.0	-16.1	721.4	705.3	0.0	-43.0	1,933.5	1,890.4
Retail Trade	0	0	27	27	0.0	-14.0	1,225.7	1,211.7	0.0	-26.7	2,418.2	2,391.5
Information	0	0	3	3	0.0	-21.9	348.6	326.7	0.0	-99.7	1,366.4	1,266.7
Financial Activities	0	-1	24	23	0.0	-89.6	1,334.0	1,244.4	0.0	-395.4	8,301.7	7,906.3
Services	0	-7	99	92	0.0	-511.1	5,351.1	4,839.9	0.0	-866.5	9,538.4	8,671.9
Government	0	0	1	1	0.0	-2.7	142.9	140.2	0.0	-4.7	272.6	268.0
Total	**-27**	**-17**	**177**	**132**	**-2,011.9**	**-1,160.0**	**10,087.3**	**6,915.3**	**-6,828.3**	**-2,597.1**	**28,675.1**	**19,249.7**

Note:
* In 2012 dollars.

Table 19B.31 Changes in Agricultural-related Regional Economic Impacts for the Sacramento Valley under Alternative 5 as Compared to the No Action Alternative in Dry and Critical Dry Years

	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
Economic Sectors	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	3	2	0	4	0.4	0.1	0.0	0.4	0.8	0.1	0.0	0.9
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation, Warehousing & Utilities	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wholesale Trade	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Retail Trade	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Financial Activities	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2
Services	0	0	1	2	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1
Government	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**3**	**2**	**2**	**7**	**0.4**	**0.1**	**0.1**	**0.6**	**0.8**	**0.2**	**0.3**	**1.3**

Note:
* In 2012 dollars.

Table 19B.32 Changes in Agricultural-related Regional Economic Impacts for the San Joaquin Valley under Alternative 5 as Compared to the No Action Alternative in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	-5	-9	0	-14	-1.3	-0.3	0.0	-1.6	-2.7	-0.4	0.0	-3.0
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	-0.2
Transportation, Warehousing & Utilities	0	0	0	-1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Wholesale Trade	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Retail Trade	0	0	-2	-2	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1	-0.1
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Financial Activities	0	-1	-1	-1	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.5
Services	0	-1	-4	-5	0.0	0.0	-0.2	-0.2	0.0	-0.1	-0.4	-0.4
Government	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**-5**	**-11**	**-7**	**-24**	**-1.3**	**-0.4**	**-0.3**	**-2.1**	**-2.7**	**-0.9**	**-1.0**	**-4.6**

Note:
* In 2012 dollars.

Table 19B.33 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Sacramento Valley under Alternative 5 as Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	0	0	0	0.0	-0.4	0.0	-0.4	0.0	-0.8	0.1	-0.7
Manufacturing	0	0	0	0	0.0	0.0	0.1	0.0	0.0	-0.1	0.6	0.5
Transportation, Warehousing & Utilities	0	0	0	0	-1.8	0.0	0.1	-1.7	-7.8	-0.1	0.5	-7.4
Wholesale Trade	0	0	0	0	0.0	0.0	0.2	0.2	0.0	0.0	0.7	0.7
Retail Trade	0	0	0	0	0.0	0.0	0.6	0.6	0.0	0.0	1.2	1.1
Information	0	0	0	0	0.0	0.0	0.1	0.1	0.0	-0.1	0.5	0.4
Financial Activities	0	0	0	0	0.0	-0.1	0.4	0.4	0.0	-0.4	3.7	3.4
Services	0	0	0	0	0.0	-0.5	2.2	1.7	0.0	-0.8	3.9	3.0
Government	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total	**0**	**0**	**0**	**0**	**-1.8**	**-1.0**	**3.8**	**0.9**	**-7.8**	**-2.3**	**11.2**	**1.1**

Note:
* In 2012 dollars.

Table 19B.34 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Joaquin Valley under Alternative 5 as Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	0.2	0.3	0.0	0.1	0.7	0.8
Mining & Logging	0	0	0	0	0.0	0.1	0.2	0.3	0.0	0.4	0.7	1.0
Construction	0	0	0	0	0.0	7.4	0.3	7.7	0.0	13.9	0.6	14.5
Manufacturing	0	0	0	0	0.0	0.1	0.4	0.5	0.0	1.4	4.8	6.2
Transportation, Warehousing & Utilities	1	0	0	1	41.5	0.4	1.2	43.1	146.6	1.4	4.6	152.6
Wholesale Trade	0	0	0	0	0.0	0.1	1.3	1.4	0.0	0.4	3.9	4.3
Retail Trade	0	0	0	0	0.0	0.2	5.2	5.5	0.0	0.4	10.6	11.0
Information	0	0	0	0	0.0	0.2	0.5	0.7	0.0	1.0	2.8	3.8
Financial Activities	0	0	0	0	0.0	0.7	1.8	2.5	0.0	4.5	27.7	32.3
Services	0	0	0	0	0.0	6.4	16.5	22.8	0.0	12.2	31.1	43.3
Government	0	0	0	0	0.0	0.1	0.7	0.7	0.0	0.1	1.3	1.5
Total	**1**	**0**	**1**	**1**	**41.5**	**15.6**	**28.5**	**85.6**	**146.6**	**35.8**	**88.8**	**271.2**

Note:
* In 2012 dollars.

Table 19B.35 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Francisco under Alternative 5 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	0.3	0.3	0.0	0.0	0.5	0.5
Mining & Logging	0	0	0	0	0.0	-0.1	0.1	0.0	0.0	-0.2	0.3	0.1
Construction	0	0	0	0	0.0	-10.5	1.5	-9.0	0.0	-17.4	2.4	-15.0
Manufacturing	0	0	0	0	0.0	-0.3	3.3	3.0	0.0	-3.2	30.9	27.8
Transportation, Warehousing & Utilities	-1	0	0	-1	-64.8	-0.4	4.2	-60.9	-163.1	-1.2	11.8	-152.5
Wholesale Trade	0	0	0	0	0.0	-0.2	10.3	10.1	0.0	-0.5	22.9	22.4
Retail Trade	0	0	0	0	0.0	-0.3	19.7	19.4	0.0	-0.5	36.4	35.9
Information	0	0	0	0	0.0	-0.5	5.9	5.4	0.0	-1.8	19.8	18.0
Financial Activities	0	0	0	0	0.0	-1.3	14.1	12.8	0.0	-6.1	112.3	106.2
Services	0	0	1	1	0.0	-9.2	85.2	75.9	0.0	-14.6	139.4	124.8
Government	0	0	0	0	0.0	0.0	2.0	1.9	0.0	-0.1	3.6	3.5
Total	**-1**	**0**	**2**	**1**	**-64.8**	**-22.8**	**146.5**	**58.9**	**-163.1**	**-45.5**	**380.3**	**171.7**

Note:
* In 2012 dollars.

Table 19B.36 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Central Coast Region under Alternative 5 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	0.2	0.1	0.0	0.0	0.3	0.2
Mining & Logging	0	0	0	0	0.0	-0.1	0.1	0.0	0.0	-0.4	0.6	0.2
Construction	0	0	0	0	0.0	-6.8	0.4	-6.5	0.0	-13.0	0.7	-12.3
Manufacturing	0	0	0	0	0.0	-0.1	0.2	0.1	0.0	-1.7	3.5	1.8
Transportation, Warehousing & Utilities	0	0	0	0	-23.9	-0.2	0.9	-23.2	-97.1	-1.1	3.9	-94.3
Wholesale Trade	0	0	0	0	0.0	-0.1	1.4	1.3	0.0	-0.3	4.0	3.7
Retail Trade	0	0	0	0	0.0	-0.2	4.2	4.0	0.0	-0.4	8.1	7.8
Information	0	0	0	0	0.0	-0.1	0.6	0.5	0.0	-0.8	2.7	1.9
Financial Activities	0	0	0	0	0.0	-0.8	2.0	1.3	0.0	-4.4	24.1	19.7
Services	0	0	0	0	0.0	-5.7	16.7	11.0	0.0	-10.7	30.7	19.9
Government	0	0	0	0	0.0	0.0	0.5	0.4	0.0	-0.1	0.9	0.8
Total	**0**	**0**	**1**	**0**	**-23.9**	**-14.3**	**27.1**	**-11.0**	**-97.1**	**-32.9**	**79.5**	**-50.5**

Note:
* In 2012 dollars.

Table 19B.37 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Southern California Region under Alternative 5 Compared to the No Action Alternative

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.9	1.6	2.5	0.0	2.5	3.3	5.9
Mining & Logging	0	0	0	0	0.0	9.9	0.9	10.8	0.0	33.1	3.3	36.4
Construction	0	9	0	9	0.0	570.2	2.9	573.1	0.0	1,049.4	5.1	1,054.5
Manufacturing	0	0	0	1	0.0	36.5	10.4	46.9	0.0	292.8	80.2	373.0
Transportation, Warehousing & Utilities	35	0	0	36	2,594.1	33.2	12.3	2,639.6	8,804.2	119.3	37.0	8,960.5
Wholesale Trade	0	0	0	0	0.0	20.7	-0.1	20.6	0.0	55.5	-0.2	55.3
Retail Trade	0	0	1	2	0.0	18.1	50.3	68.4	0.0	34.4	99.3	133.7
Information	0	0	0	0	0.0	28.3	9.3	37.6	0.0	128.5	32.2	160.8
Financial Activities	0	2	1	2	0.0	115.6	43.4	158.9	0.0	509.8	257.7	767.4
Services	0	9	3	13	0.0	659.0	169.6	828.6	0.0	1,117.3	301.8	1,419.1
Government	0	0	0	0	0.0	3.5	4.5	8.0	0.0	6.0	7.6	13.6
Total	**35**	**22**	**6**	**63**	**2,594.1**	**1,495.7**	**305.1**	**4,394.9**	**8,804.2**	**3,348.6**	**827.3**	**12,980.1**

Note:
* In 2012 dollars.

Table 19B.38 Changes in Agricultural-Related Regional Economic Impacts for the Sacramento Valley under Alternative 5 as Compared to the Second Basis of Comparison in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	-84	-20	0	-104	-2.3	-0.8	0.0	-3.1	-10.5	-1.2	0.0	-11.8
Mining & Logging	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0	-1	0	-1	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	-0.1
Manufacturing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Transportation, Warehousing & Utilities	0	-1	0	-2	0.0	-0.1	0.0	-0.1	0.0	-0.3	-0.1	-0.5
Wholesale Trade	0	-1	0	-1	0.0	-0.1	0.0	-0.1	0.0	-0.2	-0.1	-0.3
Retail Trade	0	0	-3	-4	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.3	-0.3
Information	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Financial Activities	0	-7	-2	-8	0.0	-0.2	-0.1	-0.3	0.0	-1.6	-0.7	-2.3
Services	0	-3	-10	-13	0.0	-0.1	-0.5	-0.6	0.0	-0.3	-0.9	-1.1
Government	0	0	0	0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1
Total	**-84**	**-34**	**-17**	**-135**	**-2.3**	**-1.4**	**-0.8**	**-4.5**	**-10.5**	**-4.0**	**-2.2**	**-16.8**

Note:
* In 2012 dollars.

Table 19B.39 Changes in Agricultural-Related Regional Economic Impacts for the San Joaquin Valley under Alternative 5 as Compared to the Second Basis of Comparison in Dry and Critical Dry Years

Economic Sectors	Employment				Labor Income ($ millions)*				Economic Output ($ millions)*			
	Direct	**Indirect**	**Induced**	**Total**	**Direct**	**Indirect**	**Induced**	**Total**	**Direct**	**Indirect**	**Induced**	**Total**
Agriculture	-145	-61	0	-206	-6.5	-2.2	0.0	-8.7	-22.9	-2.7	-0.1	-25.7
Mining & Logging	0	-1	0	-1	0.0	-0.1	0.0	-0.1	0.0	-0.3	0.0	-0.4
Construction	0	-2	0	-2	0.0	-0.1	0.0	-0.1	0.0	-0.2	0.0	-0.2
Manufacturing	0	-1	-1	-2	0.0	-0.1	0.0	-0.1	0.0	-2.0	-0.4	-2.4
Transportation, Warehousing & Utilities	0	-3	-1	-4	0.0	-0.2	-0.1	-0.3	0.0	-0.9	-0.3	-1.2
Wholesale Trade	0	-2	-1	-3	0.0	-0.1	-0.1	-0.2	0.0	-0.4	-0.2	-0.6
Retail Trade	0	0	-9	-9	0.0	0.0	-0.4	-0.4	0.0	0.0	-0.7	-0.8
Information	0	0	0	-1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.2
Financial Activities	0	-13	-4	-16	0.0	-0.3	-0.1	-0.4	0.0	-2.8	-1.8	-4.6
Services	0	-6	-25	-31	0.0	-0.3	-1.1	-1.4	0.0	-0.6	-2.1	-2.7
Government	0	-1	0	-1	0.0	-0.1	0.0	-0.1	0.0	-0.2	-0.1	-0.3
Total	**-145**	**-90**	**-42**	**-277**	**-6.5**	**-3.6**	**-1.9**	**-12.0**	**-22.9**	**-10.2**	**-5.9**	**-39.0**

Note:
* In 2012 dollars.

Table 19B.40 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Sacramento Valley under Alternative 5 as Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	0.8	0.7	0.0	-0.1	1.7	1.6
Mining & Logging	0	0	0	0	0.0	-0.1	0.1	-0.1	0.0	-0.4	0.3	-0.1
Construction	0	0	0	0	0.0	-16.1	1.5	-14.7	0.0	-29.9	2.6	-27.3
Manufacturing	0	0	0	0	0.0	-0.4	2.4	2.0	0.0	-3.2	22.7	19.5
Transportation, Warehousing & Utilities	-1	0	0	-1	-70.3	-0.8	5.6	-65.4	-295.2	-2.9	18.4	-279.6
Wholesale Trade	0	0	0	0	0.0	-0.4	9.7	9.3	0.0	-1.0	27.8	26.8
Retail Trade	0	0	1	1	0.0	-0.5	23.9	23.4	0.0	-0.9	47.7	46.8
Information	0	0	0	0	0.0	-0.5	3.5	3.0	0.0	-3.5	21.1	17.6
Financial Activities	0	0	0	0	0.0	-2.3	17.3	15.0	0.0	-13.4	151.3	137.9
Services	0	0	2	1	0.0	-17.3	88.9	71.5	0.0	-31.8	158.5	126.8
Government	0	0	0	0	0.0	-0.1	2.0	1.9	0.0	-0.2	3.9	3.8
Total	**-1**	**-1**	**3**	**1**	**-70.3**	**-38.6**	**155.6**	**46.7**	**-295.2**	**-87.3**	**456.1**	**73.6**

Note:
* In 2012 dollars.

Table 19B.41 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Joaquin Valley under Alternative 5 Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	2.4	2.5	0.0	0.1	7.4	7.5
Mining & Logging	0	0	0	0	0.0	0.3	2.3	2.5	0.0	0.8	7.1	7.8
Construction	0	0	0	0	0.0	14.4	3.4	17.8	0.0	27.2	6.1	33.4
Manufacturing	0	0	0	0	0.0	0.2	4.2	4.4	0.0	2.8	51.3	54.1
Transportation, Warehousing & Utilities	1	0	0	1	81.4	0.7	13.0	95.1	287.4	2.8	49.4	339.5
Wholesale Trade	0	0	0	0	0.0	0.2	14.6	14.8	0.0	0.7	42.9	43.6
Retail Trade	0	0	1	1	0.0	0.4	53.6	54.0	0.0	0.8	107.9	108.7
Information	0	0	0	0	0.0	0.3	5.4	5.7	0.0	2.0	29.8	31.8
Financial Activities	0	0	1	1	0.0	1.3	19.7	20.9	0.0	8.9	291.4	300.3
Services	0	0	4	4	0.0	12.5	171.8	184.3	0.0	23.9	323.4	347.2
Government	0	0	0	0	0.0	0.1	6.9	7.0	0.0	0.2	14.2	14.5
Total	**1**	**1**	**6**	**8**	**81.4**	**30.5**	**297.2**	**409.2**	**287.4**	**70.1**	**930.8**	**1,288.4**

Note:
* In 2012 dollars.

Table 19B.42 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the San Francisco under Alternative 5 Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	0.0	4.3	4.3	0.0	-0.1	8.4	8.3
Mining & Logging	0	0	0	0	0.0	-0.8	1.9	1.1	0.0	-1.7	5.3	3.5
Construction	0	-1	0	-1	0.0	-106.6	24.3	-82.3	0.0	-176.1	39.5	-136.6
Manufacturing	0	0	1	0	0.0	-3.4	55.2	51.8	0.0	-32.0	509.0	477.0
Transportation, Warehousing & Utilities	-6	0	1	-5	-656.9	-3.7	69.2	-591.5	-1,654.5	-12.4	195.3	-1,471.6
Wholesale Trade	0	0	2	1	0.0	-2.5	168.2	165.7	0.0	-5.5	373.6	368.1
Retail Trade	0	0	7	7	0.0	-2.5	326.2	323.7	0.0	-4.7	603.7	599.0
Information	0	0	1	1	0.0	-4.9	97.6	92.7	0.0	-18.6	326.5	307.9
Financial Activities	0	0	5	5	0.0	-13.2	232.9	219.7	0.0	-61.9	1,853.1	1,791.2
Services	0	-1	22	20	0.0	-93.5	1,406.9	1,313.4	0.0	-148.2	2,302.6	2,154.4
Government	0	0	0	0	0.0	-0.4	32.4	32.0	0.0	-0.7	58.7	57.9
Total	**-6**	**-3**	**37**	**29**	**-656.9**	**-231.6**	**2,419.1**	**1,530.6**	**-1,654.5**	**-462.0**	**6,275.6**	**4,159.1**

Note:
* In 2012 dollars.

Table 19B.43 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Central Coast Region under Alternative 5 Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	0	0	0.0	-0.2	2.4	2.2	0.0	-0.6	4.3	3.7
Mining & Logging	0	0	0	0	0.0	-1.9	2.3	0.3	0.0	-6.8	9.9	3.1
Construction	0	-2	0	-2	0.0	-113.0	5.8	-107.2	0.0	-214.8	10.4	-204.4
Manufacturing	0	0	0	0	0.0	-1.7	2.8	1.1	0.0	-28.6	55.4	26.8
Transportation, Warehousing & Utilities	-7	0	0	-7	-394.8	-4.0	14.3	-384.5	-1,606.9	-18.1	60.1	-1,565.0
Wholesale Trade	0	0	0	0	0.0	-1.8	21.6	19.8	0.0	-5.1	62.7	57.5
Retail Trade	0	0	1	1	0.0	-3.4	65.2	61.8	0.0	-6.5	126.7	120.2
Information	0	0	0	0	0.0	-2.5	9.6	7.2	0.0	-12.8	41.7	29.0
Financial Activities	0	0	1	1	0.0	-12.6	31.8	19.3	0.0	-73.3	376.2	303.0
Services	0	-2	5	3	0.0	-94.5	260.1	165.5	0.0	-177.8	478.2	300.4
Government	0	0	0	0	0.0	-0.5	7.1	6.6	0.0	-1.0	14.1	13.1
Total	**-7**	**-4**	**9**	**-2**	**-394.8**	**-236.2**	**423.1**	**-207.9**	**-1,606.9**	**-545.3**	**1,239.6**	**-912.6**

Note:
* In 2012 dollars.

Table 19B.44 Changes in Municipal and Industrial Water Supply-related Regional Economic Impacts for the Southern California Region under Alternative 5 Compared to the Second Basis of Comparison

Economic Sectors	Employment				Labor Income ($ thousands)*				Economic Output ($ thousands)*			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Agriculture	0	0	2	1	0.0	-3.6	128.5	124.9	0.0	-10.0	276.1	266.1
Mining & Logging	0	0	1	1	0.0	-39.2	99.6	60.3	0.0	-131.1	372.3	241.2
Construction	0	-35	3	-32	0.0	-2,258.1	224.9	-2,033.2	0.0	-4,156.1	400.7	-3,755.4
Manufacturing	0	-2	10	9	0.0	-144.4	813.8	669.4	0.0	-1,159.8	6,894.7	5,734.9
Transportation, Warehousing & Utilities	-140	-2	12	-130	-10,274.1	-131.4	833.0	-9,572.5	-34,869.2	-472.7	2,639.9	-32,702.0
Wholesale Trade	0	-1	20	19	0.0	-82.0	1,618.8	1,536.8	0.0	-219.8	4,338.8	4,119.1
Retail Trade	0	-2	59	58	0.0	-71.5	2,638.7	2,567.2	0.0	-136.2	5,205.5	5,069.3
Information	0	-1	7	6	0.0	-112.0	761.6	649.7	0.0	-509.0	2,994.4	2,485.4
Financial Activities	0	-7	52	45	0.0	-457.7	2,896.9	2,439.2	0.0	-2,019.0	18,055.5	16,036.5
Services	0	-37	215	178	0.0	-2,610.1	11,630.4	9,020.3	0.0	-4,424.9	20,732.4	16,307.5
Government	0	0	3	3	0.0	-13.7	310.6	296.9	0.0	-23.8	594.9	571.1
Total	**-140**	**-86**	**384**	**158**	**-10,274.1**	**-5,923.8**	**21,956.8**	**5,758.9**	**-34,869.2**	**-13,262.4**	**62,505.2**	**14,373.6**

Note:
* In 2012 dollars.

Appendix 23A

Scoping Report

This appendix includes the Scoping Report as it was published in February 2013.

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RECLAMATION

Managing Water in the West

Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Environmental Impact Statement Scoping Report

Mid-Pacific Region
Bay-Delta Office

U.S. Department of the Interior
Bureau of Reclamation

February 2013

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Contents

Abbreviations and Acronyms

BDCP	Bay Delta Conservation Plan
BA	Biological Assessment
BIA	Bureau of Indian Affairs
CFR	Code of Federal Regulations
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
District Court	US District Court for the Eastern District of California
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMFS BO	National Marine Fisheries Service Biological Opinion
NOI	Notice of Intent
Reclamation	Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
SWP	State Water Project
SWRCB	State Water Resources Control Board
USACE	US Army Corps of Engineers
USEPA	US Environmental Protection Agency
USFWS	US Fish & Wildlife Service
USFWS BO	US Fish & Wildlife Service Biological Opinion

Chapter 1

Introduction

An Environmental Impact Statement (EIS) is being prepared by the Department of the Interior Bureau of Reclamation (Reclamation) for the Remanded Biological Opinions on the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP). Reclamation intends to prepare an EIS for modifications to the continued long-term operation of the CVP, in a coordinated manner with the SWP, that are likely to avoid jeopardy and destruction or adverse modification of designated critical habitat in accordance with the federal Endangered Species Act (ESA). The EIS will be prepared in accordance with the National Environmental Policy Act (NEPA). Reclamation initiated the public scoping process to obtain suggestions and information on the alternatives and topics to be addressed, and any other important issues related to the proposed action.

This Scoping Report documents the public scoping process and comments received by Reclamation on the scope of the EIS.

Scoping Purpose and Process

Scoping provides an opportunity to involve other agencies, interested persons, and the public early in the decision-making process to identify concerns and alternatives, collect information to be considered during preparation of the EIS, and identify the need to focus on specific issues during the impacts and benefits analysis.

Scoping is conducted in accordance with NEPA regulations (40 Code of Federal Regulations (CFR) 1501.7) defined as "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." The information will be used to identify significant issues, including issues related to the approach to resource issues, study constraints, potentially affected geographical areas, and extent of impact assessments; study participants and methods for participation in the study; alternatives to be considered; potential cumulative impacts; and related activities. The lead Federal agency is required by 40 CFR 1501.7(a) to:

- Invite participation of affected Federal, State, and local agencies; affected Indian tribes; and other interested persons.
- Determine the scope and the significant issues to be analyzed in depth in the environmental impact statement.
- Identify study issues which are not significant or which have been covered by prior environmental review, and narrow the discussion of these issues to a brief presentation of why these issues will not have a significant effect on the human environment or providing a reference to their coverage elsewhere.

- Allocate assignments for preparation of the EIS among lead and cooperating agencies, with the lead agency retaining responsibility for the EIS.
- Indicate any public environmental assessments and other environmental impact statements which are being or will be prepared that are related to but are not part of the scope of the impact statement under consideration.
- Identify other environmental review and consultation requirements so the lead and cooperating agencies may prepare other required analyses and studies concurrently with, and integrated with, the EIS.
- Indicate the relationship between the timing of the preparation of environmental analyses and the agency's tentative planning and decision-making schedule.

Scoping comments can be used to focus the NEPA analysis on the potentially significant issues (40 CFR 1500.4(g)).

Scoping is to be initiated as soon as possible after the lead agency(s) decides to prepare an EIS (40 CFR 1508.22) through the publication of a Notice of Intent (NOI) to prepare an EIS. The NOI is published in the Federal Register prior to initiating the public scoping process. Public scoping meetings are generally held following publication of the NOI. Comments continue to be collected for several weeks following the scoping meetings. A scoping report is often published to summarize the issues identified in the formal scoping process and publicize decisions related to preparation of the EIS. Scoping frequently continues throughout the preparation of the Draft EIS.

Overview of Scoping Process

Reclamation initiated the public scoping process by issuing the NOI to prepare an EIS on March 28, 2012. A copy of the NOI is included in Attachment A. In accordance with the NOI, Reclamation initially held four public scoping meetings throughout the State. In response to numerous requests from other agencies and interested persons, Reclamation held a fifth scoping meeting. The scoping process is described in more detail in Chapter 3, Scoping Process, of this Scoping Report.

Cooperating Agencies

A cooperating agency is defined as any Federal agency, except the NEPA lead agency, that has jurisdiction by law or has special expertise with respect to any environmental issue that should be addressed in the EIS. A cooperating agency also can include a governmental entity (state, tribal, or local) that has jurisdiction by law or special expertise with respect to any environmental impact associated with the action being considered.

For this EIS, the Federal cooperating agencies include the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (USEPA), U.S. Army Corps of Engineers

(USACE), and Bureau of Indian Affairs (BIA). Reclamation has also provided non-Federal agencies with the opportunity to participate in the NEPA process as a cooperating agency.

In August of 2012, Reclamation mailed invitations to the following 747 non-Federal entities to be cooperating agencies for this EIS:

- California Department of Water Resources
- California Department of Fish and Game
- State Water Resources Control Board (SWRCB)
- Agencies that have contracts with the CVP or SWP for water delivery, water service repayment, exchange or settlement, or use of CVP or SWP facilities for conveyance
- State and Federal Contractors Water Agency
- Cities and counties within the CVP and SWP service areas
- Federally-recognized tribes within the CVP and SWP service area or areas affected by CVP or SWP operations

Non-Federal entities that meet the specified criteria for cooperating agencies are required to enter into a Memorandum of Understanding with Reclamation to memorialize their participation as a cooperating agency.

As of November 2012, Reclamation has received 15 responses in the affirmative and has distributed Memorandum of Understanding to the following entities:

- Contra Costa Water District
- Del Puerto Water District
- Reclamation District 108
- Friant Water Authority
- San Juan Water District
- San Luis & Delta-Mendota Water Authority
- Stockton East Water District
- Sutter Mutual Water District
- Tehama Colusa Canal Authority
- City of Hesperia
- San Diego County Water Authority
- Zone 7 Water Agency
- California Valley Miwok Tribe
- Humboldt County Board of Supervisors
- Oakdale Irrigation District

Reclamation also received a request from an interested party to include the Federal Emergency Management Agency (FEMA) as a cooperating agency. However, Reclamation concluded that FEMA does not have special expertise related to environmental issue that would not be addressed by other Federal agencies, including USFWS, NMFS, USEPA, BIA, or USACE.

Organization of Scoping Report

This Scoping Report summarizes: (1) the purpose for the action to be evaluated in the EIS (Chapter 2), (2) the public scoping process (Chapter 3), (3) the scoping comments (Chapter 4), copies of the NOI and notice of extension of the public scoping period (Attachment A), the Reclamation News Releases and a typical newspaper notification (Attachment B), scoping meeting materials (Attachment C), scoping meeting transcripts (Attachment D), and written scoping comments (Attachment E).

Chapter 2

Overview of Potential Action

As described in the NOI published March 28, 2012, an EIS is to be prepared for modifications to the continued long-term operation of the CVP, in a coordinated manner with the SWP, that are likely to avoid jeopardy and destruction or adverse modification of designated critical habitat. This chapter provides an overview of this action and background information related to the decision by Reclamation to prepare an EIS.

Purpose of Initiating the Action

The CVP is operated in coordination with the SWP under the Coordinated Operation Agreement between the Federal government and the State of California (authorized by Public Law 99–546). Operation of the CVP and SWP are described in Reclamation's 2008 Biological Assessment (BA), as modified by general changes due to the passage of time and those items that have changed due to legislation or litigation since the completion of the BA.

In December 2008, USFWS issued a Biological Opinion (USFWS BO) analyzing the effects of the coordinated long-term operation of the CVP and SWP in California. The USFWS BO:

- Concluded that ''the coordinated operation of the CVP and SWP, as proposed, [was] likely to jeopardize the continued existence of the delta smelt'' and ''adversely modify delta smelt critical habitat.''
- Included a Reasonable and Prudent Alternative (RPA) for CVP and SWP operations designed to allow the projects to continue operating without causing jeopardy or adverse modification.

On December 15, 2008, Reclamation provisionally accepted, and began implementing, the USFWS RPA.

In June 2009, the NMFS issued a Biological Opinion (NMFS BO) analyzing the effects of the coordinated long-term operation of the CVP and SWP on listed salmonids, green sturgeon and southern resident killer whale. The NMFS BO:

- Concluded that the long-term operation of the CVP and SWP, as proposed, was likely to:
  - Jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, southern distinct population segment of North American green sturgeon, and southern resident killer whales.
  - Destroy or adversely modify critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central

Valley steelhead and the Southern distinct population segment of North American green sturgeon.

- Included a RPA designed to allow the projects to continue operating without causing jeopardy or adverse modification.
- On June 4, 2009, Reclamation provisionally accepted and began implementing the NMFS RPA.

Several lawsuits were filed in the United States District Court for the Eastern District of California (District Court) challenging various aspects of the USFWS and NMFS BOs and Reclamation's acceptance and implementation of the associated RPAs. Many of the lawsuits were consolidated into two proceedings focused on each BO. The outcomes of the consolidated cases are summarized below.

- On November 16, 2009, the District Court ruled that Reclamation violated NEPA by failing to conduct a NEPA review of the potential impacts to the human environment before provisionally accepting and implementing the 2008 USFWS BO and RPA. Reclamation was ordered to review the USFWS BO and RPA in accordance with NEPA.
- On March 5, 2010, the District Court held that Reclamation violated NEPA by failing to undertake a NEPA analysis of potential impacts to the human environment before accepting and implementing the RPA in the 2009 NMFS BO. Reclamation was ordered to review the USFWS BO and RPA in accordance with NEPA.
- The District Court found certain portions of the USFWS BO to be arbitrary and capricious, and remanded those portions of the Biological Opinion to USFWS. The District Court remanded the USFWS BO to USFWS without vacatur for further consideration.
- The District Court found certain portions of the NMFS BO to be arbitrary and capricious. The District Court remanded the NMFS BO to NMFS without vacatur for further consideration.

To comply with the District's Court orders regarding NEPA, Reclamation initiated a combined NEPA process addressing both the USFWS and NMFS RPAs. The combined NEPA process will analyze the effects of modifications to the coordinated long-term operation of the CVP and SWP that are likely to avoid jeopardy to listed species and destruction or adverse modification of designated critical habitat.

Purpose and Need for Action

The purpose of the action is to continue the operation of the CVP, in coordination with operation of the SWP, to meet the authorized purposes of the CVP and SWP, in a manner similar to that described in the 2008 BA with appropriate modifications, in a manner that:

- Is consistent with Federal Reclamation law, applicable statutes, previous agreements and permits, and contractual obligations;
- Avoids jeopardizing the continued existence of federally listed species; and
- Does not result in destruction or adverse modification of designated critical habitat.

Continued operation of the CVP is needed to provide flood control, water supply, fish and wildlife restoration and enhancement, and power generation. It also provides navigation, recreation, and water quality benefits. However, coordinated operation of the CVP and SWP, as described in the 2008 BA, was found to likely jeopardize the continued existence of listed species and adversely modify critical habitat. The ESA requires Federal agencies to insure that their actions are not likely to jeopardize listed species or result in the destruction or adverse modification of critical habitat. Modifications to the coordinated operation of the CVP and SWP to be evaluated should be consistent with the intended purpose of the action, within the scope of Reclamation's legal authority and jurisdiction, economically and technologically feasible, and avoid the likelihood of jeopardizing listed species or resulting in the destruction or adverse modification of critical habitat.

Chapter 3

Scoping Process

As part of the public scoping process, Reclamation published the NOI, conducted five scoping meetings, and reviewed scoping comments presented at the scoping meetings and submitted during the public scoping period.

Public Outreach Efforts during Scoping Process

The scoping process was initiated on March 28, 2012, with the publication of the NOI in the Federal Register and continued through June 28, 2012.

Notice of Intent and Notice of Extension

As described in Chapter 2 of this Scoping Report, the NOI provided a summary of the purpose of initiating review of the action and purpose of the action, description of the Project Area, initial list of alternatives to be considered, statutory authority to prepare an EIS), and the process to provide scoping comments. Reclamation published the NOI on March 28, 2012. Initially the public scoping process was to be completed on May 29, 2012. During the public scoping process, other agencies and interested persons requested an extension of the public scoping process to provide additional opportunities to provide scoping comments. In response to these requests, Reclamation published a notice of extension of the public scoping on May 25, 2012 to extend the public scoping period through June 28, 2012. Copies of the NOI and the notice of extension are included in Attachment A.

Scoping Meeting Notifications

Reclamation issued a press release on March 28, 2012, to announce the initiation of the public scoping process, the basic need for preparing an EIS, dates and locations of the scoping meetings, and information as to Reclamation's contact person and how to submit comments. Reclamation also issued a press release on May 25, 2012, to announce that the public scoping period extension. Reclamation also distributed the press release to Reclamation's media list and e-mail notification list.

Reclamation placed display advertisements in newspapers that served areas where the first four scoping meetings were held, as summarized in Table 3.1. The advertisements announced the basic need for preparing an EIS, dates and locations of the scoping meetings, and information as to Reclamation's contact person and how to submit comments.

The press release and a typical display advertisement are included in Attachment B.

Table 3.1 Newspaper Display Advertisements to Announce Scoping Meetings

Newspaper	Date of Display Advertisement	General Newspaper Distribution Area (General Weekday Circulation)
Sacramento Bee	April 11, 2012	Sacramento Valley (200,000)
Chico Enterprise Record	April 11, 2012	Butte, Glenn, and Tehama Counties (31,500)
Appeal-Democrat	April 11, 2012	Sutter and Yuba Counties (20,000)
Fresno Bee	April 11, 2012	San Joaquin Valley (380,700)
Madera Tribune	April 11, 2012	Madera and Fresno Counties (4,600)
Contra Costa Times Oakland Tribune San Jose Mercury News	April 11, 2012	San Francisco Bay Area (530,000 in total)
Los Angeles Times	April 11, 2012	Southern California and Central Coast (631,700)

Reclamation Website

Reclamation maintains a project website for the Remand Process for the Coordinated Long-term Operation of the CVP and SWP linked to the Bay-Delta Office website (http://www.usbr.gov/mp/BayDeltaOffice/Documents/remand.html). The website includes information prepared for the scoping meetings and the scoping comments, information to be considered by Reclamation in preparation of the BA, and reference materials related to the BOs.

Scoping Meetings

Five scoping meetings were held to inform the public and interested stakeholders about the project, and to solicit comments and input on the EIS. Initially, four scoping meetings were held in:

- Madera, California on April 25, 2012 (6 participants)
- Diamond Bar, California on April 26, 2012 (3 participants)
- Sacramento, California on May 2, 2012 (15 participants)
- Marysville, California on May 3, 2012 (2 participants).

Following the initial scoping meetings, Reclamation received several requests to hold an additional scoping meeting in the western San Joaquin Valley and to extend the public scoping comment period. As described above, Reclamation issued a notice of extension of the public scoping comment period and conducted a fifth scoping meeting as follows:

- Los Banos, California on May 22, 2012 (230 participants).

Each participant in the scoping meetings was invited to sign an attendance sheet and provided with an agenda, fact sheet, comment card, and speaker card. The agenda, fact sheet, and comment card were available in both English and Spanish. The scoping meeting agenda, fact sheet, comment card, and speaker card are provided in Attachment C.

Each scoping meeting began with a presentation by Reclamation. The presentation, included in Attachment C, described the purpose of the meeting and the public scoping process, an overview of the reasons that Reclamation was preparing the EIS, description of the process and schedule that Reclamation will use to complete the EIS, and methods to provide comments at the scoping meeting and subsequently until the end of the public scoping period. The participants were encouraged to submit written comments by mail, email, or fax until the close of the public scoping comment period. During the presentation, Reclamation responded to questions as they arose from the meeting participants. Following the presentation, Reclamation heard testimony from those who presented oral comments. Oral comments were recorded by a transcriber and are included in Attachment D. Reclamation offered to provide Spanish translation of the presentation and oral comments at each scoping meeting; however, the translation service was only requested and provided at the scoping meeting in Los Banos.

Chapter 4

Summary of Scoping Comments

This chapter summarizes the range of scoping comments received during the public scoping period that extended from March 28, 2012 through June 28, 2012. The public was provided opportunities to comment in writing and orally at public scoping meetings, and to provide written comments to Reclamation via mail, email, or fax.

Scoping Commenters

Reclamation received verbal comments from scoping meeting participants and written comments in comment cards, letters, and emails from agencies, interested parties, and individuals, as summarized in Table 4.1 (presented at the end of this chapter). The commenters are arranged in this table with the oral comments from the scoping meetings presented in chronological order of the scoping meetings. For each scoping meeting and for all written comments, the comments are categorized by the type of affiliation of the commenter. The comments are arranged in the following order: Federal agencies, state agencies, local agencies, interested parties, and individuals. Within each grouping, the agencies and interested parties are arranged alphabetically by their affiliation and the individuals are arranged alphabetically by their last name.

Summary of Scoping Comments

The following summary of the scoping comments are organized by topic area and arranged in the order that the topics are addressed in a typical EIS. This organization does not represent a relative importance among comments or topic areas, but rather is intended to facilitate presentation of comments in an orderly manner.

A summary of comments received from each commenter is presented at the end of this chapter in Table 4.2. Table 4.2 does not include the complete text of each comment, but presents a brief excerpt from the comments. The comments are arranged in the following order: Federal agencies, state agencies, local agencies, interested parties, and individuals. Within each grouping, the agencies and interested parties are arranged alphabetically by their affiliation and the individuals are arranged alphabetically by their last name.

Transcripts from the scoping meetings and written scoping comments are included in Attachments D and E, respectively.

Purpose and Need

Several comments were provided which addressed the purpose and need for the action. Specifically, comments suggested:

- The purpose and need should be to avoid jeopardy of listed species and destruction or adverse modification of critical habitat while supplying sufficient water to meet the agricultural, municipal, and industrial needs of millions of Californians in the CVP and SWP service areas.
- The purpose of the action should not include compliance with ESA. The need for the action should consider providing water supply as fully as possible while complying with ESA.
- The purpose of the action should not include measures to meet water contract quantity amounts.

Study Area

Comments which addressed the study area to be considered in the EIS suggested that the EIS study area should include the Delta, Sacramento and San Joaquin river watersheds, and other areas that use water provided by the CVP and SWP. Other comments suggested that portions of the CVP facilities and operations not be included in the study area, including the New Melones Unit and diversions by Contra Costa Water District, except for diversions at Rock Slough.

No Action Alternative

Several comments were provided which addressed the definition of the No Action Alternative. Specifically, comments suggested:

- The No Action Alternative should include implementation of the RPAs in the 2008 USFWS and 2009 NMFS BOs.
- The No Action Alternative should not include implementation of the RPAs in the 2008 USFWS and 2009 NMFS BOs.
- The No Action Alternative should include new project operations, including San Joaquin River Restoration Program.
- The No Action Alternative should define actions related to operations of the CVP and SWP that are not discretionary, including providing water supplies to water rights contractors and exchange contractors, and "Level 2" water supplies to refuges; water operations in accordance with requirements of the SWRCB orders and decision; water supplies for water rights holders; and flood management operations.
- The No Action Alternative should include implementation of the Bay Delta Conservation Plan (BDCP) and the 2006 SWRCB Water Quality Control Plan for the San Francisco Bay and Sacramento-San Joaquin Delta Estuary.
- The No Action Alternative should include environmental conditions related to other actions, including discharge of constituents into waterways by point and non-point dischargers.
- The "environmental baseline for the EIS" should reflect conditions at the time of the initial consultations with USFWS and NMFS in the 1990s.

Definition of Alternatives

Several comments were provided which addressed the range of alternatives. Specifically, comments suggested:

- Alternatives should be developed using new scientific information which may result in less focus on food web support or the location of brackish water/salt water interface in the Delta (also known as “X2 location”).
- Some alternatives should include additional opportunities to transfer water through the Delta.
- Some alternatives should include measures to benefit the survival and recovery of listed species that do not involve modifications of CVP and SWP operations, such as improved water quality, reduction of predation of aquatic resources, or regulation of small unscreened water diversions.
- Some alternative could consider complete cessation of CVP and SWP operations to indicate the benefits of these water projects.
- Some alternatives should include measures to meet Federal and state fish population doubling mandates and goals.
- Some alternatives should include measures to reduce reliance on Delta water supplies, energy use, and greenhouse gas emissions.
- Some alternatives should not include operations plans for the Stanislaus River that have been developed by local water rights holders.
- Some alternatives should include measures that assume all CVP water supplies available within the American, Sacramento, and Trinity watersheds will be used within those watersheds or within the combined boundaries of these watersheds prior to use of the water in other portions of the CVP service area.
- Some alternatives should include measures that assume that Central Valley Project Improvement Act (CVPIA) restoration funds collected from CVP water users within the American River Division be used for restoration of the lower American River.
- Some alternatives should either not include Contra Costa Water District intakes within the calculations for CVP and SWP south Delta intake operational criteria referred to as “Old and Middle River Flow Criteria” to reduce reverse flows in the south Delta, or replace the criteria with an index developed by Contra Costa Water District.
- One of the alternatives should include the following measures:
  - Different criteria for Old and Middle River Flow Criteria than included in the 2008 USFWS and 2009 NMFS BOs.
  - Different criteria for operations of south Delta intakes based upon San Joaquin River inflow and south Delta exports than included in the 2009 NMFS BOs.

  - Predation control program focused on population reduction of black bass, striped bass, and pike minnows.
  - Floodplain habitat restoration for salmon and delta smelt habitat.
  - Trap and haul program upstream of the Head of Old River Barrier for juvenile salmonids entering the Delta from the San Joaquin River.
  - Minimize harvest mortality of natural origin Central Valley Chinook salmon.
- One of the alternatives should include the following measures:
  - Floodplain development limits and habitat restoration for salmon and delta smelt.
  - Levee vegetation and armoring policy for salmon and delta smelt.
  - Predation control program focused on population reduction of black bass, striped bass, and pike minnows.
  - Water quality improvement program at the Sacramento Regional County Sanitation District and the Fairfield-Suisun Sewer District treatment plant.
  - Trap and haul program upstream of the Head of Old River Barrier for juvenile salmonids entering the Delta from the San Joaquin River.
  - Harvest restrictions for salmon.
- One of the alternatives should include the following measures:
  - Different criteria for operations of south Delta intakes based upon San Joaquin River inflow and south Delta exports than included in the 2009 NMFS BOs to increase San Joaquin River inflow.
  - Measures to calculate the winter run Chinook salmon juvenile production estimate to reflect the best available science, including corrections for overestimation of in-river survival to the Delta in light of results of acoustic tagging studies.
  - Measures to reflect improved "first flush" triggers to reflect when delta smelt begin upstream migration to spawn.
  - More restrictive seasonal Old and Middle River flow requirements to further reduce entrainment of early spawning larval and juvenile delta smelt.
  - Measures to reduce impacts of CVP and SWP operations on primary productivity and food supply for delta smelt and salmonids, including effects of reduced spring outflow, exports, barrier operations, and changes in residence time.
  - Measures to protect longfin smelt, particularly increased spring Delta outflow.

Affected Environment and Impact Analysis: Water Resources

Several comments were provided which addressed surface water and groundwater resources. Specifically, comments suggested:

- Water resources impact analyses should evaluate frequency and extent of CVP and SWP operations that reduce water storage in CVP and SWP reservoirs.
- Water resources impact analyses should evaluate the impacts of water temperatures and other water quality parameters of operations of the frequency and extent of CVP and SWP operations that reduce water storage in CVP and SWP reservoirs.
- Water resources impact analyses should evaluate conditions under a wider range of drier and wetter periods of hydrology than has been evaluated in recent analyses, including projects that have relied upon Delta Simulation Model 2 results.
- Water resources impact analyses should consider the effects of increased salinity in Delta water supplies related to the ability of water users in southern California to dilute salinity in Colorado River water supplies.
- Water resources impact analyses should consider the effects of increased salinity in Delta water supplies related to the need for additional water treatment processes by municipal and industrial water users, effects on groundwater aquifers that use Delta water supplies for partial recharge, and effects on uses of recycled water from communities that use Delta water supplies.
- Water resources impact analyses should consider the effects of increased frequency of maintaining cold water storage in upstream reservoirs on irrigated agriculture and municipal and industrial water treatment plants that use CVP and SWP water supplies.
- Groundwater resources analyses should evaluate the impacts of increased groundwater pumping that cause increased rates of subsidence and the related impacts to infrastructure and agricultural production.

Affected Environment and Impact Analysis: Land Use and Economic Issues

Several comments were provided which addressed land use and economic issues. Specifically, comments suggested:

- Land use and economic impact analyses should evaluate the impacts on land use and socioeconomics related to the frequency and extent of CVP and SWP operations that reduce water availability to water users.
  - Potential impacts to be evaluated could range from the effects on agricultural water users that may shift crops or change land fallowing patterns, effects on crop yield, and the cost of purchasing supplemental water supplies.

  - Potential impacts to be evaluated could range from effects on municipal and industrial water users that may reduce the ability for communities to grow in accordance with their general plans and influence industrial users to invest in these communities.
- Land use and economic impact analyses should evaluate the impacts on land use and socioeconomics related to the frequency and extent of CVP and SWP operations that reduce water storage in CVP and SWP reservoirs and specifically constrain water deliveries to water users in the Trinity, American, and Sacramento rivers' watersheds.
- Economic impact analysis should evaluate impacts to the regions and communities as well as primary and secondary impacts to the water users, including the cost on businesses and industries that are directly and indirectly linked to agricultural or industrial production or community development, public services that may have changes in demand for services with less funding support, and costs for social services.
- Economic impact analyses should evaluate the recreational values for communities located near reservoirs that may experience frequent and/or extensive periods when declines in water elevations could result in less recreational opportunities.

Affected Environment and Impact Analysis: Biological Resources Issues

Several comments were provided which addressed biological resources issues. Specifically, comments suggested:

- Biological resources impact analyses should evaluate the impacts not only within the Sacramento and San Joaquin rivers' watersheds, but also changes in habitat in areas that use Delta water. These habitat areas could include:
  - Wetland and riparian areas, including areas within wildlife refuges that use Delta water, groundwater recharge ponds, and areas that may experience less stream flows if water is diverted to be used as supplemental water for areas that receive less Delta water.
  - Fallowed fields reduces agricultural habitat and increases the potential for invasive species.
- Biological resources impact analyses should include:
  - Citations to the data supporting statements as to the status of the species.
  - Information on the species with specific discussions of the basis of the information supported directly by data, based on hypothesis, and "best professional judgment."
  - Information related to the effects of water quality, including ammonia deposition, on food web support, especially related to delta smelt populations.

  - Information related to operation of the south Delta intakes and the long-term abundance of delta smelt.
  - Information related to the assumption that changes in the hydrology have resulted in "year-round flows," and that if these changes have occurred, these flows have resulted in "year-round salmon runs" through hybridizing of distinct salmon runs.
  - Information related to the occurrence of delta smelt populations, especially in locations recently identified.
  - Information related to delta smelt spawning in the wild.
  - Information related to the effect of spring inflows on delta smelt populations.
  - Information related delta smelt life-cycle models.
  - Information related to the effectiveness of ongoing conservation actions implemented under existing biological opinions in accordance with the USFWS Policy for Evaluating Conservation Effectiveness.
- Biological resources impact analyses should analyze other fish species in addition to the Federally-listed threatened and endangered species, including longfin smelt and the species addressed in the BDCP.
- Biological resources impact analyses should analyze the effects of changes in Sacramento River operations on salmonids in the Sacramento River, and include analytical methods developed by Northern California Water Association to evaluate impacts on the anadromous fishery in the Sacramento River.
- Biological resources impact analyses should analyze the effects of changes in American River operations on fish in the American River and the ability to achieve lower American River flow standards proposed through the regional Water Forum Agreement.
- Biological resources impact analyses should analyze the effects of Delta Cross Channel gate operations on the migration of Mokelumne- and Cosumnes-origin Central Valley Steelhead and fall-run Chinook salmon, including with consideration of cumulative impacts of implementation of the San Joaquin River Restoration Program.
- Biological resources impact analyses should consider alternative analytical tools to evaluate effects on salmonids in the Stanislaus and lower San Joaquin rivers and the south Delta as compared to analytical tools developed by California Department of Fish and Game.

Affected Environment and Impact Analysis: Air Quality Issues

Several comments were provided which addressed air quality issues. Specifically, comments suggested:

- Air quality impact analyses should evaluate the potential changes in dust generation and compliance with adopted State Air Quality Implementation Plans related to changes in the frequency and extent of fallowed fields due to changes in availability of CVP and SWP water supplies.

Affected Environment and Impact Analysis: Recreation and Visual Resources Issues

Several comments were provided which addressed recreation and visual resources issues. Specifically, comments suggested:

- Recreation and visual resources impact analyses should evaluate the effects of changes in the frequency and extent of low reservoir storage elevations at CVP and SWP reservoirs
- Visual resources and aesthetics impact analyses should evaluate the effects of fallowed agricultural lands due to changes in availability of CVP and SWP water supplies.
- Visual resources and aesthetics impact analyses should evaluate the effects of communities that may experience urban decay due to loss of agricultural employment related to changes in availability of CVP and SWP water supplies.

Several scoping comments discussed the preparation and presentation of information used in the development of the EIS and Reclamation's decisions. Comments were provided related to the need to provide: peer-reviewed information; descriptions of the degree of scientific uncertainty of the information and potential effects on impact analyses results; and a description of basis of all analyses including results supported directly by data, based on hypothesis, or "best professional judgment."

Table 4.1 Commenters During the Scoping Process

Type of Comment	Affiliation	Name	Date of Comment
Oral Comments at the Madera Scoping Meeting	Farmer in Westlands Water District	Todd Neves	4/25/12
	Friant Water Authority	Steve Ottemoeller	4/25/12
	Superior Almond Hauling	Brad Craven	4/25/12
	Westlands Water District	Tom Glover	4/25/12
	Westlands Water District	Gayle Holman	4/25/12
Oral Comments at the Diamond Bar Scoping Meeting	Metropolitan Water District of Southern California	Delaine Shane	4/26/12
	State Water Contractors	Melissa Cushman	4/26/12
Oral Comments at the Sacramento Scoping Meeting	California Department of Water Resources	Mike Ford	5/2/12
	San Luis Delta Mendota Water Authority and Westlands Water District	Rebecca Akroyd	5/2/12
Oral Comments at the Marysville Scoping Meeting	California Department of Fish and Game	Tricia Bratcher	5/3/12
	Tehama Colusa Canal Authority	Jeff Sutton	5/3/2012
Oral Comments at the Los Banos Scoping Meeting	20th Congressional District	Congressman Pete Costa	5/22/12
	California Water Alliance	Aubrey J.D. Bettencourt	5/22/12
	California Women for Ag and American Ag Women	Pamela Sweeten	5/22/12
	Circle A Farms	Chris Hurd	5/22/12
	City of Coalinga	Ron Ramsey	5/22/12
	City of Coalinga	Darrel L. Pyle	5/22/12
	City of San Joaquin	Cruz Ramos	5/22/12
	County of Fresno	Judy Case	5/22/12
	Firebaugh Canal Water District	Jeff Bryant	5/22/12

Type of Comment	Affiliation	Name	Date of Comment
Oral Comments at the Los Banos Scoping Meeting (continued)	Fresno Community Food Bank	Dayatra Latin	5/22/12
	San Luis Water District	Martin McIntyre	5/22/12
	Water 4 All	Piedad Ayala	5/22/12
	Water 4 All	Gracy Villavazo	5/22/12
Comment Cards from the Los Banos Scoping Meeting	California Water Alliance	Aubrey J.D. Bettencourt	5/22/12
	California Women for Ag and American Ag Women	Pamela Sweeten	5/22/12
	City of Coalinga	Darrel L. Pyle	5/22/12
	County of Fresno	Judy Case	5/22/12
	Clark Bros. Farming	Allen Clark	5/22/12
	Doubler & Sons Family Ranch	John Garza	5/22/12
	Empresas Del Bosque	Joe DelBosque	5/22/12
	Fresno Community Food Bank	Dayatra Latin	5/22/12
	Hall Management Corporation	Rodolfo Villa C.	5/22/12
	Harris Farms, Inc.	Luis A. Monad	5/22/12
	Rodriguez Familia Ranch	Marisela Rodriguez	5/22/12
	Tolmachoff Farms	David Tolmachoff	5/22/12
	Water 4 All	Piedad Ayala	5/22/12
	Water 4 All	Gracy Villavazo	5/22/12
	Westside Harvesting	Alonzo Garcia	5/22/12
	Westside Harvesting	David Aguilar	5/22/12
	Westside Harvesting	Jose T. Torrer	5/22/12
	Westside Harvesting	Baltazar Rodriguez	5/22/12
Written Scoping Comment – State Agencies	Delta Stewardship Council	P. Joseph Grindstaff	6/27/12
Written Scoping Comment – Local Agencies	City of Folsom	Ryan S. Bezzera	6/28/12
	City of Roseville	Pauline Roccucci	6/28/12
	City of Folsom, City of Roseville, Sacramento Suburban Water District, and San Juan Water District	Ryan S. Bezzera, Derrick Whitehead, Robert Roscoe, and Shauna Lorance	6/28/12

Type of Comment	Affiliation	Name	Date of Comment
Written Scoping Comment – Local Agencies (continued)	Contra Costa Water District	Leah Orloff	6/28/12
	East Bay Municipal Utility District	Richard G. Sykes	6/26/12
	Glenn-Colusa Irrigation District	Andrew M. Hitchings	6/20/12
	Kern County Water Agency	James M. Beck	6/28/12
	Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District	William C. Paris, III and Karna E. Harrigfeld	6/28/12
	San Juan Water District	Shauna Lorance	6/28/12
	San Luis Delta Mendota Water Authority, State Water Contractors, and Westlands Water District	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham	6/28/12
Written Scoping Comment – Interest Groups	Catholic Charities in the Diocese of Fresno	Kelly Lilles	5/23/12
	Center for Environmental Science, Accuracy, & Reliability	Leah Zabel	6/28/12
	Coalition for a Sustainable Delta	William D. Phillimore	6/28/12
	Fresno County Farm Bureau	Ryan Jacobsen	6/25/12
	Natural Resources Defense Council, The Bay Institute, Northern California Council Federation of Fly Fishers, San Francisco Baykeeper, Pacific Coast Federation of Fishermen's Association, Planning and Conservation League, Winnemem Wintu Tribe, Sierra Club California, and Sacramento River Preservation Trust	Katherine S. Poole, Gary Bobker, Mark Rockwell, Jason Flanders, John Mertz, Zeke Grader, Jonas Minton, Gary Mulcahy, and Jim Metropulos	6/28/12
	Northern California Water Association	David J. Guy	5/29/12
	Stone Land Company	Justin Dutra	

Type of Comment	Affiliation	Name	Date of Comment
Written Scoping Comment – Individual	Farmer near Firebaugh, California	Todd Allen	5/30/12
	Farmers near Firebaugh, California	Mark and Mary Fickett	6/27/12
	Resident of Fresno	William M. Ragsdale	6/11/12
	Farmers near Firebaugh, California	Frank and Judy Williams	6/26/12

4.2 Summary of Scoping Comments

Category of Commenter	Commenter and Affiliation	Excerpts from the Scoping Comments (Citations from written or oral comments; please note "…" is used to indicate that portion of the comment was not reproduced in Table 4.2. Complete transcripts from scoping meetings and comment letters are presented in Appendices D and E)
Federal Agency	Congressman Jim Costa, 20th Congressional District	Among the highest priorities in our valley is water, water for farmers, for our campesinos, for our farm communities…Because of the flawed regulations that were formed in 2008 and 2009, blame was placed on our valley for the decline of fisheries in the Sacramento and San Joaquin River delta. Only in recent times, through the National Academy of Science and other studies that have come out, has it demonstrated that there are many other factors, stress factors that are contributing to the decline of fisheries in the delta…Our water -- our local water agencies are working together and over the last three years developed a strategy to bring more water for our valley… The administrative strategy, to create more flexibility in the operations of the projects, have also provided results this year, going from a 30 percent water allocation on the west side to a 40 percent, going from 45 percent water allocation among Friant water users to 55 percent, but that's not enough. But our valley cannot live with half of it's water supply on a year to year basis…more water equals more jobs…The remanded court decision must, as Judge Wanger said, take into account the social and economic impacts to our valley…These regulations were called into question by Judge Wagner. As part of our legal strategy the judge found that key provisions of the biological opinion were arbitrary – were capricious – were bad – and were not in accordance with the law. And that's why the judge remanded the Bureau of Reclamation in essence to go back to the drawing board. Judge Wanger also held that the balancing the need of protected species and the needs of the people are important public policy choices and judgments should be made. As one of your representatives, I remain committed to fighting the daily fight to bring a reliable, clean, and sustainable water supply to the people of our valley. Reliable – long-term supply. So I urge all of us here today as well as my colleagues in Congress to ask the administration to take a hard look at these flawed regulations.
State Agency	P. Joseph Grindstaff, Delta Stewardship Council	…the Council requests that water supply reliability as well as the ecosystem be considered under the impacts analysis. It is the policy of the state of California that the coequal goals be considered together without giving deferential treatment to either goal. The Council also requests, to the extent that it may be appropriate as part of this EIS, an expansion of the fish species to be analyzed; at a minimum, being consistent with the list of fish species being analyzed in the Bay Delta Conservation Plan. The Delta Stewardship Council's draft Delta Plan does not attempt to protect, restore and enhance the Delta ecosystem for only specific species, rather the Delta Stewardship Council believes a more holistic approach to the ecosystem and all its native fish species would be more effective. The Bureau of Reclamation may now have an opportunity to expand the analysis of the long-term operations beyond only those fish species currently listed, and include species, such as longfin smelt, which have a high likely hood of becoming listed sometime in the near future. Consistency of the fish species between this EIS and the BDCP should harmonize the analysis efforts and minimize any duplicate analysis between the operation of the two very related projects. Consistency with the BDCP fish species will add several additional fish species to the EIS, including the aforementioned longfin smelt, white sturgeon, Sacramento splittail, river lamprey and Pacific lamprey.
State Agency	Mike Ford, Department of Water Resources	…how you define baseline will measure the impacts of the proposed project… there's been a lot of discussion or different views expressed about the economic impacts of BiOps…So I think that question of baseline -- or no project condition is very important…
State Agency	Tricia Bratcher, Department of Fish and Game	So the BO also address some of the state water project elements, so how does that get integrated into this? This is not an EIS/EIR? Shasta Lake Water Resource Investigation… with that be included… how do you kind of work out the cumulative effects like that because Shasta Lake will use the 2009… long-term ops. We'll use those RPAs and… terms of the flow recommendations to do their modeling. So are those the kind of flows that are in question here?

4.2 Summary of Scoping Comments

Category of Commenter	Commenter and Affiliation	Excerpts from the Scoping Comments (Citations from written or oral comments; please note "…" is used to indicate that portion of the comment was not reproduced in Table 4.2. Complete transcripts from scoping meetings and comment letters are presented in Appendices D and E)
Local Agency	Ron Ramsey, City of Coalinga	Valley fever, a lot of people don't know what valley fever is. It's in our ground around Coalinga. It's in the whole valley here. And when you have crops on that land, the dirt doesn't come up… There's people I work with that have died of valley fever. It's like a cancer…It eats you up and it's not good at all. Water is our City's life blood. Our economy is heavily driven by agriculture. For our city to flourish we need agriculture to succeed...And we would like Reclamation to look at ways to avoid these impacts where possible. .
Local Agency	Darrel L. Pyle, City of Coalinga	In our city, economic development and job creation are a high priority. Our attempts to diversify our economy are also limited by our unpredictable annual water delivery. We fear that we will succeed in attracting new industries to town but then lose them due to our inability to deliver them water. Agriculture is key but we do need to diversify the economy, and it's also impacted the same as ag. Based on water limitations.
		We are a community of 19,000 who are 100% dependent on Bureau water for our potable supply. Our economy is constrained by the unpredictable actual annual water delivery. Air quality is negatively impacted on short water delivery years.
Local Agency	Ryan S. Bezzera, City of Folsom	Project description – Conserved water – The EIS's project description must assume that the City will use, either in its service area or by transfer to a third party, all water that the City conserves pursuant to Senate Bill 7 (SB 7) that the California Legislature enacted in 2009. Under Water Code section 1011 and SB 7 (see Water Code section 10608.8(a)(1)), urban retail water suppliers retain the rights to water that they conserve. To the extent that water that the City conserves pursuant to SB 7 is water delivered under a CVP contract, CVPIA section 3405 authorizes the City to transfer all water subject to such a contract within the area of origin. Water-supply analysis – The EIS's analysis of the proposed project's impacts must separately assess its impacts on the City's supplies under the two water-right water contracts with Reclamation under which the City has rights and under the City's subcontract with Sacramento County Water Agency (SCWA) for deliveries under SCWA's CVP water-service contract… Reclamation must ensure that the City's full supplies under these contracts, and the water rights they represent, are satisfied whenever sufficient water is physically available to Folsom Reservoir.
Local Agency	Pauline Roccucci, City of Roseville	The Bureau's EIS must assume that the Bureau will not export American River water that the Bureau diverts under its water-right Permits Nos. 11315 and 11316 unless the Bureau has complied with those permits' Term 14…Term 14 requires that the Bureau meet the City of Roseville's demands through deliveries under our CVP water-service contract with the Bureau before the Bureau exports any water to areas outside of Placer, Sacramento and San Joaquin Counties. The EIS's project description must assume that Roseville will use, either in its service area or by transfer to a third party, all water that Roseville conserves pursuant to Senate Bill 7 (SB 7) that the California Legislature enacted in 2009. Under Water Code section 1011 and SB 7 (see Water Code section 10608.8(a)(1)), urban retail water suppliers retain the rights to water that they conserve. To the extent that water that Roseville conserves pursuant to SB 7 is water delivered under a CVP water-service contract, Central Valley Project Improvement Act (CVPIA) section 3405 authorizes Roseville to transfer all water subject to such a contract within the area of origin. Roseville has certified its Environmental Impact Report (EIR) for its Aquifer Storage and Recovery Program (ASR…The project description in the Bureau's EIS should incorporate deliveries of CVP project water to support Roseville's ASR program under Roseville's CVP water-service contract.

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Local Agency	Ryan S. Bezerra, Derrick Whitehead, Robert Roscoe, and Shauna Lorance City of Folsom, City of Roseville, Sacramento Suburban Water District, San Juan Water District (Folsom, Roseville, SSWD, SJWD)	... the lower American River has been designated under the federal Wild & Scenic Rivers Act and is one of the few – if not the only – urban river with such a designation. (46 Fed.Reg. 7484 (Jan. 23, 1981).) Project description – Full use of CVP supplies – The EIS's project description should assume that all CVP water supplies available within the American, Sacramento and Trinity River Divisions are used within those divisions' combined boundaries…Consistent with this intent of CVPIA, our agencies, and other agencies within this region, may need to transfer CVP project water among ourselves to address, among other things, future demands, groundwater contamination, environmental concerns or the increasing need for our region to implement integrated management of available water supplies…Accordingly, the EIS's project description should assume that all water subject to CVP contracts within the American, Sacramento and Trinity River Divisions is used within those divisions' combined boundaries. Project description – Area-of-origin laws – The EIS must demonstrate that its project description is consistent with California's area-of-origin laws… Consistent with the area-of-origin laws, Reclamation's operation of Folsom Reservoir must not prevent this region from using the amounts of American River water that is, as those laws put it, reasonably required to adequately supply the beneficial needs of this region. Project description – CVP M&I allocation preferences – The EIS's project description should incorporate implementation of preferences for M&I water-service contract deliveries reflected in Reclamation's current practice, its proposed CVP M&I water shortage policy and its water-right permits for the Folsom Unit.

4.2 Summary of Scoping Comments

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Local Agency	Ryan S. Bezerra, Derrick Whitehead, Robert Roscoe, and Shauna Lorance City of Folsom, City of Roseville, Sacramento Suburban Water District, San Juan Water District (Folsom, Roseville, SSWD, SJWD)	Project description – Warren Act contracts – …To date, Reclamation has not approved long-term Warren Act contracts that would allow our region to optimize management of local and regional water supplies. For example, Sacramento Suburban Water District (SSWD) has been required to obtain short-term Warren Act contracts to obtain water available in Folsom Reservoir under the contract that SSWD and Placer County Water Agency (PCWA) executed under PCWA's water rights. There is existing capacity under other agencies' long-term Warren Act contracts sufficient to deliver PCWA water to SSWD and other agencies, but it currently cannot be used for that purpose. Reclamation's project description for the EIS should incorporate long-term Warren Act contracts that allow this region's water supplies to be managed as efficiently as possible. Project description - Restoration projects – The EIS's project description should include identified projects under which restoration funds paid by American River Division contractors are used to restore environmental resources within the division and, specifically, in the designated lower American River. Wild and scenic Lower American River and fisheries – The EIS must analyze the project's impact on the biological, cultural and recreational values that support the lower American River's designation under the Act. These values include the river's fish, which include steelhead and fall-run Chinook salmon. Our agencies have signed the region's Water Forum Agreement, which includes the implementation of an improved flow standard for the lower American River as a key element. Folsom Reservoir levels and intakes – The EIS must analyze the impacts of implementing the proposed project on water levels in Folsom Reservoir to determine: (A) how often the project's implementation would prevent or constrain water-supply deliveries through the reservoir's water-supply intakes; and (B) any land use and socioeconomic impacts that would occur because of any reduced deliveries. Folsom Reservoir water quality – The EIS must analyze the impacts of implementing the proposed project on water temperatures and other water quality parameters in Folsom Reservoir and the indirect environmental and economic impacts associated with the delivery of lower quality water through the reservoir's water-supply intakes. Groundwater quantity and quality – The EIS must analyze the effects of implementing the proposed project on groundwater quantity and quality in this region. These effects could result in impacts in numerous resource categories. To the extent that the proposed project would reduce CVP deliveries within the American River Division, it indirectly would cause increased groundwater pumping….Increased pumping could result in the growth and migration of the region's groundwater contamination plumes, causing at least water quality, soils and socioeconomic impacts. Folsom Reservoir aesthetic, recreation and economics – The EIS must analyze the project's impact on the reservoir's aesthetic and recreational values, as well as the project's resulting impacts on the economic benefits generated by use of the reservoir.
Local Agency	Cruz Ramos, City of San Joaquin	…water means jobs. But water means more than just jobs. The city of San Joaquin is a very, very small community on the west side of Fresno County. Under normal circumstances, that means the water, where we – when we have water, our population, three-quarters of our population, either meets or exceeds the poverty guidelines that the federal government dictates. Our economy is based on agriculture. And agriculture is our life blood. Our people, when they don't have jobs, line up for food…I was one at those long lines for food distribution in the city of San Joaquin. And I was shocked. The irony of us living in an agricultural community, agricultural valley, and we're feeding – we're giving food to the farm workers, food that comes from China. What a shame.

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Local Agency	Judy Case, County of Fresno	We're here to talk about what happens when there is no water on the west side. Workers lost their jobs. And they not only lost their jobs, they had lost jobs that had become permanent, with benefits, so they had health care for their families. Unemployment in Fresno County – we had unemployment up to 43 percent. And people who had worked really hard to purchase their first home had lost it in foreclosure and were put in food lines in which there was foreign food provided. As a county we provide safety net programs to help people that are in a position they can't help themselves and our requests for services soared. Some families were forced to leave the area to look for jobs and for work. And they left with their children, which affected the local schools…Families, to survive, they left the house they had just bought and been hopeful for and moved in with relatives with two and three and four families living in the same house or apartment. Our farm businesses suffered and a large industry that supports farms, farmers, farm workers, from grocery stores to car dealers to suppliers for working on the farms, many of them suffered, many of them ended up closing because they couldn't survive. We also had farmers that when they didn't receive surface water, they turned to ground water to be able to sustain crops. As a result, we continued to have our water tables lower, which has very long term impacts for all of us. …we hope you're able to fully quantify the impacts on all of the people when we don't have a reliable water supply so that they can feed their families and make sure their kids get educated and have all the things we all want. And I do believe there is one environmental impact that hasn't fully been studied and that is when you take water away from the west side, the potential for dust effects that harm human health is much greater…We have a higher incidence of valley fever on the west side, and when the dust is kicked up, the risk is much higher for everybody.
		Without water, there is no farming, no farm jobs, no secondary businesses to support the ag industry, no food production, potential for increased dust events in the westside of the central San Joaquin Valley
Local Agency	Leah Orloff, Contra Costa Water District	As currently implemented, the OMR restrictions are determined using imperfect measurements that are affected by factors, such as the weather, that are outside of the control of the CVP and SWP.… implementation of revised fish protection actions should protect the intended species without placing further undue restrictions on water operations that do not cause such entrainment…Since CCWD has implemented fishery protection measures that already minimize take at its facilities and has fully mitigated for fishery effects in the Delta, it is not reasonable to have CCWD operations be further affected by the OMR flow regulations - regulations that are explicitly intended to limit entrainment at the Banks and Jones facilities. Nor is it reasonable to have OMR regulations expressed in a way that allows CCWD operations to affect Banks and Jones operations when CCWD operations are unrelated to fish entrainment at those facilities…CCWD diversions, which are already fully mitigated, can and should be explicitly removed from the regulation of OMR flows…we believe that this can be done in a way that maintains or improves fish protection and reduces operational constraints on CVP and SWP exports. PROPOSED ALTERNATIVE: An index based on San Joaquin River flow, export pumping at Banks and Jones pumping plants, and status of the Head of Old River Barrier can improve implementation of the current OMR flow regulations. Use of an index provides the same level of protection, is comparable to field data and will eliminate unnecessary complexity in operations. An example of an alternative index is illustrated in the attachment to this letter…the simplified index simulates the currently regulated value, and therefore has equal power for the purpose of fish protection.…Alternatively, if implementation of new OMR restrictions relies upon the existing flow gauges, the restrictions should be formulated to explicitly remove the effect of CCWD's operations.
		PROPOSED ALTERNATIVE: CCWD requests that the Environmental Impact Statement (EIS) for the Coordinated Long-Term Operations of the Central Valley Project and State Water Project include CCWD's proposals for removing CCWD's operations from the determination of compliance with OMR requirements.

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Local Agency	Richard G. Sykes, East Bay Municipal Utility District	EBMUD has a strong commitment to sustaining and enhancing the populations of fall-run Chinook salmon and Central Valley steelhead in the Mokelumne River below Camanche Reservoir….EBMUD works closely with the resource agencies in managing the Mokelumne fishery, especially under the framework of the Lower Mokelumne River Partnership (Partnership), which is made up of representatives from the California Department of Fish and Game, the United Stated Fish and Wildlife Service, and EBMUD. The analysis of all alternatives should address the effects of Delta Cross Channel gate closures to enhance in-migration and reduce straying of Mokelumne- and Cosumnes-origin Central Valley Steelhead and Fall Run Chinook salmon. Straying rates of Mokelumne origin salmonids to other systems, particularly the American River, have exceeded 70% in past years based on analysis of coded wire tag returns. In reviewing the data, the Partnership identified several factors that can influence straying including but not limited to tributary flow operations, Delta water management operations (including Delta Cross Channel gate operations), temperature, and planting practices for hatchery fingerlings and smolts…During October, adult salmonids migrating to the Mokelumne may be influenced by Sacramento River flows being diverted through the Delta Cross Channel. Working with operators from EBMUD, Department of Water Resources, and Reclamation, the Partnership developed a number of adaptive management actions to test their effect on stray rates and total escapement. These actions include closures of the Delta Cross Channel gates and attraction releases from Camanche Reservoir. Since implementation of the adaptive management actions, straying of Mokelumne River salmon to the American River has been reduced to levels below 10%. Furthermore, Mokelumne River returns since 2009 have been well above long-term average with 2011 being more than 400% of average. In fact, 2011 Chinook salmon escapement to the river was the highest observed since 1940. The early successes of the adaptive management actions warrant further evaluation within the context of the EIS for the OCAP BO. The analysis of all alternatives should address the role of export pumping in exacerbating entrainment and predation of juvenile Central Valley Steel head and Fall Run Chinook entering the Delta from the Cosumnes and Mokelumne Rivers. Current actions under BOs that are to be replaced are focused to a large degree on protecting salmonids originating from the Sacramento basin. A fact often overlooked is that naturally produced salmonids from the Mokelumne and Cosumnes rivers have no migratory alternatives other than the central Delta. Therefore, analysis of alternatives should address and mitigate impacts to migrating juvenile salmonids originating from the Mokelumne and Cosumnes rivers...Mortalities are generally attributed to increased residence time, a longer migration route, reverse flows, altered salinity gradient, predation, elevated water temperatures, contaminants, and reduced food supply… Cumulative effects regarding entrainment and predation of juvenile Central Valley Steelhead and Fall Run Chinook entering the Delta from the Cosumnes and Mokelumne Rivers should be analyzed for the San Joaquin River Restoration flows including return of Millerton releases via the export pumps. The primary outmigration period of juvenile salmonids from the Mokelumne River is February through June. These fish use the lower San Joaquin River, including portions of the Old and Middle River channels, as a migration corridor to the ocean and are vulnerable to entrainment by flows in these channels towards the export pumps.
Local Agency	Jeff Bryant, Firebaugh Canal Water District	Due to ground water pumping necessary to augment reductions in water supplies in the San Luis unit, the Central California Irrigation District has spent approximately 4.5 million dollars to rehab their conveyance facilities, and that was done -- the damage was done due to subsidence. In addition to the 4.5 million dollars that CCID has spent, they will undertake a program with the county of Fresno to the tune of 2.5 million dollars to study and replace a damaged bridge that has also settled due to the same effects of subsidence…I don't think there's any other alternative to be considered but restoring the water supply to the Central Valley Project.

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Local Agency	Steve Ottemoeller, Friant Water Authority	…San Joaquin River Restoration Program. The program is in place now in terms of development and planning, and there has been modeling…we want to make sure that the analysis of the biological opinions and everything associated with that does include both the river restoration flows that are going to hit the Delta and recapture…
Local Agency	Andrew M. Hitchings, Glenn-Colusa Irrigation District	GCID joins in and incorporates by reference herein the written comments that the Northern California Water Association (NCWA) previously submitted to Reclamation regarding the NOI, by letter dated May 29, 2012.
Local Agency	James M. Beck, Kern County Water Agency	Agency staff has reviewed the NOI. Additionally, Agency staff has reviewed the comments prepared by the State Water Contractors, Inc. and the Coalition for a Sustainable Delta. The Agency joins in all of the comments submitted by these two organizations.
Local Agency	Delaine Shane, Metropolitan Water District of Southern California	… are you seeing any sorts of construction activities proposed? … Are we talking about one or two environmental impact statements…?

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Local Agency	William C. Paris, III and Karna E. Harrigfeld, Oakdale Irrigation District, South San Joaquin Irrigation District, Stockton East Water District	The Scope of the Proposed EIS is Incorrect and Needs to Be Changed. - The Notice indicates that Reclamation operates the Central Valley Project (CVP) in coordination with the State Water Project (SWP) in accordance with the Coordinated Operation Agreement (COA) between the United States and the State of California. (Notice, p. 18858). The Notice goes on to indicate that the proposed action will address continued operation of the CVP, in conjunction with the SWP…and that the purpose of the action is to continue the operations of the CVP, in coordination with the SWP, as described in the 2008 Biological Assessment…The New Melones Unit is not operated pursuant to or in accordance with the COA, and is not otherwise coordinated with the operation of other units of the CVP or SWP. As such, the New Melones Unit of the CVP needs to be excluded from the scope of the EIS process being developed by Reclamation. The Districts asserted in the litigation that the New Melones Unit of the CVP should not be included in the Biological Opinion analyzing the long-term operation of the CVP and SWP. There was no evidence in the Administrative Record supporting the notion that the New Melones Unit is, in fact, operated in a coordinated fashion with other units of the CVP or SWP. To the contrary, the evidence in the Administrative Record, including the 1992 OCAP Biological Opinion, 2004 OCAP Biological Opinion, 2008 OCAP Biological Assessment, and express language of the COA all demonstrated that the New Melones Unit's operation is not included in the Coordinated Operating Agreement (COA), and it is operated as a separate feature…In response, Reclamation submitted a declaration… that Reclamation typically coordinates operations of the CVP and SWP, including the New Melones Unit…did not address how such coordination took place in light of the fact that the operation of the New Melones Unit is not covered by the COA, nor…explain when such coordination began, which is important since Reclamation concluded in 1992 and 2004 that the New Melones Unit was properly not included in the OCAP Biological Opinion since it was operated as a separate unit…the court…determine that inclusion of the New Melones Unit was legally defensible…the Districts vehemently disagree…declaration conflicts directly with that of…dated September 19, 2005…a hardcopy is attached hereto as Exhibit A…PowerPoint presentation prepared by…Reclamation entitled, Forecasting and Operations Advances from a Reservoir Operator's Perspective…a hardcopy is attached hereto as Exhibit B…state New Melones Dam and Reservoir and Friant Dam and Millerton Lake are part of the CVP, but are not operationally integrated into the CVP.……findings of Reclamation concerning the 1992 and 2004 OCAP Biological Opinions, both of which excluded the New Melones Unit since it was operated as a separate feature and was not coordinated with other elements of the CVP and SWP...it must be inferred that such coordination is recent since all prior evidence demonstrates that no such coordination occurred. Assuming…there is typical and daily coordination between the operation of the New Melones Unit and the other elements of the CVP and SWP, Reclamation must demonstrate the time, rationale, and purpose for such change. The Districts, which are intimately familiar with all legal, factual and policy aspects concerning the operation of New Melones, are frankly unaware of any change made by Reclamation which lead to or supports such coordination. Moreover, the Districts are unaware of any instance of coordination, let alone coordination that could be described as typical or daily.…Absent the provision of policies, procedures and facts which demonstrate actual coordination between the operation of the New Melones Unit and the other elements of the CVP and SWP, Reclamation must amend its scope to exclude the New Melones Unit in its EIS. Even if such evidence of coordination can be presented, Reclamation should choose to exclude New Melones and conduct environmental review and a separate biological opinion for New Melones Unit operation.

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Local Agency	William C. Paris, III and Karna E. Harrigfeld, Oakdale Irrigation District, South San Joaquin Irrigation District, Stockton East Water District	The Project Description and Modeling of Both Baseline Conditions and Conditions - Expected Under the Evaluated Reasonable and Prudent Alternatives Must Identify an Operations Plan that Will Work Through the 1928-1934 Drought Sequence. Reclamation's 2008 BA correctly noted that the 1997 Interim Plan of Operations (NMIPO) was not designed or intended to establish the permanent operating plan for New Melones…Further, the 2008 BA stated that the drought year sequence used to evaluate risk had changed from the 1987-1992 sequence to the 1928-1934 sequence. ..As a result of these two changes, Reclamation developed a Transitional Operating Plan (TOP) which utilizes three allocation bands for high allocation years, mid allocation years, and conference years ... The problem with the TOP is that the conference year contains no rules at all as to how the New Melones Unit will be operated. Indeed, under the conference year band, there is no stated plan at all for deliveries to the Districts, water quality objectives, fisheries or other requirements. Instead, in a conference year, Reclamation would meet with USFWS, stakeholders, DFG, and NOAA Fisheries to coordinate a practical strategy to guide New Melones Reservoir Operations……This is not an operations plan that can be modeled, evaluated and altered; this is a plan to develop a plan. Moreover, there is no guiding or overarching principle that will inform a conference year operation save that it is a practical strategy.…Certainly, any operations plan developed is unlikely to work through the 1987-1992 drought sequence, and the use of a conference year or other non-specified set of procedures to be determined by coordination of all affected parties is reasonable. However, such conference years must be an exception to the operating plan, not part of the operating plan itself. The inclusion of the conference year band as part of the TOP itself, instead of as an exception to the TOP, is inappropriate and must be rectified…First, Reclamation must identify how often the conference years are expected to occur. Second, Reclamation must identify the available deviations from the operations plan that could be considered in a conference year. This is extremely important since not all deviations are legal or appropriate and some depend upon the actions of third parties…that when NMFS and Reclamation modeled the conference years, it did so by making a host of assumptions that would require the approval of the State Water Resources Control Board, including the relaxation of the dissolved oxygen requirement at Ripon and waiver on meeting flow requirements at Vernalis. Reclamation should provide a discussion of whether it expects such waivers and relaxations to be granted, and why. NMFS and Reclamation also assumed that deliveries to the Districts would be less than required under CVP contract and by law. …Reclamation's discretion to limit deliveries to SEWD is extremely limited, and is non-existent as to OID and SSJID. Assuming Reclamation may consider reduced deliveries to the Districts as part of any conference year, it must disclose its lack of discretion and explain under what terms and conditions it would expect the Districts to accept deliveries that are less than they are entitled to by law and contract. …assuming that the New Melones Unit is integrated with the operation of the rest of the CVP and SWP, Reclamation should identify actions that other elements of the CVP and SWP could take in an effort to achieve water quality and other requirements that Reclamation chooses to meet via the New Melones Unit. While no other element of the CVP or SWP could assist in meeting Reclamation's requirements in the Stanislaus River itself, such elements could be brought to bear to meet or assist in meeting requirements downstream of the confluence of the Stanislaus and San Joaquin Rivers.

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Local Agency	William C. Paris, III and Karna E. Harrigfeld, Oakdale Irrigation District, South San Joaquin Irrigation District, Stockton East Water District	Reclamation must develop an actual operations plan that is able, as identified in the 2008 BA, to be successfully-utilized through the 1928-1934 multi-year drought sequence. Such plan must identify the rules by which the New Melones Unit will be operated and be supported by modeling using CalSimII. Without the benefit of a baseline condition, it will be impossible for the agencies to accurately depict not only the environmental impacts, but also to develop and compare the range of alternatives…Reclamation must develop, identify and use an operations plan which (1) spells out how the New Melones Unit will be operated in all year types, and (2) is capable of successfully working through the 1928-1934 drought cycle. Districts Have Developed an Operating Plan that Works Through the 1928-1934 Drought Sequence Which Reclamation Should Adopt. - Prior to the development and approval of Reclamations 2008 BA, OID and SSJID jointly developed an operating plan for the New Melones Unit, entitled New Melones Operating Plan Current Performance and Proposed Transitional Plan. (Districts' Plan)(A hardcopy is attached hereto as Exhibit C;…The Districts' Plan was submitted to Reclamation in 2006, but as of this date, Reclamation has yet to provide any official comment. The Districts have collectively made modifications to the Districts' Plan as a result of the Stockton East Water Dist. v. U.S., 583 F.3d 1344 (Fed. Cir. 2009) litigation in the Federal District Court of Claims…The Districts' submitted this revision to Reclamation in February 2012 and, to date, Reclamation has yet to provide any official comment (A hardcopy is attached hereto as Exhibit D). Using the 1928-1934 drought sequence as its worst-case scenario from a planning perspective, the Districts' Plan is designed and intended to (1) fully comply with OID and SSJID's entitlements under the 1988 Agreement, (2) fully meet all water quality and flow requirements at Vernalis, (3) provide a base instream fishery flow under all conditions, and (4) provide a minimum water allocation for Municipal and Industrial (M&I)- Public Health and Welfare uses to SEWD in all years and other CVP contractors when the New Melones Index exceeds 1400 TAF. The Districts' Plan achieves these goals by first providing an instream schedule for fishery protection, and then adding water on to the fishery schedule if necessary to meet water quality or flow objectives at Vernalis. Second, the Districts' Plan establishes fixed rules for the delivery of water to SEWD and CVP contractors which provides them with some water in all years, including full contractual allotments in wetter years, but which also restricts deliveries for agricultural purposes in the driest years. These deliveries are not strictly compliant with the terms and conditions of the CVP contracts, but for the purposes of finding a workable future operating plan, have the backing and support of SEWD in light of the overall changes to the management of the system which make the system more reliable and which provide SEWD with more water in more years than other operating plans. Third, the Districts' Plan recognizes that Reclamation has no discretion regarding the exercise of OID and SSJID's rights and provides them with water in strict compliance with the terms and conditions of the 1988 Agreement… The Districts recommend that Reclamation adopt the Districts Plan (as revised in February 2012) as the operating plan for New Melones, and that the EIS be conducted using the Districts' Plan as the baseline. If Reclamation Refuses to Adopt the Districts' Plan, Reclamation Must Include an Evaluation of Districts' Plan as An Alternative to the TOP. - If for any reason Reclamation does not adopt the Districts' Plan as its own operations plan for the New Melones Unit, in place of the TOP which is legally and factually deficient, Districts hereby submit that Reclamation must evaluate and consider the Districts' Plan as a reasonable alternative to the TOP…

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Local Agency	William C. Paris, III and Karna E. Harrigfeld, Oakdale Irrigation District, South San Joaquin Irrigation District, Stockton East Water District	Reasonable Alternatives Must Not Involve Limitations in Water Use By The Districts Which Are Beyond Reclamation's Discretion and Which Are Not Supported By Facts. - …Reclamation must make it clear that it has no discretion over the amount of water OID and SSJID are entitled to, and that its discretion over deliveries to SEWD is severely limited based upon recent interpretation of the terms and conditions of SEWD's CVP contract. When preparing its EIS, Reclamation must not use or rely upon any future study, such as the 2030 land use study, or prior occurrence, that suggests that OID and SSJID will not consumptively use all of the water allotted to them. Usage within the Districts is changing to more permanent, tree-based agriculture, which require a consistent supply of water regardless of the year-type. Further, the Districts are expanding their boundaries and transferring more water. There is no basis upon which Reclamation can reasonably claim that OID and SSJID's overall usage in future years will be reduced, or that OID and SSJID will agree to share the pain in any dry or critically dry year type…Reclamation must reject any alternative that proposes to restrict, cut or otherwise reduce deliveries to OID and SSJID in any fashion not expressly identified in the 1988 Agreement, or that proposes to restrict, cut or otherwise reduce deliveries to SEWD in any fashion not expressly called for in its CVP contract. Reclamation simply has no discretion over these items and it is misleading at best and disingenuous at worst, to identify a reasonable alternative that includes such limitations. Temperature Modeling Done Must Be Done Using the Best Available Science, Which For the New Melones Unit Is the San Joaquin River Water Temperature Model. - To meet its legal requirement to utilize the best available science and data, Reclamation must use the San Joaquin River Water Temperature Model by Avry Dotan and Resource Management Associates. Reclamation Cannot Utilize or Rely Upon Any Salmon Model Developed By the California Department of Fish and Game, Nor Any Data or Studies that Are Based Upon Such Modeling. - The California Department of Fish and Game (DFG) has been working on a model predicting the relationship between flow and salmon smolt survival for several years now. Version 1.0, developed in 2005, was subjected to heavy peer review criticism and resulted in the development of Versions 1.5 and 2.0. However, neither of those versions has been subjected to peer review…Reclamation must not use the salmon model directly, nor rely upon any study, paper, data or report that is derived, in whole or in part, from the use of such model.
Local Agency	Shauna Lorance, San Juan Water District	Project description - Term 14 - Reclamation's EIS must assume that Reclamation will not export American River water that Reclamation diverts under its water-right Permits Nos. 11315 and 11316 unless Reclamation has complied with those permits' Term 14…This term requires that Reclamation meet San Juan's demands through deliveries under San Juan's multiple contracts with Reclamation before Reclamation exports any water to areas outside of Placer, Sacramento and San Joaquin Counties. Project description - Conserved water - The EIS's project description should assume that all CVP water supplies available within the American, Sacramento and Trinity River Divisions are used within those divisions' combined boundaries…the EIS's project description must assume that San Juan will use, either in its service area or by transfer to a third party, all water that San Juan conserved pursuant to Senate Bill 7 (SB 7) that the California Legislature enacted in 2009. Under Water Code section 1011 and SB 7 (see Water Code section 10608.8(a)(1», urban retail water suppliers retain the rights to water that they conserve. To the extent that water that San Juan conserves pursuant to SB 7 is water delivered under a CVP water-service contract, CVPIA section 3405 authorizes San Juan to transfer all water subject to such a contract within the area of origin. Water-supply analysis - The EIS's analysis of the proposed project's impacts must separately assess its impacts on San Juan's supplies under its pre-1914 water rights (as reflected in the April 12, 1954 Contract For Relocation, Rearrangement Or Alteration Of Facilities, Contract No. DA-04-167 -eng-61 0) and its supplies under its CVP water-service contract. Reclamation must ensure that San Juan's full supplies under its pre-1914 water rights are delivered whenever sufficient water is physically available in Folsom Reservoir.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	The proposed project operations will be materially different from the operations described in the 2008 biological assessment. Among other changes, the description of operations must include implementation of the San Joaquin River Restoration Program, the Bay Delta Conservation Plan, and new Water Quality Objectives related to San Joaquin River flow. In addition, it should include operations allowing greater opportunities to transfer water through the Delta. The new biological assessment and new biological opinions must also reflect new scientific data that has become available since 2008. These data include information related to the adverse impacts caused by nutrients discharged from wastewater treatment plants, the adverse, extra-ordinary impacts of predation, the lack of identifiable adverse impact of pumping by the CVP and SWP, and the lack of identifiable adverse impact associated with changes in the location of X2 during the fall months. The changes in operations and additional scientific data will require new analyses of the effects of project operations. The Public Water Agencies submit that these new analyses should ultimately result in significantly different conclusions regarding the effects of CVP and SWP operations on listed species, and a different decision by Reclamation, than occurred in 2008 and 2009. The proposed action should not, and presumably will not, include components of the existing opinions found to be unlawful. As the ESA consultation progresses, including particularly preparation of a new biological assessment, Reclamation should likewise be able to define a proposed action and possible alternatives to be included in its NEPA analysis. The Public Water Agencies request an opportunity to provide additional comments when and as Reclamation does so.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	…SLDMWA and SWC will be deemed cooperating agencies for this NEP A process, with specific responsibilities to be set forth in a memorandum of understanding…SLDMW A and SWC would be deemed designated non-Federal representatives in the related section 7 consultation….In addition, it may be appropriate for other local public agencies that are members of the SLDMWA or SWC to serve as cooperating agencies, including Westlands, The Metropolitan Water District of Southern California, the Kern County Water Agency, and Santa Clara Valley Water District. Several member agencies will be contacting Reclamation regarding cooperating agency status. …Reclamation, FWS, and NMFS must engage in a fundamental reanalysis of the effect of CVP and SWP operations on the listed species, and the necessity for and efficacy of any measures intended to address such effects. For their part, FWS and NMFS must do such reanalysis and issue new biological opinions. For its part, Reclamation must consider those new opinions, and make a determination of its ESA obligations. In performing these tasks, all the federal agencies should carefully consider the data and analysis of impacts and alternatives produced through the NEPA process. A new biological assessment is necessary both because of new scientific data and studies that have become available since 2008, and because of changes in current and planned project operations since 2008. Among other recent information, new science since 2008 includes life-cycle models, analyses of ammonium impacts on the food web, and analyses addressing the need for a fall X2 measure…The BDCP is expected to provide the basis for endangered species permits for, and a biological opinion regarding, in-Delta operations of the SWP and CVP beginning in about 2025…Elements of the BDCP not involving CVP and SWP operations will improve conditions for listed species even before new facilities become operative in 2025. Also, the State Water Resources Control Board (State Water Board) is in the process of revising its existing Bay-Delta Plan…the Public Water Agencies suggest that the reconsultation, and the related NEPA review, address project operations until in-Delta CVP and SWP operations are covered through the BDCP permits and BDCP-related biological opinions. …If after consultation with FWS and NMFS Reclamation concludes that project operations will not jeopardize the listed species or adversely modify their critical habitat, then no major changes to the regime governing project operations should be required, and hence there would be no significant effects on the existing human environment triggering the need for an EIS. In that circumstance, an environmental assessment would likely suffice to meet NEPA's requirements. The NOI indicates that Reclamation has decided to prepare an EIS. That is a discretionary choice NEPA allows, even if upon further analysis the likely environmental impacts are revealed to be minor…if the new consultation results in a finding of jeopardizing effect or adverse modification of critical habitat, then Reclamation must consider what reasonable and prudent alternatives (RP As) to proposed operations are both necessary and efficacious. If Reclamation concludes that major changes to project operations will be required in order to avoid jeopardizing listed species or adversely modifying their critical habitat, then the scope of Reclamation's task to meet NEPA's requirements will increase substantially…Reclamation would then be duty bound to consider the impacts from changes in project operations on the quality of the human environment, as well as alternatives that may lessen those impacts while still meeting the requirements of the ESA. That will require an EIS…Information developed in the NEPA process should inform and improve the ESA consultations. Likewise, information developed during ESA consultation should be considered for the NEPA process.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	It appears from the NOI that Reclamation may intend to analyze in a single EIS the effects of any changes to CVP and SWP operations for both the delta smelt and salmonid species. Under the remand schedules set by the court in the two cases, the entire remand process related to delta smelt must be completed by December 1, 2013, while even a draft salmonid biological opinion is not due to be completed until October 1, 2014. Hence, unless Reclamation and NMFS complete the remand required by the judgment in the Consolidated Salmonid Cases much more quickly than the court's schedule would require, a change in schedule will be necessary to accommodate a combined analysis integrating all the listed species. Depending upon further clarification and discussions with Reclamation, FWS, and NMFS, the Public Water Agencies would consider supporting a change in the remand schedules if reasonably necessary for the purpose of allowing an integrated analysis covering all the listed species. Purpose And Need - … Compliance with the ESA should not be included in the purpose of the proposed action. Instead, in the context here, providing water supply as fully as possible while still complying with the ESA gives rise to the need for the action…Reclamation's present NEPA review should therefore be keenly focused on identifying actions it and DWR can take to better serve the water supply purposes of the projects while still meeting the requirements of the ESA. Reclamation's analysis must consider what effect the coordinated operations of the CVP and SWP actually have on species survival and recovery, what measures are proposed to reduce or compensate for such effects, what the data show about the likely efficacy of those measures, and what other effects those measures will cause including through reductions of water supply. That analysis should distinguish between actions that are necessary to comply with the mandates of the ESA, and other actions that may provide some additional protection or benefit for listed species, but are not necessary to comply with the ESA. The statement of purpose and need should make clear that an action alternative under which operations will comply with the ESA with minimal water supply impacts would be deemed superior to an action alternative under which operations will comply with the ESA but cause substantial water supply impacts…the Public Water Agencies reject any suggestion that the conclusions of the existing biological opinions regarding effects on listed species are a legitimate starting point for the NEP A process or the new consultations.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Affected Environment - …The condition of the affected environment includes the presence of a suite of stressors other than project operations that affect listed species. It also includes conditions within the service areas that are dependent upon water deliveries from the CVP and SWP….We agree that the directly affected environment includes all of the CVP and SWP service areas, as well as the areas where CVP and SWP facilities are located.…The affected environment should include the area of and conditions within the Delta, and the Sacramento and San Joaquin river watersheds. The affected environment will encompass areas extending beyond the CVP and SWP service areas as well. For example, reductions in water supplies exported from the Delta may increase demands on Colorado River water as an alternative supply for Southern California.…there are many historic and existing factors and conditions that affect the survival and recovery of listed species, factors that are unrelated to the operations of the projects (e.g., loss of habitat, upstream water use and diversions by other water users, alterations in land uses, municipal and industrial discharges, exotic species etc.). Those factors and conditions should be carefully described as part of the affected environment so that the effects of future project operations are considered in the appropriate context. While the historic changes in the Delta and throughout the area of analysis have occurred and may be identified to set the stage, the impacts analysis must not attempt to attribute these past changes and existing impacts to any action alternative. Instead, an accurate and complete description of existing conditions is essential because the effects of the no action alternative are measured against the existing affected environment (e.g., not the environment that existed before the projects began operations). No Action Alternative - the no action alternative should be defined to include operations consistent with Reclamation's and DWR's obligations and all legal requirements except the requirements of the ESA.…In the EIS, Reclamation must compare the environmental consequences of the no action alternative to the environmental consequences of the action alternatives. With respect to consequences for listed species, that comparison should measure and disclose how many more fish are expected to survive and reproduce under one scenario as opposed to another. For example, if reverse flows in Old and Middle rivers are limited by other existing non-ESA regulations but not by additional measures under the ESA, what are the expected effects on population abundance? If additional restrictions on such flows are imposed under the ESA, what is the expected affect on abundance of listed species? Do other measures that do not involve restrictions on project operations, such as habitat restoration, offer greater promise of improving abundance? The results of these analyses may then be considered together with the other environmental consequences associated with various alternatives, including consequences related to differences in water supply…

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Proposed Action - …Reclamation should at least consider defining the relevant Federal action subject to NEPA review to include the actions of FWS and NMFS in issuing the new biological opinions, as well as any role they reserve for themselves in implementing any measures imposed in the new biological opinions…First, Reclamation does not yet know the outcome of reconsultation, and should not presume at this point that any reasonable and prudent alternatives are needed to avoid jeopardizing the continued existence of listed species or the adverse modification of designated critical habitat. Furthermore, many of the specific components of the 2008 FWS and 2009 NMFS RPAs were found unlawful, and hence are poor candidates for inclusion in a proposed action…It may be appropriate to include some elements of the RPAs in the existing BiOps in potential alternatives for discussion and analysis, but the arbitrary and illegal nature of those measures would provide a sound basis for rejecting them. The NOI states that the proposed action will not consider alternatives that would require future studies. However, NEPA requires new studies where the available information is incomplete, unless the agency can make specific findings of exorbitant cost and infeasibility. The Public Water Agencies submit that a scientifically rigorous analysis of the effects of CVP and SWP operations would likely conclude that those operations do not jeopardize the listed species or adversely modify their critical habitat. Accordingly, the Public Water Agencies suggest that for NEPA review Reclamation define the proposed action as the continued operation of the projects, including existing, valid regulatory requirements, subject to lawful requirements of the incidental take statements in new biological opinions, without major changes to project operations imposed under the ESA. That proposed action, measured in comparison to the no action alternative, should have only modest environmental impacts. That proposed action would also meet the purpose and need described above. Action Alternatives - …The Public Water Agencies urge Reclamation to consider measures that may benefit the survival and recovery of listed species that do not involve modifications to project operations…There have been numerous scientific developments since the BiOps and their RPAs were issued…new scientific understanding of the various stressors and means to alleviate their impacts on listed species must be evaluated as part of the best available environmental data for developing alternatives. Attached hereto as Exhibit B is a list of some of the recent scientific articles issued since the 2009 BiOp was released…the alternatives should allow for adequate water deliveries and prevent significant impacts to public health and the human environment, and also explore various methods to sufficiently maintain and protect the listed species and their critical habitats. Thus, alternatives that simply focus on flow regimes or decreasing water exports would be inappropriately narrow…Reclamation is required to consider potentially reasonable alternatives beyond its own jurisdiction and to consider the jurisdictions of other agencies (Federal and otherwise) when determining what reasonable alternatives should be considered.…Such alternatives may include actions within the jurisdiction of agencies such as the State Water Board and the Regional Water Quality Control Boards, to address water quality habitat stressors created by the discharge of pollutants and contaminants. Alternatives may also include actions within the jurisdiction of the California Department of Fish and Game and the Fish and Game Commission, to address predator stressors created by implementation and enforcement of the bass fishing regulations.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Alternatives For The Protection Of All Listed Fish Species In The Delta - General measures should be included as alternatives to decrease the need to rely on curtailing exports by the projects. For example, Reclamation should consider methods for reducing the populations or impacts of alien species/predator species, such as striped bass…Alternatives that regulate smaller water diversions, especially unscreened diversions, should also be considered. It would also be appropriate to evaluate alternatives that require and implement an alternative conveyance, and/or reduce toxic chemicals… Alternatives That Address Specific Concerns Related To The Delta Smelt - a. X2 Location Management Should Not Be Considered Because It Is Not A Reasonable Alternative - …As further discussed in the document attached hereto as Exhibit C, the LSZ [Low Salinity Zone] only weakly overlaps the delta smelt's habitat, which is comprised of a multitude of biotic and abiotic characteristics. In light of the analysis in Exhibit C as well as the thorough rejection of the Fall X2 Action by the Court, Reclamation should not commit to an inappropriate overemphasis of the LSZ's influence… Food Availability For Delta Smelt - Three recent life-cycle modeling studies (Maunder & Deriso 2011, MacNally et al. 2010, and Miller et al. 2012) found that food availability was a significant driver of delta smelt abundance. Consistent with these modeling efforts, the available scientific data from CDFG surveys show evidence that zooplankton food supplies for delta smelt are an important factor affecting the species' population dynamics. By contrast, these studies also show that the location of fall X2 and associated estimates of abiotic habitat area are not strong predictors of delta smelt population dynamics. Food availability could be improved through alternatives that require: wetlands restoration, particularly salt marsh work, controlling ammonia discharges … and nutrient inputs (i.e., total N inputs related to ammonium loading) rather than using flows to dilute the pollution; controlling the *Corbula amurensis* clam…controlling aquatic macrophytes; and/or controlling blooms of toxic cyanobacterium *Microcystis aeruginosa* … A Combination Of Turbidity Conditions And Spring Flow Should Be Evaluated, Rather Than Just Focusing On OMR Flow Alone - The best available scientific data also confirm that imposing OMR flow controls alone, without simultaneous consideration of other factors affecting species geographic location and abundance, is insufficient. For the protection of delta smelt, in particular, the correlation of normalized salvage as a function of both turbidity and OMR flow shows that during conditions of low turbidity (i.e., clear water), salvage rates are low even when OMR is highly negative. This may occur because delta smelt avoid open waters and mid-channel areas where they are subject to higher predation and other stressors…Importantly, OMR flow controls imposed in a vacuum do not provide any particular benefit to the species. The best available scientific data show that OMR flows have application in reducing entrainment, when used in combination with turbidity triggers and normalized salvage. Based upon this information, consideration should be given in the NEPA process to evaluating the environmental effects of an alternative action to protect delta smelt based upon coupling normalized salvage, turbidity and flow regimes. Using this information, alternatives can be developed to provide for the lowest salvage at the lowest possible water cost. Another important question is whether entrainment has population level effects, and if so under what circumstances. Any restrictions on OMR to limit entrainment should be limited to circumstances where doing so is necessary to avoid meaningful population level effects…

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Conclusion Re Fall X2 Productivity in the LSZ has been drastically limited by springtime suppression of phytoplankton blooms from ammonium loading and feeding by the *Corbula amurensis* clam, which has resulted in a reduced carrying capacity in the Suisun Bay region…the delta smelt occupies a much larger area than just the LSZ…These and other factors show that regulatory efforts should be directed toward life-cycle modeling related to the relevant fish species to help better determine what factors (e.g., ammonium loading and food supply) are contributing to reductions in delta smelt abundance and how those factors can be addressed to improve the health and numbers of the species… Alternatives That Address Specific Concerns Related To Salmonids – a. Temperature Control Adequate temperatures need to be maintained for successful spawning, egg incubation, and fry development (between 42.5 and 57.5°F)… Recreational And Commercial Fishing The potential effects on listed species of recreational and commercial fishing should also be very carefully evaluated. Ocean harvest is one of the dominant factors affecting Salmonid populations… Ocean Conditions Ocean conditions directly tie into ocean survival of salmonids. The NRC has explained that patterns in atmospheric temperature, wind, and precipitation drive ocean temperatures, mixing and currents, which in turn control growth and advection of plankton that provide food for salmon. (NRC 2012, p. 95 (citing Batchelder and Kashiwai, 2007).) Thus, an alternative that increases the diversity of wild and hatchery salmon ocean entrance timing would help ameliorate unfavorable ocean conditions. (NRC 2012, p. 107.) Green Sturgeon -Reclamation should also consider alternatives that address the green sturgeon population. Due to known temporal and spatial differences with salmonids, green sturgeon should be evaluated separately. To better understand these differences, more studies may be needed… Operational Constraints, Non-Project Factors, And Water Demand May Exacerbate Water Supply Impacts From Pumping Restrictions - The level of San Joaquin River flow at Vernalis affects OMR flows, which in turn affects the magnitude of the impact of the OMR flow restrictions... Project demands can affect the level of exports…Storage capacity can restrict or expand exports…Exports at the SWP's Banks Pumping Plant can also be increased when the federal share of San Luis Reservoir fills and pumping capacity at the CVP's Tracy Pumping Plant is available to be used to enhance the pumping capacity otherwise available at the Banks Plant alone…State Water Resources Control Board Water Right Decision 1641 also restricts exports based on several parameters including the export-to-total Delta inflow ratio, thus providing protections to listed species and their habitats. Mitigation Measures - …Some of the actions discussed above in the section on alternatives could potentially also function as mitigation measures. Other types of mitigation measures, including restoration of habitat, could also be explored.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Water Resources, Including Groundwater - Lower export water deliveries translate directly into water losses for urban and agricultural users. Such reduced deliveries compel greater reliance by retail agencies and their customers on groundwater to meet demand not only in dry years, but in other year types when greater exported water deliveries are currently anticipated. In turn, reduced exports and deliveries during more year types and in greater quantities diminish the ability of water managers to replenish and store groundwater when water is available to do so. These circumstances can, and likely will, lead to additional groundwater overdraft (pumping beyond an aquifer's safe yield) throughout the Public Water Agencies' service areas, particularly in agricultural areas. Reduced groundwater levels can also lead to land subsidence that can additionally damage water conveyance facilities and other infrastructure, as has been documented throughout the state. For example, at the recent May 22, 2012 Scoping Meeting held in Los Banos, a speaker from the Central California Irrigation District stated that the District has spent $4.5 million to rehabilitate its conveyance facility, due to land subsidence resulting from groundwater overdraft and is involved in another $2.5 million program with Fresno County to study and replace a bridge damaged by land subsidence… The negative effects of land subsidence include the permanent loss of groundwater storage space and changes in elevation and the slope of streams, canals, and drains. Additionally, in some areas where groundwater levels have declined, surface streams lose flow to adjacent groundwater systems. These losses entail significant impacts to hydrology, as well as the biological systems that depend on those groundwater or surface flows. In addition, land subsidence can lead to cracks and fissures at the land surface, which may damage bridges, roads, railroads, storm drains, sanitary sewers, canals, levees, and private and public buildings. Furthermore, land subsidence leads to the failure of well casings, which will require additional well drilling and attendant environmental impacts to air quality… Reduced ability to replenish ground and surface water reserves also adversely impacts the ability of water purveyors to store water for dry years and emergencies. As just one example, reduced water storage can be expected to render southern and central California increasingly vulnerable to having insufficient supplies to suppress wildfires or sufficient supplies to survive a severe earthquake affecting conveyance facilities or other catastrophic events. Reduced exports of Delta waters also results in increased reliance by retail water users and their customers on other limited and lower quality supplies, such as recycled water, that need to be blended with SWP water to make them available for beneficial use…any impacts to the ability of the CVP and SWP to facilitate water transfers, including transfers of non-project water, should be addressed. For example, Reclamation must evaluate and disclose whether an alternative imposes additional operational constraints that limit (from no action conditions) the time or frequency when such transfers could be accomplished. Reduced SWP water supplies will result in increased reliance on Colorado River supplies, which are conveyed through Metropolitan Water District's Colorado River Aqueduct. However, Colorado River supplies have been limited to a basic apportionment of 550,000 acre-feet per year, and they are generally high in salinity (averaging 700 mg/L of total dissolved solids (compared to SWP concentrations that range from 200-300 mg/L)). Thus, blending of SWP water is needed to make use of Colorado River supplies.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Land Use, Including Agriculture - Reduced SWP and CVP deliveries will result in significant changes in land use, particularly in agricultural landscapes. As dramatically shown during the 2007-2010 period, reduced export water deliveries can and will increase fallowing of land across the Central Valley and elsewhere. Reduced water supplies can also cause shifts toward planting permanent crops that have diminished ongoing water requirements, but which also require watering year-in and year-out, thus diminishing future flexibility in water budgeting by precluding management options such as annual crop shifting or fallowing. Reduced supplies and lower quality water can also impact the production of certain crops, as well as the yield of crops that are grown. The unavailability of project water also increases the costs to obtain supplemental water. Lost exports also negatively impact water management plans that are produced by water agencies as source documents for evaluating land use projects. …in the SWP service area, it takes approximately 3 acre-feet of water per acre to sustain a crop for a growing season. In the CVP service area, it has been estimated that approximately 400 acres of land may remain out of production for every 1000 acre-feet of water lost… …In response to reduced surface water deliveries, farmers must increase their reliance on groundwater, which in many locations is an inferior water source due to its higher salinity. Unfortunately, not all fields and crops can be irrigated with groundwater, and the increased soil salinity from irrigating with saline groundwater impacts the ability to grow certain salinity intolerant crops in those areas. Because some crops are particularly sensitive to salinity concentrations, the use of high-salinity water may reduce the yields of these crops. … Impacts To Water Management Planning Related To Land Use - California law requires all urban water suppliers to prepare urban water management plans…The plans must identify and discuss factors affecting current and projected water supplies and demand, and they must identify steps being taken to ensure availability and reliability of supplies…development projects and land use planning decisions that depend on these plans will also be constrained by any future imported water supply reductions caused by the new BiOps.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Socioeconomics - Reduced Delta water supplies also cause socioeconomic impacts. In response to reduced water supplies, farmers fallow fields and this reduced agricultural productivity results in layoffs, reduced hours for agricultural employees, and increased unemployment in agricultural communities. Reduced agricultural productivity also has socioeconomic impacts for agriculture-dependent businesses and industries. In addition, unavailability of stable and sufficient water supplies reduces farmers' ability to obtain financing, which results in employment losses, due to the reduced acreage of crops that can be planted and the corresponding reduction in the amount of farm labor needed for that reduced acreage. Reduced water supplies and the resulting employment losses also cause cascading socioeconomic impacts in affected communities, including increased poverty, hunger, and crime, along with dislocation of families and reduced revenues for local governments and schools. In the urban sector, reduced supplies or increased supply uncertainty can cause water rates to increase as agencies seek to remedy supply shortfalls by implementing measures to reduce demand or augment supplies. Connection fees and other one-time costs for new developments may also increase and further retard economic development. …Farmers would be required to make up for any shortfall in imported water deliveries by purchasing supplemental water at drastically increased costs, if such supplemental water is even available… ..the 2009 delivery reduction that resulted from implementing FWS's 2008 BiOp's RPA resulted in a loss of 9,091 jobs in the San Joaquin Valley, relative to the year 2005, most likely as a result of reduced agricultural acreage under production…The removal of 250,000 acres from production translated into the loss of approximately 4,200 permanent agricultural worker positions, with even more jobs lost in adjunct businesses, such as packing, processing, and other related services…Unemployment resulting from water delivery reductions has led to hunger in the impacted San Joaquin Valley communities. For example, one food bank serving Fresno, Madera, and Kings Counties estimated in 2010 that 435,000 people in the area did not have a reliable source of food, that hunger in these communities would continue to increase, and that at least 42,000 people served by the food bank in October 2009 were employed in the farm industry before losing their jobs. Environmental Justice - Although the impacts from reduced water supplies will have significant impacts on people and farmland throughout the state, the hardest hit areas will be in predominantly poor and minority communities--especially in the Central Valley where employment losses and environmental effects will be the most prevalent. As a result, water export losses have the potential to disproportionately impact disadvantaged communities and persons.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Biological Resources, Including Fish, Wildlife, And Plant Species -…reduced Delta exports will impact biological resources dependent upon imported water from the CVP or SWP for their sustenance. Indeed, wetland and riparian areas across the state, including some national and local wildlife refuges, are maintained, in part, by imported water supplies from the CVP and SWP. The fallowing of fields in response to the reduced availability of CVP and SWP water supplies also increases the proliferation of weeds and other invasive species. Invasive species can harbor disease, choke out native species, adversely affect transportation corridors, and clog irrigation canals…the EIS will also have to assess the impacts or biological benefits, if any, to the listed species and other biota from the various alternatives evaluated…In evaluating and comparing these action alternatives, NEP A requires that Reclamation discuss the level of uncertainty and conflicting information in the data used to develop the impacts analyses… Lack Of Water For Wetlands And Species Outside The Delta - Although a biological opinion's purpose is to aid the recovery of listed species, if the expected new BiOps result in reduced project exports, there will also be a significant impact on other protected species, which impacts should be analyzed…For example, the northwestern portion of Kern County is home to 14,000 acres of flooded water habitat, including the Kern National Wildlife Refuge, where migratory birds, including protected and listed species, nest and feed during the fall and winter. An additional 11,000 acres of recharge ponds are located in the Kern River fan area, which provides seasonal habitat during recharge cycles. These complexes depend on the fall and winter delivery of imported surface water to provide for migratory bird habitat…Another example of protected and listed species that could be harmed is found within the boundaries of the Santa Clara Valley Water District-which receives water from both the SWP and CVP. Of the 163 miles of local streams used by Santa Clara for instream groundwater recharge, 129 miles are considered to be habitat for threatened or endangered species, including 32 species of plants, 50 species of wildlife, six amphibians, and three aquatic species listed as special status species under State or federal law. Local reservoirs, streams, and artificial recharge ponds provide habitat for 11 native species and 19 nonnative species of fish. Populations of protected steelhead trout are known to exist in Coyote Creek, Guadalupe River, Stevens Creek, and San Francisquito Creek and their tributaries. Santa Clara's average in-stream flow releases for groundwater recharge are normally about 104,000 acre-feet. Project export restrictions could reduce these flow releases, which in turn could significantly impact these species…. in the San Joaquin Valley, there are protected oak woodlands that serve as habitat for many other sensitive species. These woodlands and the species they support rely on groundwater and would be injured by further drops in groundwater levels due to increased pumping in response to a curtailment of imported water deliveries. Similar impacts would be felt on other protected species throughout the SWP and CVP service areas. These potential impacts to other listed species must be analyzed in the EIS. Beneficial Effects On The Listed Delta Species - The EIS must analyze both adverse and beneficial effects. Therefore, a discussion must also be included to show the beneficial effects of the action, if any, on the listed species. These statements must be objective, balanced, and substantiated with evidence.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Water Quality Reduced – [reduced] water supplies impact water quality by reducing water agencies' ability to blend lower quality water (e.g., from local groundwater or recycled water) with the higher quality Delta water, which is frequently needed to make the latter water sources beneficially usable. Increased pumping of local groundwater to offset export losses can adversely affect water quality by drawing poor quality or brackish water into higher quality groundwater basins. Increased reliance on groundwater for irrigation can also negatively impact the water quality of surface water streams due to the leachates present in the groundwater that becomes stream runoff. …Selenium levels are often high in runoff from farms due to concentrations found in the groundwater… …Because Colorado River water is highly saline, State Contractor member agencies that use Colorado River water, including Metropolitan, must blend that water with higher quality SWP water in order for the Colorado River water to be usable for drinking water uses or for water banking…If low salinity water is not available, membrane treatment must be used, which result in losses of up 15 percent of the water processed and increased costs. …Unless higher salinity water is treated or blended, it will affect agricultural use and degrade the quality of soils in their service areas. In addition, degradation of the water available for groundwater recharge could limit the use of local groundwater basins for storage due to the inability to meet basin plan water quality objectives established by the RWQCBs. Thus, when SWP supply water is inadequate to blend with more saline Colorado River water supplies, imported Colorado River water cannot be used to recharge groundwater basins without concern for compromising the water quality objectives of the groundwater basins. This would exacerbate the impacts to groundwater caused by any water curtailments required by the action. …Some Regional Water Quality Control Boards of the State of California (RWQCBs) have adopted water quality control plans for groundwater basins within their jurisdictions that include water quality objectives for maximum amounts of TDS. When inadequate amounts of high-quality SWP or CVP blend water are available to meet the water quality requirements of RWQCB orders for recycled water recharge, recycled water cannot be used for recharge and member agencies must consequently defer, or abandon, water recharge efforts. Loss of high quality water to blend with recycled water for recharge thus contributes to additional groundwater recharge losses and the growing overdraft of groundwater basins in Southern California and the San Joaquin Valley. Recycled water is also frequently used for landscape and agricultural irrigation, as well as industrial applications. However, such reuse becomes problematic at TDS concentrations of more than 1,000 mg/L. Some crops are also particularly sensitive to high TDS concentrations, and the use of high salinity recycled water may reduce the yields of these crops.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Air Quality - Reduced Delta water supply deliveries can adversely impact air quality because land fallowing generally results in increased dust and particulate emissions. Additionally, increased air emissions will occur because of the greater amount of energy that is needed for groundwater well pumps to lift water from a lower depth due to the greater reliance on and depletion of groundwater reserves associated with reduced availability of export water supplies. …In addition to addressing such impacts under NEPA, Reclamation and the other federal agencies involved here must comply with the federal Clean Air Act, 42 U.S.C. § 7401 et seq. Among other requirements, no federal agency is permitted to engage in an activity that does not conform to an implementation plan… …Emissions From Pumping Lift Increases - Increased reliance on groundwater reserves for water supplies also results in increased energy use due to increased pumping lift needed to access deeper groundwater… Soils, Geology, And Mineral Resources - Reduced Delta water supplies impact soils, geology, and mineral resources because increased groundwater use results in soil subsidence due to reduced groundwater replenishment. In turn, greater deposits of salts that negatively affect soil quality occur as a result of relying more heavily upon lower quality groundwater sources. In addition, reduced agricultural planting and increased fallowing leads to greater topsoil lost to erosion…The fallowing of land also leads to greater soil erosion from wind and water, which comprises an additional irretrievable resource loss. Such actions may result in substantial soil erosion and loss of topsoil. Visual, Scenic, Or Aesthetic Resources - Aesthetics are impacted by reduced water supplies because resulting socioeconomic impacts from lost agricultural employment will affect urban decay in regions affected by resulting employment losses. Lower reservoirs and water levels in the upper watersheds from restrictions that require reservoir releases, and barren and decaying farmland where planting and maintenance is infeasible due to the unavailability of delta water supplies, will have negative aesthetic impacts. Increased reliance on groundwater can also negatively impact aesthetic resources by causing damage to infrastructure from land subsidence.

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Global Climate Change, Transportation, And Recreation - Reduced water supplies from the Delta and increased reservoir releases to meet RPA requirements can also impact climate change due to the greater amount of energy and resulting emissions needed for pumping groundwater from greater depths, reductions in carbon uptake by plants, and changes in the timing and magnitude of project hydropower generation. …Land fallowing that results from failing to obtain sufficient water allocations to plant crops will also reduce the amount of carbon sequestration that would have otherwise occurred by planting crops, and would have thereby removed carbon dioxide and other greenhouse gases from the atmosphere… … Because of the operational changes to project reservoir releases, reservoir carryover, and Delta export pumping needed for meeting flow requirements, there is potential for drastic changes in the timing and magnitude of project hydropower generation. This impacts the availability and cost of clean electricity, and it also requires energy managers to rely on unclean sources of electricity… …Transportation can be impacted by greater impediments from blowing dust on fallowed lands, tumbleweeds, and bird-on-aircraft strikes… …Fallowing can also increase the incidence of bird-on-aircraft strikes, which impacts air transportation for both domestic and national security purposes. Fallowed fields are an excellent habitat for tumbleweeds (Russian thistle), which break from the soil and are transported with the wind. Proliferation of these species can hamper highways and canals, among other deleterious effects… …Recreation impacts are also likely to occur due to impacts on reservoir levels and upper watershed flows...
Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Comparison Among Alternatives – Because part of the purpose and need entails ESA compliance by operating the projects to avoid jeopardizing the species or adversely modifying their critical habitats, it is critical that the EIS at a minimum provide analyses and descriptions for the no action alternative and the various other alternatives of the estimated increase or decrease in: (1) the numbers of individuals of each species, (2) the estimated population viability of the listed species, and (3) the amount or quality of their critical habitats. This is not an exhaustive list, and Reclamation should determine if other biological metrics would also be useful and appropriate. Because maintaining the projects' water supply reliability is a key aspect of the purpose and need, Reclamation should provide a commensurate level of analysis and detail regarding the degree to which each alternative would impair the ability of the CVP and SWP to serve their water supply functions… Cumulative Impacts - …there are numerous other stressors currently affecting the listed species that are or may be having a cumulative effect on the species…The Public Water Agencies also encourage Reclamation to explore in the EIS whether any mitigation would address these other causes of cumulative effects, which could maintain or improve the conditions of any of the listed species so as to allow sustained and improved project operations for water supply reliability. Additionally, there are numerous actions that have recently been completed or are currently being implemented by private, local, state, and federal actors throughout the project area to improve the habitat and status of the listed species whose benefits to the species must be taken into account in all the alternatives. These actions include gravel augmentation to improve salmon spawning conditions, changes in the operations or physical character of diversions (better screens or ladders), and modifications to other structures to improve passage for salmonids and green sturgeon…

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Local Agency	Daniel G. Nelson, Terry L. Erlewine, and Thomas Birmingham, San Luis & Delta-Mendota Water Authority, State Water Contractors, Westlands Water District	Disclosure And Discussion Of Scientific Uncertainty And Data Gaps - Past regulatory decisions taken without the guiding light of NEP A have been made with an unjustified claim of certainty or necessity without acknowledgment of the significant uncertainty or imprecision that accompanied such actions…when Reclamation is evaluating the reasonably foreseeable significant adverse effects on the human environment in [the EIS] and there is incomplete or unavailable information, it is required to always make clear that such information is lacking. 40 C.F.R. § 1502.22…However, [e]very effort should be made to collect all information essential to a reasoned choice between alternatives. NEPA Handbook at 8-16. At a bare minimum, if the relevant incomplete information cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, Reclamation must include a statement in the EIS explaining the nature of such information, its relevance, a summary of existing credible scientific evidence, and Reclamation's evaluation of potential impacts based on approaches or methods generally accepted in the scientific community. 40 C.F.R. § 1502.22(b). In 2004, the National Research Council issued a report addressing the degree of scientific certainty, or lack thereof, regarding measures imposed under the ESA for the protection of listed fishes in the Klamath River basin. National Research Council, Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery. Washington, DC: The National Academies Press, 2004. To accomplish their charge, the committee developed specific conventions for judging the degree of scientific support for a proposal or hypothesis in the Klamath biological opinions. Id. at p. 35…If the federal agencies make a policy decision to apply the precautionary principle here, that choice should be explicit, so that the choice and the tradeoffs involved are made clear to the public and any reviewing courts. Information Quality Act - The Information Quality Act (Public Law 106-554) and orders, regulations, and guidelines issued thereunder impose additional requirements on Reclamation that must be applied to this NEPA process. Reclamation recently issued its peer review policy to implement the mandate in the Office of Management and Budget's Bulletin and Guidelines that important scientific information shall be peer reviewed by qualified specialists before being used to inform a government decision (IQA Policy). Reclamation's IQA Policy requires peer reviews of all scientific information that is determined to be influential scientific information or highly influential scientific assessments, The IQA Policy applies to NEPA documents…the Public Water Agencies urge Reclamation to be prepared to implement the IQA peer review policy.
Local Agency	Rebecca Akroyd, San Luis & Delta Mendota Water Authority and Westlands Water District	…we'd request… an additional scoping meeting somewhere in the West Side, San Joaquin Valley.
Local Agency	Martin McIntyre, San Luis Water District	When these biological opinions were implemented, the water supply, the federal water supply at San Luis Water District and other federal contractors was reduced almost 50 percent. There is absolutely no doubt that this water supply reduction had serious unmitigated human, social, and economic impacts…I'm concerned about the bias continuing to affect the process as we revisit these opinions… …When the National Marine Fisheries was preparing the biological opinion governing commercial fishing -- they found that fishermen could kill 10 to 25 percent of adult endangered salmon without jeopardizing the species… When the same agencies, the agency, the National Marine Fisheries Service prepared the biological opinion for the pumps ---- they found that any take by the pumps of more than one percent of the return in juvenile salmon would jeopardize the species. So I would ask, and my request tonight is, that during the preparation of these opinions that the responsible agencies reconcile the difference between these numbers, 25 percent taken on one hand, 1 percent taken on the other…

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Local Agency	Jeff Sutton, Tehama Colusa Canal Authority	…the RPAs as they exist in current biological opinions have dramatic impacts associated with reduction in water supply… the socioeconomic impacts that would be felt if the water was removed as a result of the implementation of RPAs, that would reduce the water supply. It was estimated about a billion dollars to a regional economy of 150,000 acre-service area. Sixteen thousand jobs associated to the lands were the loss of that. And the socioeconomic impacts that would be felt if the water was removed as a result of the implementation of RPAs, that would reduce the water supply. … if you remove that water supply the surface water supply folks are going to move to ground water. And with that you have a variety of impacts; overdraft, environmental impacts to creeks and subsidence and impacts that go along with the overdraft law. That's something that will impact other water users as well. And then have the ground water work themselves as well…those impacts and would also cause environmental and economic impacts… The environmental impacts of surface water you would have water in drains, impact the specific flyway impacts, impacts the terrestrial species, aquatic species by not being able to apply that surface water in the way we've seen the projects historically operate. And again with those impacts you also see recreational impacts and therefore economic impacts…Whatever comes out of coordinated biological opinion, the RPAs can't contradict each other…somewhere there's got to be a balancing act and some decisions made on that…
Local Agency	Tom Glover, Westlands Water District	…I would ask that you reschedule this meeting to a time and notice it properly. And also the location in Madera, I think there's other locations that would serve us much better: Los Banos, Mendota, Paris Ranch… We're concerned in Westlands because any time our surface water is cut, what that does is our farmers are more reliant on ground water. It accentuates the overdraft problem on the West Side. Also you can experience the greater air quality issues with the diesel generators…In wet years we utilize surface water and in drier years we pump groundwater and allow the [aquifer] to recharge during wet years and pump like sell during dry years when the water is needed. So part of the reason the canal went in in the first place is mitigation with subsidence on the West Side…but there is definite effects to our growers on the West Side. So the other area of concern is unpredictability of our allocation…So that is our growers, them knowing what their allocation is early in the season is very important so they can plan accordingly and plant and go to the bank for the funding for their planting. So when we get squeezed in the Delta there are direct affects on the allocation and the ground water pumping…I know you're going to get comments on the fishery issues, but this is really on the ground of what's happening. Look at the umemployment…Every acre that's fallowed, if the allocation isn't up, that means land is out of production…In Westlands…probably between 20 and 25 percent of our crops are permanent crops. So the growers can fallow land, but it's hard to make a mortgage payment off of fallowed land. So when we get cut, our growers get cut and land is out of production. And we've been looking at what the farm gate value is, and to use the number of about $1,500 an acre for the produce coming off of the fields. And if you looked at two-and-a-half times of the benefit to the region, that's about $4,500 an acre. And you multiply that in 2009 we had about -- I'm trying to remember what the number was -- 260,000 acres. So you multiply that and that's a lot of zeros that the economy has lost, the region has lost. And so when they're making cuts in the Delta, they're affecting lives on the West Side growers. To get back to my original comment, I really would like to see our growers be able to interact.

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Local Agency	Gayle Holman, Westlands Water District	So when I think about this and what we are 4 working towards here, this long term effect for 2016, the thing that comes to mind is the human impact of it, the economic impact. California is in a state of deficit spending, and here we have a tangible project where farming produces an enormous amount of revenue that comes to our state of California like no other industry. People won't stop eating. It's a given. It's going to sustain and it will continue. So we have growers year after year, generation after generation, continuing providing that. And maybe through the bumps in the roads they want to throw in the towel when they have the 10 percent allocation. But the bottom line is I ask you to look at the long-term human and economic impact and to see the tax revenues that these guys generate. And it's just astounding the things we take for granted. The unemployment is still very, very high in these communities. Yesterday I was out on the West Side…And I drove through San Joaquin at 7:30 in the morning and saw the Community Food Bank there setting up shop. And all the residence lined up waiting to receive their free handout of groceries because there are not enough jobs to go around.
Interested Party	Aubrey J.D. Bettencourt, California Water Alliance	…these biops and RPA's, they aren't just acronyms, that they have true human impacts and they have a face and you've seen them here today…as long as the environment is broken, government agencies will continue to regulate in an attempt to fix it, shutting another farm, another family, another fishing fleet, another American dream down…In the 21st century I refuse to believe that we cannot provide, we cannot develop a comprehensive solution which provides an equitable and reliable supply for agricultural, urban and environmental water users.
		Recommendation/Requests: Transparency with public & water users, comprehensive consideration of stressors on Delta ecosystem, earlier and accurate allocation announcements.
Interested Party	Pamela Sweeten, California Women for Ag and American Ag Women	Suffering economic losses, both farmers and vendors, due to lack of water, consulting companies, trucking companies, and fiber companies, and PCAC's, contractors, workers, land that was left with no need to purchase supplies from the suppliers. Other instrumental people lost their jobs as well. And without farmers generating sales tax, California is going to be in worse shape than ever…without farms, we have no food, no national security, and an issue also, air quality for our valley.
		Farmers and vendors suffered economic loss due to lack of water. Consulting companies, trucking, fiber companies, PCA, seed, contractors, and workers. Land left fallow, no need to purchase supplies. No farms – no food – farmers generate sales tax – national security issue – air quality.
Interested Party	Kelly Lilles, Catholic Charities in the Diocese of Fresno	As the Agency Administrator of Catholic Charities, I have great concern over decisions being made to protect the Delta Smelt and Salmon without regard of the impact it has on all the people in the Central Valley. The Agencies haven't considered what types of impact might occur each time they turn the pumping facilities off… I witness firsthand the need to have access to quality produce for our clients and the negative impact that would take place if our farmers don't have enough water to grow their crops. Our lines will increase around the building with folks who are out of work due to the restricted water supply and lack of jobs. Many of the people we serve are farm laborers and count on jobs in the Ag industry for work year round. Each time we see unemployment rise, we witness more domestic violence taking place in the homes of those who are under great financial stress to provide for their hungry families. When our clients don't have access to proper fruits and vegetables needed to sustain well balanced nutrition, we see a rise in health problems…43 percent of the clients we serve are under the age of 17 and have a difficult time staying in school when mom and dad need extra help with income. We see more graffiti and crime rise when people are unemployed and hungry for proper nutrition.

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Interested Party	Leah Zabel, Center for Environmental Science, Accuracy, & Reliability (CESAR)	The EIS must provide information acknowledging that California's water system is virtually wholly managed, that there is no longer a 'natural' flow regime, and that any preferred alternative is simply the result of a series of policy choices based on implicit water allocation priorities. This information must include: A description of the physical changes over the past 150 years that have resulted in the existing managed water system which supplies farms and cities throughout the state with fresh clean water. This information is necessary for the public to understand the consequences of these water allocation choices on the human environment…The EIS must provide information on the historical changes in California's water systems in order for the public to assess and comment on significant changes in OCAP and the appropriateness of the 'environmental baseline' chosen for the Section 7 consultation required by the ESA. This baseline is important as it forms the basis for evaluating the consequences of the 'agency action' for the purposes of the biological opinion which is the result of an ESA consultation. The biological opinion in large part defines the extent to which OCAP 'continued' operations are altered and water supplies reallocated. - An enumeration of the legal requirements that govern operation of the OCAP, from water delivery to flood control. In assessing the effects of the Bureau's proposed operation on listed species for the purposes of the ESA Section 7 consultation, only discretionary actions are considered. The Bureau must identify those actions which over which they have no discretion in order to ensure that they are properly included in the environmental 'baseline' for the purposes of a Section 7 consultation under the ESA. The NEPA document must provide this information so that the public and the consulting wildlife agencies have the benefit of the Bureau's interpretation of their own authorities in identifying which agency actions generate 'effects' for the purposes of the ESA. Some examples of requirements imposed on the Bureau which are not discretionary: Wildlife refuge contracts and exchange contracts; California's State Water Resources Control Board (SCWRB) orders which impose multiple constraints on the operations of the CVP and SWP; Water Rights Decisions; such as Decision1641which implements the objectives identified in the SWRCB 1995 Bay-Delta Water Quality Control Plan and protects beneficial uses in the Delta through the use of flow and water quality objectives. The distinctions between discretionary and non-discretionary actions are important because only those effects that are the result of the Bureau's discretionary actions generate any ESA 'effects' to listed species. All other actions are part of the ESA's 'environmental baseline' and are not considered 'effects of the action' under the ESA….The Bureau must provide information on those individual actions within the operation of the OCAP which they have distinguished as discretionary, as those actions create the 'effects' which concern the Section 7 consultation. Further, the Bureau must provide the public with the rationale for each determination that an action is discretionary, since the determination itself can result in significant NEPA environmental effects as a result of conditions in the biological opinion which are the result of identified discretionary actions…It is plausible that flexibility exists within a non-discretionary action. If the Bureau identifies such circumstance, the NEPA document must provide a clear explanation of whether and how such flexibility renders the entire action discretionary.

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Interested Party	Leah Zabel, Center for Environmental Science, Accuracy, & Reliability (CESAR)	The EIS must provide an explanation of the requirements of an ESA Section 7 consultation and the resulting biological opinion, in the context of the OCAP. This information is important as it enables the public to understand whether and how the FWS has met the legal and policy requirements for the requirements generated by the biological opinion that results from a Section 7 consultation…This analysis must take place within the same time frame for the entire biological opinion; there is no authority to vary timeframes based on the effect being analyzed. There are two reasons that a single time frame is essential, first, because it is the Agencies' own requirement for an analysis that complies with the requirements of the Act, and second, failure to use a single timeframe for the baseline could, as a practical matter, lead to conflicting or inconsistent requirements for environmental conditions that would be practically impossible to achieve…The regulations and the Act contemplate an analysis whereby incremental change is identified and analyzed, any other interpretation results in biological opinions which are retroactive and result in agencies being required to compensate for conditions for which they have no responsibility. …the Bureau must either comply with the existing published Guidelines or provide information to the public on how they determine what is 'best scientific and commercial data available' in assessing the validity of the OCAP BiOp…The Bureau may only accept those conservation conditions included in the Biological Opinion which are based on data and consistent with the transparency and peer review requirements of the OMB's IQA Guidelines which have been adopted by the Services. …the Bureau's NEPA examination must provide information demonstrating that: a. The conservation actions required by the OCAP biological opinion are based on data, and b. that the science and analysis used to support the BiOp conclusions data is consistent with the requirements of the OMB IQA guidelines. …the Bureau must provide the public information on how the BiOp conservation actions and RPAs are effective under PECE [USFWS Policy for Evaluating the Conservation Effectiveness] so that the public has access to the evaluations of the effectiveness of the RPAs and other conservation actions which will enable them to determine whether these actions are likely to be effective. …The conditions existing today are the effect of the imposition of regulatory controls that were not legal, but left in place in the absence of any alternative. This creates a practical problem whereby litigants have achieved de facto imposition of illegal conditions which has resulted in the significant reallocation of water supplies and catastrophic losses for the public. The EIS must provide information on: 1. How the Bureau intends to identify the environmental baseline for the EIS, will it be the environment as it existed at the time of the first consultation in 1995, or some other baseline, and if so what, and how will the Bureau account for changes to the environment which are the result of invalid biological opinions. 2. How the Bureau intends to define the environmental baseline for the purposes of the ESA Section 7 biological opinion. Does the Bureau intend to use the environmental baseline as it existed at the time of the first consultation, or some other baseline later in time, which is the result of the operation of an invalid biological opinion? Whatever baselines are chosen by the Bureau, sufficient information must be provided to the public in the EIS to allow informed comment on the baseline itself and the rationale for the choice.

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Interested Party	Leah Zabel, Center for Environmental Science, Accuracy, & Reliability (CESAR)	The EIS must provide the public with full information on what is known and unknown regarding the listed species…the EIS must at a minimum: 1. For each listed species, provide citations to the data supporting statements as to the status of the species; 2. For each listed species clearly distinguish which information on the species is supported directly by data, which information is based on hypothesis, and the supporting data, and which information is based on the 'best professional judgment' of wildlife agency staff or consultants 3. Provide information to the public regarding the concern that food supply, affected by ammonia deposition, is depressing delta smelt populations 4. Provide information to the public regarding the fact that no data supports an assumption that OCAP pumping is adversely affecting Delta Smelt long term abundance; 5. Provide information to the public regarding the fact that year-round flows are resulting in year-round salmon runs, and that distinct salmon runs are hybridizing; 6. The Bureau must provide information to the public regarding; a. New delta smelt populations discoveries; b. Knowledge of delta smelt spawning in the wild; c. The effect of spring inflows on delta smelt populations d. The effect of spring outflows on delta smelt populations e. Existing delta smelt life-cycle models. The EIS must develop a new biological assessment and may not rely on the 2008 Biological Assessment (BA) prepared by the Bureau as the 2008 BA…the Bureau's proposed use of the 2008 assessment for the EIS is inexcusable given the tremendous increase in scientific data and analysis in the ensuing 4 years, including but not limited to, availability of delta smelt life cycle models, new published research demonstrating the detrimental effects of ammonia deposition on delta smelt food supply, evidence that salmon runs are now almost constant, rather than seasonal, and the federal court's findings regarding the arbitrary and capricious nature of the science used by the government in the 2008 and 2009 Delta Smelt and Salmon BiOps.

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Interested Party	Leah Zabel, Center for Environmental Science, Accuracy, & Reliability (CESAR)	The EIS must at least consider the following alternatives: a. The 'no action' alternative which must be continued operations pursuant to the last valid biological opinion. b. An alternative which consists of complete cessation of all CVP operations and water management. …First the Bureau must consider a true 'no action' alternative, that is: operate to the conditions of the last valid biological opinion and its associated incidental take permit. Second, CESAR believes that the Bureau must consider an alternative that assumes no managed or coordinated operation of the dams in any form, this alternative would have the Bureau open the flood gates of the dams and allow the river to flow unimpeded. This alternative would most closely resemble 'natural flow' pattern. If the OCAP is operated consistent with the provisions in the last valid biological opinion, there can be no 'incremental change' as identified in the ESA Section 7 regulations. Operation consistent with the management regimes consistent with any of the invalidated biological opinions is a change from the legal operation. Thus, the 'no action' alternative, to continue operation with no change from the last valid biological opinion should result in no jeopardy or significant constraints in the biological opinion…. CESAR believes that it may not be possible to harmonize the requirements for the identified endangered species and continue to operate the federal CVP…If that is the case, it will not be possible to operate the projects in a manner consistent with their legal authorization, it will not be possible to generate sufficient revenue to maintain the projects and to continue operations, and in the case of biological opinions with competing demands, it may not be possible for Bureau of Reclamation employees to operate the projects in a manner and avoid personal liability for take under the ESA. In such a case, it may be that the gates at the dams must be left open and flows be allowed to pass through unimpeded. The public must be provided an opportunity to review and comment on the consequences of either of these two alternatives to the human environment as well as the flora and fauna affected by their operation.

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Interested Party	Leah Zabel, Center for Environmental Science, Accuracy, & Reliability (CESAR)	The EIS must provide information to the public demonstrating how the requirements of the Biological Opinion on the OCAP preferred alternative: a. Are supported by a Section 7 effects analyses using the best available data; b. Are the result of discretionary actions as defined by the Bureau; c. Are supported by an effects analysis consistent with the requirements of CFR 50 Section 402 et seq.; d. Are effective. …Unless the conservation actions identified in the biological opinion, including any reasonable and prudent alternatives to avoid jeopardy, meet the substantive requirements of the ESA the Bureau may not unilaterally incorporate them into their NEPA alternatives and cite them as a basis to override other legally binding limitations on their operational authority. The EIS must provide information to the public explaining how the provisions of any biological opinion adopted as part of the preferred alternative meets the substantive requirements of the ESA, it's implementing regulations and the agency's guidance. In assessing the effects of Alternatives under NEPA the EIS must include any requirements which are the result of a biological opinion.…Water delivery to communities and farms are controlled by contractual agreements with some delivery flexibility. The Bureau of Reclamation has little authority to go outside those contractual boundaries and substitute other priorities.…The real 'change in the environment' of this agency action to, 'continue to operate', are the conditions imposed by Biological Opinions to allow that continued operation. Typically, under NEPA, when an action agency proposes alternatives, the Services only analyze the effects of the preferred alternative. In the case of the OCAP, the proposed agency action is for the Bureau to continue to operate the project consistent with its contractual obligations. The actual effect of the project on the human environment flows not from the agency action, but from the consequence of changes to the contractual deliveries of water which result from the conditions contained in the Biological Opinions designed to conserve listed species…A full analysis and proper review of those effects under NEPA would provide an opportunity to avoid the errors made by the Services, provide the public an opportunity to review and comment on assumptions, data and analysis used in the ESA effects analysis, and assist the action agency, the state and other affected parties to identify potential alternatives… If the Bureau chooses an alternative that cedes operational control of the CVP to the wildlife agencies as was the case with the 2008 biological opinion, the EIS must identify the legal authority for such delegation to another federal agency…If the conditions imposed by the OCAP BiOp are supported by data and analysis, they can be articulated as a series of decision rules developed by the Services for implementation by the biologists and engineers of the Bureau. There is no reason for the Services to have any ongoing participation in the operation of the project. The Bureau will have identified their action, accepted the decision rule related to operation of the project articulated by the biological opinion and can move forward based on that rule until the Bureau makes a discretionary decision to change that action. However, if it is the Wildlife Agency position that only they and their biologists are able to discern the necessary actions based on their 'best professional judgment' and thus must be active participants in the operation of the projects, that is not a conservation action based on the best available data and thus does not meet the requirements of the ESA.

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Interested Party	Chris Hurd, Circle A Farms	…the water coming in through the delta, CVP water is applicable to federal and state contractors of over five million acres. My range is from almonds to pistachios. And when there is water available, we also have tomatoes and other crops...The hardship was apparent with all of us on the west side, the cities, the ranchers, the workers, the vendors. It is estimated that it was somewhere between a three and five billion dollar implication to everyone involved because of the Biops in '09…As farmers and our communities, we are now challenged as the world is going to go from eight to 12 billion people. We are being asked to feed the world. And if long-term investment for all of us involved with farming is to be made by agriculture, then direction, leadership and sustainability is job one. We need hard decisions made. This is not easy. And this is not just for 2009 and 2010…the biological opinions in their remand, must reflect the truth, exact science, and all stressors.
Interested Party	Allan Clark, Clark Bros. Farming	We were not able to plant 320 acres of cotton this year, even though it had been riped listed & ready to plant. A 40% water allotment required we not farm 25% of our land. That means 25% fewer employees, 25% less income, 25% less taxes, & 25% less for all related industries. We cannot continue to farm like this!
Interested Party	William D. Phillimore, Coalition for a Sustainable Delta	The preferred alternative, described in the Notice as the proposed action, is implementation of operational components of the 2008 USFWS and the 2009 NMFS Reasonable and Prudent Alternatives. 77 Fed. Reg. at 18,860. The Bureau explains that we will develop and consider a proposed action and a reasonable range of alternatives, including a No Action Alternative. Id.…In light of the federal government's unwavering adherence to a failed and indefensible set of RPAs to date, its identification of those RPAs as the preferred alternative at the outset of the NEPA process raises the specter that the process will be an exercise in form over substance designed to rationalize a decision already made by the federal bureaucracy behind closed doors. The preferred alternative is arbitrary and unlawful. - The Bureau is required to rigorously explore and objectively evaluate a range of reasonable alternatives. 40 C.F.R. § 1502.14. An alternative that is arbitrary or unlawful is per se unreasonable. Therefore, it is improper to include any such alternative among those under consideration. Here, the Bureau is proposing an alternative that includes implementation of RPAs held to be unlawful by the United States District Court for the Eastern District of California. The preferred alternative is based on misinterpretation or mischaracterization of data and analyses or reliance on data and analyses that are demonstrably improper. - …the preferred alternative should be disregarded because it includes components that are out of step with prevailing norms and practice in the fields of ecology, quantitative biology, and statistics.

4.2 Summary of Scoping Comments

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Interested Party	William D. Phillimore, Coalition for a Sustainable Delta	…the Fall X2 Action, which was included in the USFWS RPA is based on data and analysis drawn directly from a journal article by Feyrer et al. (2007) and from a then in-manuscript predecessor to an article subsequently published as Feyrer et al. (2011). Neither of the articles supports the Fall X2 Action, and both have significant shortcomings that fully compromise their application in water and ecosystem management…First, and of primary concern, is that the biological opinion recapitulates Feyrer et al.'s (2007) investigation of environmental correlates of delta smelt occupancy in the estuary, which was limited to just three physical variables; it ignored other physical variables that appear in the agency's own conceptual models that link delta smelt population responses to environmental attributes, and disregarded biotic variables, such as food availability and the presence of predators, altogether…Second, the biological opinion makes two fundamental analytical mistakes that contribute to mischaracterizing the relationship between the locations of X2 in the estuary to delta smelt abundance…Third, the characterization of delta smelt as preferentially inhabiting just a portion of the estuary's low-salinity zone is drawn at least in part from a mischaracterization of that distributional relationship as presented in Feyrer et al. (2007) and perpetuated in Feyrer et al. (2011)…Fourth, the biological opinion failed to relate explicitly the various adverse effects from environmental factors to population effects on delta smelt…Fifth, eschewing analysis of the effects of water exports on the demographic condition of delta smelt as required, the biological opinion adopts a habitat index (from Feyrer et al. 2011) that incorporated data generated by the above sampling shortcomings to make predictions regarding the availability of habitat under different flows scenarios…Any of the five technical errors above render the Fall X2 action not consistent with best available science as required by law. Furthermore, the flows-management prescription that is set forth as the Fall X2 Action is premised on an incorrect definition of delta smelt habitat and an inappropriate interpretation of habitat in the context of resource management…There simply is no evidence to support the link made in the USFWS biological opinion and RPA between the location of X2 in the estuary in the autumn, and either the extent (or quality) of delta smelt habitat or trend in population numbers of the fish. Another component of the preferred alternative that cannot be reconciled with prevailing norms and practice in the fields of ecology, quantitative biology, and statistics is implementation of the I:E Action…It is based on the Vernalis Adaptive Management Plan (or VAMP) studies. These studies involve the release and tracking of tagged hatchery fall-run Chinook salmon smolts during a 31-day period during April and May when a pulse flow of water was released at Vernalis. NMFS states that the VAMP studies provide support for the proposition that increasing flows increases survival of outmigrating salmon smolts. They then reason that wild steelhead would likely benefit in the same way as hatchery fall-run Chinook salmon. Flaws in NMFS's interpretation of the VAMP studies and other pertinent studies, a break in the logic chain that links its interpretation to the purpose of the I:E Action, and a fundamental flaw in the underlying VAMP studies that use acoustic tags all combine to compromise the conclusions drawn by NMFS. Continued adherence to the I:E Action is inconsistent with norms and practice in the fields of ecology, quantitative biology, and statistics.

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Interested Party	William D. Phillimore, Coalition for a Sustainable Delta	The purpose and need should not be to implement the operational components of the Services' respective RPAs, but to avoid jeopardy of listed species and destruction or adverse modification of critical habitat while supplying sufficient water to meet the agricultural, municipal, and industrial needs of millions of Californians in the CVP and SWP service areas…The underlying purpose of the Bureau's action is to continue to supply its share of the water needed by tens of millions of Californians and over 1.5 million hectares of irrigated agriculture in the CVP and SWP service areas without jeopardizing listed species or adversely modifying designated critical habitat. This underlying purpose and need is also consistent with the California Legislature's stated goal for the Delta, namely, to achieve the two coequal goals of providing a more reliable water supply for California and protect, restore, and enhance the Delta ecosystem. Public Resources Code § 29702; see also Water Code § 85001(c); id. § 85054... The Bureau must consider a reasonable range of potentially feasible alternatives, including alternatives outside the Bureau's control. - …The Coalition urges the Bureau to consider a broad range of feasible alternatives, commensurate in breadth with the broad purpose of the action discussed above, including alternatives that are not within the Bureau's jurisdiction. Although the Bureau has begun the scoping process, based on the NOI, it appears that the Bureau will not proceed in a manner consistent with the scoping requirements set forth in the NEPA regulations…First, in its Notice, the Bureau indicated its intent to invite the State and Federal Contractors Water Agency to participate as a cooperating agency, but it did not indicate an intent to invite the state and federal water contractors themselves despite the fact that they are affected local agencies.…not only do the contractors have a manifest and sustained commitment to improving the health of the Delta ecosystem, they have also developed considerable expertise on the Delta and Delta ecosystem over the decades, and especially in the last decade or more. Their expertise can assist the Bureau in identifying and analyzing feasible alternatives. In addition, the Coalition requests that the Bureau invite the Federal Emergency Management Agency (FEMA) to participate as a cooperating agency. Among other things, Executive Order 11988 requires federal agencies to take action to reduce the risk of flood loss, and restore the natural and beneficial values of floodplains. Moreover, FEMA's implementation of the National Flood Insurance Program in communities in the Delta may affect listed species and their designated critical habitat… Second, the Bureau should engage with the federal and state water contractors in developing the proposed action and alternatives… Third…At this time, the Bureau and the Department of Water Resources have re-initiated formal consultation with the Services under section 7 of the Endangered Species Act on the impacts of coordinated long-term operation of the CVP and SWP. In addition, the Bay Delta Conservation Plan (BDCP) and BDCP EIR/EIS are being developed, as are the Delta Plan and Delta Plan EIR/EIS. The State Water Resources Control Board is in the process of developing revisions to the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (2006 Bay-Delta Plan) and preparing a Supplemental Environmental Document to analyze the potentially significant impacts of the project under the California Environmental Quality Act. The NOI fails to mention these other consultations, plans, and environmental review documents despite their potential to inform scoping and subsequent environmental analysis of the Bureau's proposed action… Fourth, the Bureau has not [i]ndicate[d] the relationship between the timing of the preparation of environmental analyses and the agency's tentative planning and decisionmaking schedule. 40 C.F.R. § 1501.7(a)(7). Indeed, it has not published a schedule for the environmental review process or the Bureau's decisionmaking schedule.

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Interested Party	William D. Phillimore, Coalition for a Sustainable Delta	RPA alternative 1 - Includes the following measures. - Triggers for OMR reductions for delta smelt - San Joaquin River inflow requirement for salmon - Predation control program targeting black bass, striped bass, and pike minnows for salmon and delta smelt - Floodplain habitat restoration for salmon and delta smelt - Trap and haul program upstream of the Head of Old River Barrier for juvenile salmonids entering the Delta from the San Joaquin River - Work with Pacific Fisheries Management Council, CDFG and NMFS Southwest Fishery Science Center to minimize harvest mortality of natural origin Central Valley Chinook salmon RPA alternative 2 - Includes the following measures. - Floodplain development limits for salmon and delta smelt - Levee vegetation and armoring policy for salmon and delta smelt - Predation control program targeting black bass, striped bass, and pike minnows for salmon and delta smelt - Water quality improvement program at the Sacramento Regional Wastewater Treatment Plant and the Fairfield-Suisun Sewer District treatment plant for salmon and delta smelt - Floodplain habitat restoration for salmon and delta smelt - Trap and haul program upstream of the Head of Old River Barrier for juvenile salmonids entering the Delta from the San Joaquin River - Harvest restrictions for salmon I believed that our strategy should work and believed that our water should rise more than 10% - yes we should make polictial actions a strive to succeed in getting more water in the valley. And I agree 100% with the Bureau of Reclamation.
Interested Party	Joe DelBosque, Empresas Del Bosque	2009 is a year that is engraved in my mind and it's there because it should never happen again. The impacts were severe on our farm. On my farm alone, I idled over 900 acres of land, very productive land. On those 900 acres were losses that were huge, in farm gate prices, in the millions of dollars, and in food, food enough for millions of people in the country. But the worst effect of the drought – and the affects were terrible on our farms – but the effects were more severe on our farm workers. We saw people without jobs, we saw people who were working and they were under employed…There were other impacts in my area. We saw many people that lost jobs move away. These are people that are skilled at what they do, driving tractors, irrigating, harvesting. Many of these people didn't come back. We saw in my area, the little grammar school out in the country that I went to since I was in first grade, closed down for lack of enrollment… In the delta we have other stressors, we have invasive species. We have partially treated waste discharge into the delta that harm the ecosystem. We have unscreened pumps, over a thousand pumps in the delta with no screens pumping at will. And you can't tell me that there's no smelt or salmon that are swimming by those pumps… We have to look at the infrastructure. We have a system that was made in the 50's and 60's and this system is not keeping up with the state. The state is probably twice the size and population and it is grown tremendously. And if we don't catch up with our infrastructure, the state is going to be headed for disaster. So I urge the people at Bureau of Reclamation to remember about some of these impacts that we had in 2009 and that we plan for the future so this never happens again.

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Interested Party	Dayatra Latin, Fresno Community Food Bank	The end of July 2009 … We held our first drought distribution providing food to over 680 families in the city of Mendota. At that point, Community Food Bank had distributed about seven and a half million pounds of food every year. After everything is said and done, Community Food Bank was distributing thirty million pounds in food… We really need to fix that because in this country, it shouldn't be that way. We served thousands of people affected by this decision.
Interested Party	Ryan Jacobsen, Fresno County Farm Bureau	…San Joaquin Valley (SJV) farmers are faced with severe water restrictions that provide a 2012 water allotment of just 40 percent from the CVP. This decision has tremendous economic repercussions locally, as well as throughout the state and nation…It is estimated by water contractors that in just a six week period this spring, restrictions on CVP operations under the Endangered Species Act (ESA) cost south of the delta water users more than 180,000 acre-feet of water. This is enough water to irrigate 72,000 additional acres via increasing the allocation to 55 percent. In a county that still faces 15.8 percent unemployment, that additional water means additional jobs. Fresno County's 1.63 million acres of fertile farmland produces over 400 different types of crops which contributed more than $5 .9 billion to the California economy in 2010 and supports 24.2 percent of all jobs in the area. Fresno County agricultural products are exported to 94 different countries around the world. Therefore, the BOs that produce CVP operational restrictions when the Reasonable and Prudent Alternatives (RP A's) are implemented result in impacts that are felt well beyond the agricultural industry and The SJV region. According to the Berkeley Economic Consulting group's 2009 study, the initial Delta Smelt pumping constraints would have a $500 million to $3 billion annual impact on the California economy, depending on hydrological conditions. In 2008, when a 40 percent water allocation was implemented, there was a 65 percent full-time decrease in on farm employment and hundreds of thousands of acres were not farmed. Also in 2009, a UC Davis report estimated 80,000 jobs were lost, over 350,000 acres were left fallow and there was a loss of $2.2 billion in farm revenue as impacts were felt from the smelt BO alone. West side unemployment soared over that of the urban core. For many of those who work to harvest our food, the food lines became a staple during this period. These individuals were unable to work because the land lay fallow; they were unable to afford the produce that they would have normally been harvesting. Demand for social services increased while the cities and counties struggled to serve the residents due to the increased economic strain. The effects of this year's 40 percent CVP water allotment are just beginning to become apparent. Preliminary estimates are that 85,000 acres have been left fallow. A continued lack of surface water deliveries due to restrictions places a tremendous strain on our already depleted ground water. A reliable surface water supply is the only way that we can begin to systematically replenish our groundwater. There have been environmental impacts as well, as non-irrigated fields lay fallow. These open fields can often produce dust, negatively impacting the air quality in our region. Non-cultivated fields can also produce non-native plant species and noxious weeds that can have further economic impacts as additional work must be done to eradicate them.

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Interested Party	Ryan Jacobsen, Fresno County Farm Bureau	These BOs have resulted in a tremendous amount of human and economic impact without a correlating improvement in species numbers due to operational restrictions. Scientists who have studied the Delta agree that there are numerous factors contributing to the fisheries' decline. In a recently released Public Policy Institute of California (PPIC) study entitled, Aquatic Ecosystem Stressors in the Sacramento-San Joaquin Delta, flow regime change was identified as only one of five broad categories of stressors. PPIC concluded ... maintaining the status quo appears to be the least likely avenue to successfully managing the Delta's native biodiversity. Yet, the federal agencies responsible for drafting the BOs that impact Delta pumping operations have failed to quantify or analyze these stressors. The EIS must analyze all of these stressors because it is clear that the status quo management strategy of simply curtailing water pumping has failed urban and rural water users, as well as the environment.
Interested Party	Rodolfo Villa C, Hall Management Corporation	Antes que nada gracias por hacer esto por todos. Sin agua no tendríamos ninguna posibilidad de sobrevivir y ya se comprobó en el 2009 cuando más de la mitad de nosotros perdió su trabajo.
Interested Party	Mike Stearns, Hammonds Ranch	Hammonds Ranch is a third generation family farm. Farming for more than 90 years, land which is now served by the Panoche Water District and the Firebaugh Canal Water District. For the past 20 years we have seen our farm decrease in size by more than 50% and in turn, labor, equipment and materials, all of which are having a negative effect on our area. This is primarily due to the reduced water supply from regulation of the Delta and the way CVPIA has been implemented. What really hurts is now we are primarily drip irrigated (90%,+) on the land we are farming and fallowing 10% or more, depending on the annual water allocation and having a heck of a time making these investments pay. These investments in irrigation efficiency are paid through loan commitments and due to the way the delta is being regulated we have such wide variations in the water allocation plus not knowing what the allocation may be until late in year, we are not able live up to the commitments banks require. In addition, planning, contracting and planting of annual crops is impossible if you don't know if and when you have water. As chairman of the San Luis Delta Mendota Water Authority and a director for Panoche Water District and Firebaugh Canal Water District, I am convinced that beginning with this Remanded Biological Opinion process, the Bureau bas a real opportunity to provide the necessary leadership to assure that the BO is based on sound facts and science and that at the same time all stressors on the delta will be addressed with equal effort. Without that leadership we will be bogged in law suits and our efforts to improve the economy, including water transfers which result from the irrigation efficiency investments, will be killed, to the detriment of agriculture, M & I AND the environment.
Interested Party	Luis A. Monad, Harris Farms, Inc	Central Valley is the heart of California. We all depend upon agriculture either in the city or at the fields. We need more water to grow California.

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Interested Party	Katherine S. Poole, Gary Bobker, Mark Rockwell, Jason Flanders, John Mertz, Zeke Grader, Jonas Minton, Gary Mulcahy, and Jim Metropulos, Natural Resource Defense Council, The Bay Institute, Northern California Council Federation of Fly Fishers, San Francisco Baykeeper, Pacific Coast Federation of Fishermen's Association, Planning and Conservation League, Winnemem Wintu Tribe, Sierra Club California, Sacramento River Preservation Trust	…the most reliable and lasting approach to reducing conflicts between CVP/SWP operations and listed species is to recover those species (as all federal agencies are obligated to do under § 7(a)(1) of the ESA) and operate the CVP/SWP in a manner that is fully compatible with long-term ecosystem health. We believe such operations are entirely feasible, and should be the focus of Reclamation's NEPA review. I. Both The Proposed Action and Baseline Should Incorporate the Existing BiOps and RPAs - We agree that the Reasonable and Prudent Alternatives (RPAs) in the 2008 delta smelt and 2009 salmonid biological opinions (BiOps) provide the appropriate starting place for the CVP/SWP operations that define the proposed action. This approach is consistent with the district court's rulings, which directed Reclamation to conduct NEPA review on its decision to implement the RPAs. However, it is also important to recognize that those RPAs are currently being implemented, have been in place for over three years, and will remain in place at least until the pending NEPA review and BiOp remand is complete. CVP/SWP operations according to the RPAs, therefore, also represent the baseline operations for analysis under NEPA. II. Reclamation Should Define the Project Purpose Expansively and Consider a Wide Range of Alternatives - A. The 2008 Biological Assessment and Contractual Obligations Should Not Limit the Reasonable Range of Alternatives - …Reclamation's NOI describes the purpose of the action as continuing the coordinated operations of the CVP and SWP as described in the 2008 Biological Assessment (as modified) in a manner that avoids jeopardy and adverse habitat modification of listed species and is consistent with law and other requirements, including contractual obligations. …To the extent that Reclamation views either the 2008 Biological Assessment or contractual obligations as limiting the range of reasonable alternatives, we urge you to omit these qualifiers from the project purpose. The 2008 Biological Assessment describes only one of several possible ways of operating the CVP and SWP in a coordinated manner and in compliance with legal and other obligations. Moreover, the operations described in the 2008 Biological Assessment would indisputably lead to jeopardy and adverse modification of critical habitat for numerous listed species, conflicting with one of the primary purposes of the project as described in the NOI…Because numerous alternatives exist to operating the CVP and SWP as described in the 2008 Biological Assessment – alternatives that better meet the objectives of avoiding jeopardy and adverse habitat modification – Reclamation should not limit the range of alternatives analyzed under NEPA to those that comply with the 2008 Biological Assessment. …Reclamation and DWR have signed long-term water delivery contracts for the CVP and SWP that far exceed the capacity of the Projects to meet on a regular basis, let alone in an environmentally sustainable manner. Full contract deliveries for both Projects have rarely, if ever, been made, and are based on invalid build-out assumptions, outdated land use assumptions, and extremely favorable hydrology that occurs only very infrequently. Contract quantities are, therefore, unrealistic, and should not limit the range of reasonable alternative operating regimes…In addition, contract obligations do not trump Reclamation's duties to conserve threatened and endangered species and their critical habitats under the Endangered Species Act…Meeting contract quantity amounts is, therefore, neither a reasonable nor a legally-required objective.

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Interested Party	Katherine S. Poole, Gary Bobker, Mark Rockwell, Jason Flanders, John Mertz, Zeke Grader, Jonas Minton, Gary Mulcahy, and Jim Metropulos, Natural Resource Defense Council, The Bay Institute, Northern California Council Federation of Fly Fishers, San Francisco Baykeeper, Pacific Coast Federation of Fishermen's Association, Planning and Conservation League, Winnemem Wintu Tribe, Sierra Club California, Sacramento River Preservation Trust	Alternatives Should Consider Reclamation's Non-ESA Environmental Obligations and Alternative Water Supplies - 1. Alternatives Should Include Measures to Meet State and Federal Salmon Doubling Mandates - Numerous non-ESA environmental obligations apply to Reclamation that should cause it to modify Project operations in a manner that is more protective of the environment than the baseline RPAs. Reclamation's Development of Alternatives and Impacts Analysis Should Consider the Availability of Existing and New Alternative Water Supplies - …Reclamation and DWR have numerous non-ESA environmental obligations that likely exceed the effect of RPA compliance on water supplies if properly implemented, including salmon doubling obligations, public trust requirements, California ESA obligations, Fish and Game Code § 5937 requirements to keep fish in good condition below dams, and more. While California needs to maintain an adequate water supply to meet the needs of a growing population and economy, water delivered from the CVP and SWP is a small portion of the total water supplies both used by and available to the State, and cannot and should not be viewed in isolation from other supplies available to meet the State's water supply needs and CVP/SWP contractors' water supply needs. We urge Reclamation to take a far more holistic view of the State's available and potential water supplies when considering alternative operational scenarios and assessing water supply impacts…this document should include an analysis of the significant progress made in recent years by water users south of the Delta in reducing reliance on the Delta and increasing water use efficiency. This progress has been seen in both the agricultural and urban sectors … Reclamation should also analyze the additional benefits of investments to reduce reliance on the Delta, including reduced energy use and greenhouse gas emissions. Finally, Reclamation's analysis must reflect the state policy, established in SB 7X1 and codified at Water Code § 85021 to reduce reliance on Delta water supplies… This state policy requires Reclamation to change its traditional focus on maximizing water deliveries and focus instead on a broader set of tools that have the potential to reduce reliance on CVP and SWP deliveries… In summary, Reclamation can and should analyze ways to increase water supplies to its contractors through a variety of these investments in its alternatives analysis. Reclamation should also consider these and other supplies available to its contractors when analyzing impacts, as investments by the contractors and their member agencies can and should allow the contractors to better meet water needs in a way that is fully compatible with reduced exports under the BiOps.

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Interested Party	David J. Guy, Northern California Water Association	NCWA previously submitted to Reclamation the enclosed May 19, 2011 and December 16, 2011 letters [Attachment 1] with their respective enclosures, for consideration and use in the Endangered Species Act (ESA) consultations for the remanded BiOps, and Reclamation's accompanying environmental impact analysis being conducted under the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et seq.)…evidence of the problems and potential solutions regarding Sacramento River Basin native anadromous fishery issues, and will be critical in Reclamation's consultations on the potential effects of the proposed project operations of the CVP and SWP on listed species, including both salmonids and delta smelt, and the environmental impacts that must be addressed in the EIS. …the enclosed December 16 letter and its enclosure (Attachment 2…) …analysis enclosed with the letter utilizes a longer-term hydrologic period of record, and is superior to the analyses … which used a truncated period of record and ignored the plain fact that the 1956-87 period was wetter than the subsequent period from 1988-2009.3 Reclamation's analysis of the potential impacts of the remanded BiOps, and Reclamation's development of any flow management actions or alternatives must be based on the full datasets…Reclamation must consider and evaluate the…analysis that there is no relationship between diversions in the Sacramento River basin and the Delta smelt index. Finally, Reclamation must consider and evaluate the finding …that the implementation of a fall X2 measure as part of the remanded BiOps would have the effect of severely reducing carryover storage at Shasta Reservoir, with the consequent adverse effects on salmonids in the Sacramento River, as well as water supplies.

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		NCWA is also submitting herewith the enclosed April 25, 2012 scoping comments, and certain exhibits thereto (Attachment 4 hereto), which the Sacramento Valley Water Users filed with the SWRCB for the proposed update to the SWRCB's Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan). To the extent that Reclamation, FWS, or NMFS are considering flow management actions or alternatives in the remanded BiOps based upon some percentage of unimpaired flows, Reclamation must consider and evaluate the information included in that scoping comment letter and its exhibits. In this regard, the information demonstrates that flow management actions based on 40% or 50% of unimpaired flows would cause severe hydrologic, environmental, and water supply impacts, and would require Reclamation to analyze in detail the many significant environmental impacts that would occur in numerous resource categories. The information also demonstrates that state-of-the-art streamflow requirements already govern the major rivers in the Sacramento Valley. Because these streamflow requirements have been developed largely to integrate fishery protection and water supplies, NEPA requires Reclamation to analyze reasonable alternative flow management actions based upon the Delta inflows produced by existing streamflow requirements for the Sacramento Valley's rivers. …to the extent the remanded BiOps include any measures or Reasonable and Prudent Alternatives that could potentially affect the management of water resources in the Sacramento Valley, we note that ESA section 2(c) states congressional policy that Federal agencies shall cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species, and therefore requires Reclamation to cooperate with local Sacramento Valley water agencies in the management of water resources in this region.
Interested Party	Marisela Rodriguez, Rodriguez Familia Ranch	Pienso que todo este programa de pedir agua para nuestra comunidad es un bién para todos tanto para los Rancheros como para nuestras familias.
Interested Party	Melissa Cushman, State Water Contractors	… the State Water Project and the users of that water are interested in there being sufficient water supplies for the tens of millions of users out by the Delta who are relying on that water. And the adequate protection of listed species is of course, also a consideration…We would like to participate as a cooperating agency… …we really think it's important to look at a wide variety of different measures to see the best way so that the species can be protected, plus the water costs kept to a minimum and to see what's most effective…What should be focused on is what is sufficiently protective of the species and allows for sufficient amounts of water supplies be available to the people who use Delta water…The possibilities are, you know, there would be OMR restrictions --OMR, old and middle river flow restrictions, that were part of the previous RPAs. And one of the suggestions will probably be to look at intermediary flow restrictions… Another possibility would be turbidity-linked measures. I know some of the evidence that was put forth in the trial court was that turbidity has a large effect on certain of the species, particularly the Delta smelt, and whether an alternative that is more geared towards turbidity rather than flow regimes might be equally protective or more protective, but have lower water costs because it would be more responsive to the… exact situation of what's going on and what has the most effect on the species, particularly the Delta smelt… The head of old river barrier as far as the salmon go… There's also mitigation measures…And a lot of the mitigation measures will probably have nothing to do with flow regimes or the operation of the projects themselves, but have the possibility of incorporating almost unrelated actions that could actually benefit the fish more than a particular flow regime could. Potentially. Such as controlling predators, controlling invasive food source… Reducing toxic chemical concentrations, restoring wetlands; that, of course, was part of the previous BiOp. Also, regulating smaller water diversions. Measures like that may be able to be imposed that can have a less significant impact on water supplies, but hopefully be very beneficial…

4.2 Summary of Scoping Comments

Category of Commenter	Commenter and Affiliation	Excerpts from the Scoping Comments (Citations from written or oral comments; please note "…" is used to indicate that portion of the comment was not reproduced in Table 4.2. Complete transcripts from scoping meetings and comment letters are presented in Appendices D and E)
Interested Party	Melissa Cushman, State Water Contractors	…Another important consideration in the NEPA process is the big concern of our clients is the fact that implementing, especially the flow-control measures, the X2 action, which is part of the previous BiOp as well -- one BiOp as well, and some of the other actions in the RPAs, won't just reduce the available water supply…Evidence was put forth in the trial court and the judge issued findings that water supply restrictions have a domino effect…increasing demand on local water supplies, especially groundwater, particularly in the Central Valley, which is already in severe overdraft. And severe overdraft leads to subsidence and other environmental, you know, disasters sometimes…Water quality impacts can happen because the Delta water is, as you know, very high-quality and it's used for blending with a lot of local resources and other surface water resources, including even Colorado River water and other ones like that. And this blending makes it able to be high enough quality that it can be used for a much wider number of beneficial uses. And once the high-quality water is cut back, suddenly there's a problem where you have – you can't do groundwater recharge in certain areas because the water isn't high enough quality to be able to meet the requirements of some of the regional water quality control boards. There also may be to be a limited ability to respond to emergencies, especially wildfires in certain circumstances. Agricultural land being taken out of production, I think that was the one that the District Court ended up focusing on. There's fallowing, loss of topsoil, due to erosion, air quality impacts that can result from fallowing. There's also environmental justice and socioeconomic impacts, also had a lot of testimony in the court about those…There's a loss of other farm-related jobs… water supplies reductions result in visual impacts, both urban decay resulting from economic problems, as well as just how unattractive fallowed land and dead crops are…outside of Delta water users also have a huge, huge impact to them, both direct and indirect environmental impacts from changing the amount of water that's available in particular types of years…
Interested Party	Justin Dutra, Stone Land Company	I am writing you as an employee of a diversified family farming operation. Stone Land Company was founded in 1948 by Jack G. Stone, employed just over four people and farmed approximately 640 acres. Today Stone Land Company employs approximately 60 full time employees and over an additional 200 seasonally. This is over 260 families that are counting on my employer to remain viable. Indirectly, there are countless business's that depend on these employees' dollars as well as our own: Grocery stores, Chemical/Fertilizer distributors as well as equipment dealers are all dependant on the business that we create: our annual payroll and crop expenditures are staggering. My question to you is what happens when this goes away? The loss of jobs and business's would be devastating to our already crippled economy and the main problem is once this great agricultural infrastructure is gone, it cannot come back. Currently we are investing heavily in water saving irrigation systems and the development of new wells to continue farming in this disastrous regulatory water drought we are encountering. This is not a sustainable solution but a temporary fix. Farming is not only a business but it is a way of life for us: we as well as our neighboring farms provide under the most heavily regulated environment in the world; the safest most abundant supply of food and fiber available anywhere! In order to maintain this safe food supply we must have a reliable water supply. We do not want to become a country that depends on foreign importation of food and this is exactly the road we are taking if we do not repair California's broken water system. I urge you to consider the human affect, consider the economy and consider the lives you are affecting with your decisions.

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Interested Party	Brad Craven, Superior Almond Hauling	…the community of post-harvest process is a very large group of employers. So a lot of the agricultural jobs come through our sector…On the environmental side, I just wanted to point out that farmers and processors like ourselves alike are required by the Air Pollution Control District to have conservation management plans. And conservation management plans for the most part deal with fugitive dust generation, PM10 control based on truck traffic or tractor operations… I think those plans are marginally affective in controlling the PM10 from fugitive dust. But I think it pales in comparison to fallowed lands and wind generator dust. And if you see the West Side winds in action whenever there's dry, untilled dirt, you can probably make a correlation between the frequency of traffic accidents caused by dust on the freeway and in the years that we have low water supplies. So I think the Air Pollution Control District probably doesn't have any good options in coming up with a system to control wind-generated dust in an area like that. Probably the best control would be to have a reliable and consistent water supply to make those lands productive and put a covered crop on them.
Interested Party	David Tolmachoff, Tolmachoff Farms	Reclamation makes its decisions of allocations after closed door meetings with Bay Area elites? EIS do they take include nitrates and pharmaceuticals in the Bay Delta city sphere of waste water for cities in consideration Does XXXX [waste]water from the Delta-Bay kill Fry Baby Fish? Do predator fish actually eat 90% of the schmelt-salmon? Why don't they tell people in Bay Area – it's partly their fault?
Interested Party	Piedad Ayala, Water 4 All	The problem that we have is that we, the farming industry, is getting blamed for what they are doing up north in Sacramento, Tracy and Stockton area. They're dumping all the sewage into the delta and then blaming the farming industry. The reality is, they need water to keep flushing all the problems they create up north…A lot of farmers have lost everything and with them we, as farm workers, have lost everything too because without farming, there's nothing here in this valley… Last year we have 180 percent rain, normal rainfall. We only received 80 percent. In a normal year like that we should be expecting at least what we pay for, 100 percent. We paid 100 percent for our water, in which we only receive 40 percent this year. 2009, everybody is talking about it, we got 0 percent.
		There have been countless meetings, but what ought to take place is some real action. We need to quit blaming the farmers, the fish, and the pumps. The underlying, and TRUE factor is the sewage that is being dumped in northern California.
Interested Party	Gracy Villavazo, Water 4 All	…slide show March 2012 as the initiating date of the scoping efforts and a concluding date was given of April 2016… That seems like an awfully long period of time to go out in search for reasonable alternatives when the answer is here today… Water means jobs… Water means lives. Water means our opportunity to grow and to better this economy in this crisis that we're facing today.
		I've come today to better educate myself on this issue and to question the wrongfulness in the shortage of water supplies imposed on our farmers across the state. Nowhere in the slideshow did I see the word People. Yes, lets save the Delta smelt but when did people fall second to these in importance?
Interested Party	Alonzo Garcia, Westside Harvesting	Sin el agua no se puede vivir la vida es mala, la economia, la salud los niños carecen de la nesesario. El agua es vida
Interested Party	David Aguilar, Westside Harvesting	Agua es vida, y una gran nesesidad para la comunidad entera, que sin ella no tendriamos trabajo, no mas plantaciones en todo el valle de San Joaquin. Sin el agua no habrá trabajo con que mantener nuestra familias, y proveerles alimentos, y el impacto sería fatal en todo el valle de San Joaquin.

4.2 Summary of Scoping Comments

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Interested Party	Jose T. Torrer, Westside Harvesting	Agua es vida y una gran necesida para toda. Una comunida entera y trabajo para todos. Los campesinos mejorar y no haya sed.
Interested Party	Baltazar Rodriguez, Westside Harvesting	En el 2009 la crisis estuvo muy critica, sin trabajo todo se combierte es un desastre. Lo único que se hacer es trabajar en el campo. Sin agua no se puede sembrar.
Individual	Todd Allen, Farmer near Firebaugh, California	…I am a third generation grower with farmland located close to Firebaugh, CA. I own 300 acres and lease 300 acres from my father within the Westlands water district. My father purchased the prime land in 1975 because he saw a great future for his family. He did very well and so did his employees. I farm crops such as cotton, wheat and cantaloupes. In December 2008, I planted 225 acres of wheat and was intending on planting 225 acres of pima cotton and 150 acres of cantaloupes. With the water I had left over from the year before, I was only able to irrigate 40 acres of wheat out of the 225 acres I had planted. The other 175 acres of wheat I had planted wilted up and died due to the fact that my initial allocation was zero. I have no wells on the farm and have to rely solely on Federal surface water to survive so I had to also fallow the remaining 450 acres. This created hardships for me that I thought I would never have to face, and was shocked that a 2 inch fish (Delta Smelt) was standing in the way of my success or failure as a farmer. The first thing I had to do was to lay off my employees which is a hard thing to do. Some of my employees have been working this land for 20 years or more. I then had to talk to the bank whom which I owed a substantial amount of operating money, they worked with me for a while then dropped me later on in the year. My suppliers suffered because they didn`t sell me the seed, fertilizer, pesticide, fuel and ranch supplies which amounts to thousands of dollars. I also experienced health problems due to the stress of whether I would be able to be able to take care of my beautiful daughters and wife. Had to start taking medication for high blood pressure. I also had to sell my water allocation that came to me in April (What am I gonna do with 10%?) to help pay for my land payment, home mortgage, and basic needs for my family. I luckily had my crops insured and used the indemnity to pay off my bank at the time in July, but because of the unstable water situation they told me no in November for 2010-11 crop year. I usually have operating funds for October! So I put together a package and visited 5 banks in a week and actually found a bank that wanted to take care of my operation. I still needed cash flow, so I sold my Cotton Picker, which was a painful decision, especially since I recently did a $15000 dollar overhaul on it. That got me through November and luckily was funded in December through my new bank. All this for an insignificant non-native 2 inch worthless fish. I tell this story to friends and family and they are thoroughly shocked that a little fish stands in the way of food and fiber for human beings and almost put me out of business. I really think that water diversions are not solving these fish problems. I`m convinced that its all political and a few people are benefiting from a feel good fish tale while thousands, if not millions are suffering financial or literally starving from this insanity!

4.2 Summary of Scoping Comments

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Individual	Mark and Mary Fickett, Farmers near Firebaugh, California	Our family farms almonds, pomegranates, and a variety of row crops, Our land Is situated in an area where there Is no ground water to pursue by drilling wells. We are 100% reliant on the federal CVP system to supply all of our irrigation water. In order for our business to survive we need a predictable and reliable water supply. Since the implementation of the endangered species act we have experienced unbelievable hardships. In 2009 we started our farming year with a 0% supply which caused all kinds of hardships for us. We were forced to lay off employees, who ended up In food lines in Mendota and Firebaugh. Our crop financing was completely cutoff for that crop year by the company who had been financing our crops up to that point. We were forced to see more costly financing to survive. We had no row crops that year and we had to shake the almonds that did set to the found where they were shredded up in order to qualify for a small crop Insurance payment. Later In the year we received a 10% supply which only allowed us to keep our trees alive albeit in poor condition. We are currently refinancing some of our land which is proving very difficult since we cannot produce any dependable water supply Information. We need to know an approximate range of water we will be receiving From year to year, We also need to know what the district's allocation will be before April or May of any given year because we plan what crops we are going to plant in September or October of the previous year. When we plan our cropping pattern in the fall we are also preparing financing and contracting for various input like fuel, fertilizer, labor, and chemicals. Some of these inputs must be paid for at this time when we have no Idea what the Bureau of Reclamation is going to declare at the allocation. We and our entire community are reliant on the water that's pumped from the delta and transported south. We are just as much a part of the delta ecosystem as the creatures and people Immediately in or adjacent to the delta.
Individual	Todd Neves, Farmer of Westlands Water District	…I would strongly like to invite you to a more ground zero here on, maybe Mendota. Somewhere where we can get more participation…what we really need is a reliable and a consistent allocation. It's so hard on our operations -- I'll just give you a brief example. When we get a 10 percent, a 30 percent, a 40 percent allocation, we're idling land. We're -- our next step will be laying off employees…We do everything in our power to be efficient with our water…My farm I purchased in 1999. I have paid more to conserve water by switching to drip irrigation, drilling wells to supplement water, I have paid more for those irrigation conservations than I did for my actual ranch… running wells and stuff, those are band aids, those are not long-term fixes for our operations.
Individual	William M. Ragsdale, Resident of Fresno, California	Why let Sacramento and other citys along the Sac River drain their sewers and waste into the river instead of build sewer plant and save all the water to be used instead of running it into the S.F. Bay or Ocean. Brain dead people can not figure that out??

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Individual	Frank and Judy Williams, Farmers near Firebaugh, California	We live in Firebaugh, California and farm on the west side of Fresno County in the Westlands Water District with Mark: and Mary Fickett. We have farmed out here since 1985. Our permanent crops are almonds and pomegranates. When we have more allocation, we have planted grain, cotton, dehydrated onions, cucumbers, beans, and melons. In 2009/2010 was a devastating year for us not only financially, but emotionally. We were financed with an almond company and they denied our financing prior to our receiving our 10% allocation on April 20th . Knowing that we only had 10% water. we knew our only option was to hopefully be able to keep our trees alive. We knew we would have no viable crop that year and just shook the unmarketable nuts to the ground and shredded them. We had to layoff more than half of our labor force. This was not only devastating to our employees, but to the local businesses in the community. Because of so many foreclosures In this area, our home values have plummeted. We tried to refinance our home to get a lower interest rate and the banker informed us that: because of all the foreclosures, our home is In a zero dollar tone. Basically. our home is worth nothing. Where we farm, there is not an option to financially have a well for groundwater. The uncertainty of allocation affects everything we do. Our financing depends upon how much allocation we receive. It also affects if we can plant other crops and hire additional employees. Our biggest fear is that we have another year like 2009/2010. It is hard to plan your future when there are so many unknowns with our water supply. We don't believe we could survive another year like 2009/2010.

Attachment A

Notice of Intent and Notice of Extension

associated impacts of each. Alternative 3 (Preferred Alternative) would implement the GCP as proposed.

Authority: The environmental review of this project is being conducted in accordance with the requirements of the National Environmental Policy Act of 1969 as amended (42 U.S.C. 4321 *et seq.*) and its implementing regulations (40 CFR parts 1500 through 1508), and with other appropriate Federal laws and regulations, policies, and procedures of the Service for compliance with those regulations.

Dated: February 17, 2012.

Mark J. Musaus,

Acting Regional Director.

[FR Doc. 2012–7370 Filed 3–27–12; 8:45 am]

BILLING CODE 4310–55–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLNML00000 L12200000.DF0000]

Notice of Public Meeting, Las Cruces District Resource Advisory Council Meeting, New Mexico

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of public meeting.

SUMMARY: In accordance with the Federal Land Policy and Management Act and the Federal Advisory Committee Act of 1972, the U.S. Department of the Interior, Bureau of Land Management (BLM), Las Cruces District Resource Advisory Council (RAC), will meet as indicated below.

DATES: The meeting date is April 11 2012, at the BLM Las Cruces District Office, 1800 Marquess Street, Las Cruces, NM 88005, from 10 a.m.–4 p.m. The public may send written comments to the RAC at the above address.

FOR FURTHER INFORMATION CONTACT: Rena Gutierrez, BLM Las Cruces District, 1800 Marquess Street, Las Cruces, NM 88005, 575–525–4338. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1–800–877–8229 to contact the above individual during normal business hours. The FIRS is available 24 hours a day, 7 days a week, to leave a message or question with the above individual. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION: The 10-member RAC advises the Secretary of the Interior, through the BLM, on a variety of planning and management issues associated with public land management in New Mexico.

Planned agenda items include opening remarks from the District Manager, access issues, illegal trash dumps, and the Social-Economic Strategic Plan.

A half-hour public comment period during which the public may address the Council will begin at 2:30 p.m. on April 11, 2012. All RAC meetings are open to the public.

Depending on the number of individuals wishing to comment and time available, the time for individual oral comments may be limited.

Bill Childress,

District Manager, Las Cruces.

[FR Doc. 2012–7408 Filed 3–27–12; 8:45 am]

BILLING CODE 4310–VC–P

DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project: Notice of Intent To Prepare an Environmental Impact Statement and Notice of Scoping Meetings

AGENCY: Bureau of Reclamation, Interior.

ACTION: Notice of intent and scoping meetings.

SUMMARY: The Bureau of Reclamation intends to prepare an environmental impact statement for modifications to the continued long-term operation of the Central Valley Project, in a coordinated manner with the State Water Project, that are likely to avoid jeopardy and destruction or adverse modification of designated critical habitat. We are seeking suggestions and information on the alternatives and topics to be addressed and any other important issues related to the proposed action.

DATES: Submit written comments on the scope of the environmental impact statement by May 29, 2012.

Four public scoping meetings will be held to solicit public input on alternatives, concerns, and issues to be addressed in the environmental impact statement:

1. Wednesday, April 25, 2012, 6 p.m. to 8 p.m., Madera, CA.
2. Thursday, April 26, 2012, 6 p.m. to 8 p.m., Diamond Bar, CA.
3. Wednesday, May 2, 2012, 2 p.m. to 4 p.m., Sacramento, CA.
4. Thursday, May 3, 2012, 6 p.m. to 8 p.m., Marysville, CA.

ADDRESSES: Send written comments to Janice Piñero, Endangered Species Compliance Act Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street Suite 140, Sacramento, CA 95814–2536; fax to (916) 414–2439; or email at *jpinero@usbr.gov.*

The scoping meetings will be held at the following locations:

1. Madera—Madera County Mail Library, Blanche Galloway Room, 121 N. G Street, Madera, CA 93637.
2. Diamond Bar—South Coast Air Quality Management District, Room CC6, 21865 Copley Dr., Diamond Bar, CA 91765.
3. Sacramento—Federal Building, 650 Capitol Mall, Stanford Room, Sacramento, CA 95814.
4. Yuba County Government Center, Board of Supervisors Chambers, 915 Eighth St., Marysville, CA 95901.

FOR FURTHER INFORMATION CONTACT: Janice Piñero at (916) 414–2428; or email at *jpinero@usbr.gov.*

SUPPLEMENTARY INFORMATION:

I. Agencies Involved

We, the Bureau of Reclamation, are the lead Federal agency. We will invite the following agencies to participate as cooperating agencies for preparation of the environmental impact statement (EIS) in accordance with the National Environmental Policy Act (NEPA), as amended:

- U.S. Fish and Wildlife Service (USFWS),
- National Marine Fisheries Service (NMFS),
- U.S. Army Corps of Engineers; and
- U.S. Environmental Protection Agency (EPA).

We have also identified other Federal, State, and local agencies (e.g., California Department of Water Resources, California Department of Fish and Game, State and Federal Contractors Water Agency, etc.) as potential cooperating agencies, and we will invite them to participate as such in the near future.

II. Why We Are Taking This Action

The Central Valley Project (CVP) is the largest Federal Reclamation project. We operate the CVP in coordination with the State Water Project (SWP), under the Coordinated Operation Agreement between the Federal government and the State of California (authorized by Pub. L. 99–546). Reclamation's 2008 Biological Assessment, as modified by general changes due to the passage of time and those items that have been litigated or legislated since the completion of the BA, describes operation of the projects.

In December 2008, USFWS issued a Biological Opinion analyzing the effects of the coordinated long-term operation of the CVP and SWP in California. The USFWS Biological Opinion:

- Concluded that "the coordinated operation of the CVP and SWP, as proposed, [was] likely to jeopardize the continued existence of the delta smelt" and "adversely modify delta smelt critical habitat."
- Included a Reasonable and Prudent Alternative for CVP and SWP operations designed to allow the projects to continue operating without causing jeopardy or adverse modification.

On December 15, 2008, we provisionally accepted and then implemented the USFWS Reasonable and Prudent Alternative.

In June 2009, NMFS issued a Biological Opinion analyzing the effects of the coordinated long-term operation of the CVP and SWP on listed salmonids, green sturgeon and southern resident killer whale. This Biological Opinion concluded that the long-term operation of the CVP and SWP, as proposed, was likely to:

- Jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, southern distinct population segment (DPS) of North American green sturgeon, and southern resident killer whales.
- Destroy or adversely modify critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead and the Southern DPS of North American green sturgeon.

The NMFS Biological Opinion included a Reasonable and Prudent Alternative designed to allow the projects to continue operating without causing jeopardy or adverse modification. On June 4, 2009, we provisionally accepted and then implemented the NMFS Reasonable and Prudent Alternative.

Several lawsuits were filed in the United States District Court for the Eastern District of California (the Court) challenging various aspects of the USFWS and NMFS Biological Opinions and our acceptance and implementation of the associated Reasonable and Prudent Alternatives.

III. Results of Litigation

The results of the above lawsuits were as follows.

- On November 16, 2009, the Court ruled that we violated NEPA by failing to conduct a NEPA review of the potential impacts to the human environment before provisionally accepting and implementing the 2008 USFWS Biological Opinion and Reasonable and Prudent Alternative.
- On March 5, 2010, the Court held that we violated NEPA by failing to undertake a NEPA analysis of potential impacts to the human environment before accepting and implementing the Reasonable and Prudent Alternative in the 2009 NMFS Biological Opinion.
- On December 14, 2010, the Court found certain portions of the USFWS Biological Opinion to be arbitrary and capricious, and remanded those portions of the Biological Opinion to USFWS. The Court ordered us to review the Biological Opinion and Reasonable and Prudent Alternative in accordance with NEPA.
- On September 20, 2011, in the Consolidated Salmonid Cases, the Court remanded the NMFS Biological Opinion to NMFS.

We now have an opportunity to initiate a combined NEPA process addressing both the USFWS and NMFS Reasonable and Prudent Alternatives. To that end, we are beginning this combined NEPA process to analyze the effects of modifications to the coordinated long-term operation of the CVP and SWP that are likely to avoid jeopardy to listed species and destruction or adverse modification of designated critical habitat.

IV. Purpose and Need for Action

The purpose of the action is to continue the operations of the CVP, in coordination with the SWP, as described in the 2008 Biological Assessment (as modified) to meet its authorized purposes, in a manner that:

- Is consistent with Federal Reclamation law, applicable statutes, previous agreements and permits, and contractual obligations;
- Avoids jeopardizing the continued existence of federally listed species; and
- Does not result in destruction or adverse modification of designated critical habitat.

Continued operation of the CVP is needed to provide flood control, water supply, fish and wildlife restoration and enhancement, and power generation. It also provides navigation, recreation, and water quality benefits. However, coordinated operation of the CVP, as described in the 2008 Biological Assessment was found to likely jeopardize the continued existence of listed species and adversely modify critical habitat. The ESA requires Federal agencies to insure that their actions are not likely to jeopardize listed species or result in the destruction or adverse modification of critical habitat. Modifications to the coordinated operation of the CVP and SWP to be evaluated should be consistent with the intended purpose of the action, within the scope of our legal authority and jurisdiction, economically and technologically feasible, and avoid the likelihood of jeopardizing listed species or resulting in the destruction or adverse modification of critical habitat.

V. Project Area

The project area includes the CVP and SWP Service Areas and facilities, as described in this section.

A. CVP Facilities

The CVP facilities include reservoirs on the Trinity, Sacramento, American, Stanislaus, and San Joaquin rivers.

- A portion of the water from Trinity River is stored and re-regulated in Clair Engle Lake, Lewiston Lake, and Whiskeytown Reservoir, and diverted through a system of tunnels and powerplants into the Sacramento River. Water is also stored and re-regulated in Shasta and Folsom reservoirs. Water from these reservoirs and other reservoirs owned and/or operated by the SWP flows into the Sacramento River.
- The Sacramento River carries water to the Sacramento-San Joaquin Delta (Delta). The Jones Pumping Plant at the southern end of the Delta lifts the water into the Delta Mendota Canal (DMC). This canal delivers water to CVP contractors, who divert water directly from the DMC, and exchange contractors on the San Joaquin River, who divert directly from the San Joaquin River and the Mendota Pool. CVP water is also conveyed to the San Luis Reservoir for deliveries to CVP contractors through the San Luis Canal. Water from the San Luis Reservoir is also conveyed through the Pacheco Tunnel to CVP contractors in Santa Clara and San Benito counties.
- The CVP provides water from Millerton Reservoir on the San Joaquin River to CVP contractors located near the Madera and Friant-Kern canals. Water is stored in the New Melones Reservoir for water rights holders in the Stanislaus River watershed and CVP contractors in the northern San Joaquin Valley.

B. State Water Project Facilities

The Department of Water Resources operates and maintains the SWP, which delivers water to agricultural and municipal and industrial (M&I) contractors in northern California, the San Joaquin Valley, the Bay Area, the Central Coast, and southern California.

• SWP water is stored and re-regulated in Lake Oroville and released into the Feather River, which flows into the Sacramento River.

• SWP water flows in the Sacramento River to the Delta and is exported from the Delta at the Banks Pumping Plant. The Banks Pumping Plant lifts the water into the California Aqueduct, which delivers water to the SWP contractors and conveys water to the San Luis Reservoir.

• The SWP also delivers water to the Cross-Valley Canal, when the systems have capacity, for CVP water service contractors.

VI. Alternatives To Be Considered

The proposed action for the purposes of NEPA will consider operational components of the 2008 USFWS and the 2009 NMFS Reasonable and Prudent Alternatives. These components address continued operation of the CVP, in coordination with the SWP, in a manner intended to avoid jeopardizing continued existence of federally listed species or result in the destruction or adverse modification of designated critical habitat.

• We expect to analyze flow management actions resulting from the 2008 USFWS Reasonable and Prudent Alternative that affect:

(1) Protection of adult, juvenile, and larval delta smelt; and

(2) Habitat improvements for delta smelt growth and rearing.

• We expect to analyze flow management actions resulting from the 2009 NMFS Reasonable and Prudent Alternative that affect:

(1) Attraction and channel maintenance flows;

(2) Reduction of thermal stress;

(3) Passage of fish at Red Bluff Diversion Dam;

(4) Reduction of redd dewatering, entrainment, and straying; and

(5) Reduction of negative hatchery influences on natural populations.

The proposed action will not consider:

• Structural changes prescribed in the NMFS 2009 Reasonable and Prudent Alternative that would require future evaluations, environmental documentation, and permitting; and

• Reasonable and Prudent Alternative actions that would require future studies.

As required by NEPA, we will develop and consider a proposed action and a reasonable range of alternatives, including a No Action Alternative. Reasonable alternatives to the proposed action may include physical changes or changes in operations of CVP facilities.

Alternatives could affect all or various components of the CVP, and may also include actions that affect SWP operations. We will engage with the Department of Water Resources in developing the proposed action and alternatives. We will also consider including in the alternative analysis reasonable alternatives to the proposed action identified through the scoping process.

VII. Statutory Authority

NEPA [42 U.S.C. 4321 *et seq.*] requires that Federal agencies conduct an environmental analysis of their proposed actions to determine if the actions may significantly affect the human environment. In addition, as required by NEPA, Reclamation will analyze in the EIS the potential direct, indirect, and cumulative environmental effects that may result from the implementation of the proposed action and alternatives, which may include, but are not limited to, the following areas of potential impact:

a. Water resources, including groundwater;

b. Land use, including agriculture;

c. Socioeconomics;

d. Environmental justice;

e. Biological resources, including fish, wildlife, and plant species;

f. Cultural resources;

g. Water quality;

h. Air quality;

i. Soils, geology, and mineral resources;

j. Visual, scenic, or aesthetic resources;

k. Global climate change;

l. Indian trust assets

m. Transportation; and

n. Recreation.

VII. Request for Comments

The purposes of this notice are:

• To advise other agencies, CVP and SWP water and power contractors, affected tribes, and the public of our intention to gather information to support the preparation of an EIS;

• To obtain suggestions and information from other agencies, interested parties, and the public on the scope of alternatives and issues to be addressed in the EIS; and

• To identify important issues raised by the public related to the development and implementation of the proposed action.

We invite written comments from interested parties to ensure that the full range of alternatives and issues related to the development of the proposed action are identified. Comments during this stage of the scoping process will only be accepted in written form. Written comments may be submitted by mail, electronic mail, facsimile transmission or in person (see **ADDRESSES**). Comments and participation in the scoping process are encouraged.

IX. Public Disclosure

Before including your name, address, phone number, email address or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

X. How To Request Reasonable Accommodation

If special assistance is required at one of the scoping meetings, please contact Janice Piñero at the information provided above *mailto:* or TDD 916–978–5608, at least five working days before the meetings. Information regarding this proposed action is available in alternative formats upon request.

Dated: March 14, 2012.

Anastasia T. Leigh,

Regional Environmental Officer, Mid-Pacific Region.

[FR Doc. 2012–7488 Filed 3–27–12; 8:45 am]

BILLING CODE 4310–MN–P

INTERNATIONAL TRADE COMMISSION

[DN 2885]

Certain Consumer Electronics, Including Mobile Phones and Tablets; Notice of Receipt of Complaint; Solicitation of Comments Relating to the Public Interest

AGENCY: U.S. International Trade Commission.

ACTION: Notice.

SUMMARY: Notice is hereby given that the U.S. International Trade Commission has received a complaint entitled Certain Consumer Electronics, Including Mobile Phones and Tablets, DN 2885; the Commission is soliciting comments on any public interest issues

Monday through Friday, except holidays.

Before including your phone number, email address, or other personal identifying information in your protest, you should be aware that your entire protest—including your personal identifying information—may be made publicly available at any time. While you can ask us in your protest to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Authority: 40 CFR 1506.6 and 1506.10; 43 CFR 1610.2 and 1610.5

Cindy Staszak,

Acting Deputy State Director, California.

[FR Doc. 2012–12560 Filed 5–24–12; 8:45 am]

BILLING CODE 4310–40–P

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

[LLNMA00000 L12200000.DF0000]

Notice of Public Meeting, Albuquerque Resource Advisory Council Meeting

AGENCY: Bureau of Land Management, Interior.

ACTION: Notice of public meeting.

SUMMARY: In accordance with the Federal Land Policy and Management Act and the Federal Advisory Committee Act of 1972, the U.S. Department of the Interior, Bureau of Land Management, Albuquerque District Resource Advisory Council (RAC), will meet as indicated below.

DATES: The meeting date is June 22, 2012, at the Albuquerque District Office, 435 Montano Rd., NE., Albuquerque, New Mexico 87107. The meeting is scheduled from 9 a.m. to 4 p.m. The public comment period will begin at 3:30 p.m. The public may send written comments to the RAC at the above address. All RAC meetings are open to the public. Depending on the number of individuals wishing to comment and time available, the time for individual oral comments may be limited.

FOR FURTHER INFORMATION CONTACT: Gina Melchor, Albuquerque District Office, 435 Montano Rd., NE., Albuquerque, New Mexico 87107, 505–761–8935. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1–800–877–8229 to contact the above individual during normal business hours. The FIRS is available 24 hours a day, 7 days a week, to leave a message or question with the above individual. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION: The 10-member RAC advises the Secretary of the Interior, through the Bureau of Land Management, on a variety of planning and management issues associated with public land management in New Mexico.

At this meeting, topics include a discussion on the RAC Charter and Operating Procedures, Election of Officers, and presentations from the Socorro and Rio Puerco Field Office Managers.

Edwin J. Singleton,

District Manager.

[FR Doc. 2012–12657 Filed 5–24–12; 8:45 am]

BILLING CODE 4310–AG–P

DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

AGENCY: Bureau of Reclamation, Interior.

ACTION: Notice of extension of public comment period for the scoping process.

SUMMARY: The Bureau of Reclamation is extending the public comment period for the scoping process to June 28, 2012. We published the notice of intent in the **Federal Register** on March 28, 2012 (77 FR 18858). The public review was originally scheduled to end on May 29, 2012.

DATES: Written comments as part of the scoping process will be accepted on or before June 28, 2012.

ADDRESSES: Send written comments to Janice Piñero, Endangered Species Compliance Act Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814–2536; fax to (916) 414–2439; or email at *jpinero@usbr.gov.*

FOR FURTHER INFORMATION CONTACT: Janice Piñero at (916) 414–2428; or email at *jpinero@usbr.gov.*

Public Disclosure

Before including your name, address, phone number, email address or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Dated: May 7, 2012.

Anastasia T. Leigh,

Regional Environmental Officer, Mid-Pacific Region.

[FR Doc. 2012–12738 Filed 5–24–12; 8:45 am]

BILLING CODE 4310–MN–P

DEPARTMENT OF JUSTICE

Drug Enforcement Administration

Importer of Controlled Substances; Notice of Application; Alltech Associates, Inc.

Pursuant to 21 U.S.C. 958(i), the Attorney General shall, prior to issuing a registration under this Section to a bulk manufacturer of a controlled substance in Schedule I or II, and prior to issuing a regulation under 21 U.S.C. 952(a)(2) authorizing the importation of such a substance, provide manufacturers holding registrations for the bulk manufacture of the substance an opportunity for a hearing.

Therefore, in accordance with 21 CFR 1301.34(a), this is notice that on April 19, 2012, AllTech Associates Inc., 2051 Waukegan Road, Deerfield, Illinois 60015, made application by renewal to the Drug Enforcement Administration (DEA) to be registered as an importer of the following basic classes of controlled substances:

Drug	Schedule
Gamma Hydroxybutyric Acid (2010).	I
Lysergic acid diethylamide (7315)	I
Heroin (9200)	I
Cocaine (9041)	II
Codeine (9050)	II
Hydrocodone (9193)	II
Meperidine (9230)	II
Methadone (9250)	II
Morphine (9300)	II

The company plans to import these controlled substances for the manufacture of reference standards.

Any bulk manufacturer who is presently, or is applying to be, registered with DEA to manufacture such basic classes of controlled substances may file comments or objections to the issuance of the proposed registration and may, at the same time, file a written request for a hearing on such application pursuant to 21 CFR 1301.43, and in such form as prescribed by 21 CFR 1316.47.

Any such written comments or objections should be addressed, in quintuplicate, to Drug Enforcement Administration, Office of Diversion

Attachment B

Reclamation News Releases and Typical Newspaper Notification

News Release RECLAMATION
Managing Water in the West

Mid-Pacific Region
Sacramento, CA

MP-12-043

Media Contact: Pete Lucero, 916-978-5100, plucero@usbr.gov

For Release On: March 28, 2012

Public Scoping Meetings Planned on EIS for Remanded BOs on the Coordinated Long-Term Operation of the CVP and SWP

The Bureau of Reclamation today announced that public scoping meetings will be held to prepare an Environmental Impact Statement (EIS) for the Remanded Biological Opinions (BOs) on the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP). A Notice of Intent to prepare the EIS and conduct public scoping meetings was published in the Federal Register on Wednesday, March 28, 2012. This EIS will be developed in accordance with the National Environmental Policy Act (NEPA).

The U.S. District Court for the Eastern District of California remanded portions of the U.S. Fish and Wildlife Service and National Marine Fisheries Service BOs to their respective agencies. This EIS responds to the District Court's order that Reclamation analyze and disclose, in accordance with NEPA, the potential impacts of implementing the Reasonable and Prudent Alternatives (RPAs) developed pursuant to the remanded USFWS and NMFS BOs.

Four public scoping meetings to solicit input on issues and alternatives to be addressed in the EIS are scheduled to be held:

- **Wednesday, April 25, 6-8 p.m.**-Madera County Main Library, Blanche Galloway Room, 121 North G Street, Madera, CA 93637
- **Thursday, April 26, 6-8 p.m.**-South Coast Air Quality Management District, Room CC6, 21865 Copley Drive, Diamond Bar, CA 91765
- **Wednesday, May 2, 2-4 p.m.**-John E. Moss Federal Building, Stanford Room, 650 Capitol Mall, Sacramento, CA 95814
- **Thursday, May 3, 6-8 p.m.**-Yuba County Government Center, Board of Supervisors Chambers, 915 Eighth Street, Marysville, CA 95901

Written comments associated with the Notice of Intent and the scoping process must be received by close of business on Tuesday, May 29, 2012, and should be mailed to Janice Piñero, Endangered Species Act Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814-2536; faxed to 916-414-2439; or e-mailed to jpinero@usbr.gov. For further information, please contact Ms. Piñero at 916-414-2428 or e-mail jpinero@usbr.gov. Project updates will be made available on Reclamation's Bay-Delta Office website at www.usbr.gov/mp/BayDeltaOffice.

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News Release RECLAMATION
Managing Water in the West

Mid-Pacific Region
Sacramento, CA

MP-12-082

Media Contact: Pete Lucero, 916-978-5100, plucero@usbr.gov

For Release On: May 25, 2012

Extension of Public Scoping Comment Period on the EIS for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the CVP and SWP

SACRAMENTO, Calif. – Reclamation announced today an extension of the comment period for the public scoping process on the Environmental Impact Statement (EIS) for the Remanded Biological Opinions (BOs) on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project to June 28, 2012. The public scoping comment period was originally scheduled to end on May 29, 2012. Reclamation published the Notice of Intent (NOI) in the Federal Register on March 28, 2012 (77 FR 18858).

The U.S. District Court for the Eastern District of California remanded portions of the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) BOs to their respective agencies. This EIS responds to the District Court's order that Reclamation analyze and disclose, in accordance with the National Environmental Policy Act, the potential impacts of implementing the Reasonable and Prudent Alternatives developed pursuant to the remanded USFWS and NMFS BOs.

Written comments associated with the NOI and the scoping process should be mailed to Janice Piñero, Endangered Species Act Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814; faxed to 916-414-2439, or emailed to jpinero@usbr.gov. For further information, please contact Ms. Piñero at 916-414-2428 or email jpinero@usbr.gov.

Project updates are available on Reclamation's Bay-Delta Office website at www.usbr.gov/mp/BayDeltaOffice.

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Public Scoping Meetings Planned on EIS for Remanded BOs on the Coordinated Long-Term Operation of the CVP and SWP

Public scoping meetings will be held to prepare an Environmental Impact Statement (EIS) for the Remanded Biological Opinions (BOs) on the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP). A Notice of Intent to prepare the EIS and conduct public scoping meetings was published in the Federal Register on Wednesday, March 28, 2012. This EIS will be developed in accordance with the National Environmental Policy Act (NEPA).

The U.S. District Court for the Eastern District of California remanded portions of the U.S. Fish & Wildlife Service and National Marine Fisheries Service BOs to their respective agencies. This EIS responds to the District Court's order that Reclamation analyze and disclose, in accordance with NEPA, the potential impacts of implementing the Reasonable and Prudent Alternatives developed pursuant to the remanded USFWS and NMFS BOs.

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  John E. Moss Federal Building, Stanford Room
  650 Capitol Mall, Sacramento, CA 95814
- **Thursday, May 3, 6–8 pm**
  Yuba County Government Center
  Board of Supervisors Chambers
  915 Eighth Street, Marysville, CA 95901

Written comments associated with the Notice Of Intent and the scoping process must be received by close of business on Tuesday, May 29, 2012, and should be mailed to Janice Piñero, Endangered Species Act Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814-2536; faxed to 916-414-2439; or e-mailed to jpinero@usbr.gov.

For further information, please contact Ms. Piñero at 916-414-2428 or e-mail jpinero@usbr.gov. Project updates will be made available on Reclamation's Bay-Delta Office website at www.usbr.gov/mp/BayDeltaOffice.

Attachment C

Scoping Meeting Materials

1. Scoping Meeting Agenda (English and Spanish)
2. Scoping Meeting Fact Sheet (English and Spanish)
3. Scoping Meeting Comment Card (English and Spanish)
4. Scoping Meeting Speaker Card
5. Scoping Meeting Presentation

RECLAMATION
Managing Water in the West

Public Scoping Meeting Agenda

EIS for Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Thank you for attending today's Public Scoping Meeting and helping with the first steps in preparing an environmental impact statement (EIS) for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (Remand EIS). Public Scoping Meetings are held as part of the EIS process through which an implementing agency describes a proposed action and its planned approach to analysis. The agency then seeks input from other agencies, organizations, and the public on environmental issues to be considered, potential impacts, and possible alternatives to the proposed action. We encourage you to provide us with information on your issues of concern. Please visit our website at www.usbr.gov/mp/BayDeltaOffice to stay informed.

- **Overview of Presentation.** Reclamation representatives will describe the purpose of the meeting and provide an overview of the EIS and public involvement processes.
- **Public Comment Session.** In addition to your written comments, if you wish to make a verbal comment, please fill out a Speaker's Card from the Welcome Table and hand it to the Facilitator. Speakers will be called in the order in which Speaker Cards are submitted with the exception of elected officials, who will be called first. Comments will be recorded by the transcriber who will prepare a written record of the Scoping Meeting.
- **Individual Comment Session.** Following the public comment period at this meeting, individuals can provide verbal comments to the transcriber in a more private setting.

Scoping Meeting Schedule

Madera **Wednesday** **April 25, 2012** **6:00 - 8:00 pm**	**Diamond Bar** **Thursday** **April 26, 2012** **6:00 - 8:00 pm**	**Sacramento** **Wednesday** **May 2, 2012** **2:00 - 4:00 pm**	**Marysville** **Thursday** **May 3, 2012** **6:00 - 8:00 pm**
Madera County Main Library, Blanche Galloway Room 121 North G Street, Madera, CA 93637	South Coast Air Quality Management District, Room CC6 1865 Copley Drive, Diamond Bar, CA 91765	John E. Moss Federal Building, Stanford Room 650 Capitol Mall, Sacramento, CA 95814	Yuba County Govt Center, Board of Supervisors Chambers 915 Eighth Street, Marysville, CA 95901


CVP/SWP Facilities
& Service Areas
TRINITY LAKE
SHASTA LAKE
WHISKEYTOWN LAKE
Tehama-Colusa Canal
Corning Canal
LAKE OROVILLE
THERMALITO AFTERBAY
Tehama-Colusa Canal
FOLSOM LAKE
LAKE NATOMA
HARVEY BANKS PUMPING PLANT
Folsom South Canal
TRACY FISH COLLECTION FACILITY
NEW MELONES RESERVOIR
Contra Costa Canal
JONES PUMPING PLANT
BETHANY FOREBAY
California Aqueduct
Delta-Mendota Canal
O'NEILL FOREBAY
SAN LUIS RESERVOIR
San Luis Canal
Madera Canal
Santa Clara Conduit
MILLERTON RESERVOIR
Hollister Conduit
Pacheco Conduit
LOS BANOS RES.
Friant-Kern Canal
Coalinga Canal
Coastal Branch California Aqueduct
California Aqueduct
West Branch California Aqueduct
Ownership
FEDERAL AGENCY
STATE AGENCY
STATE/FED PROJECT
State Water Projects Place of Use
Federal Consolidated Place of Use
Miles
0 25 50 100 150
N
W
E
S

Agenda de Reunión Pública

Declaración de Impacto Ambiental para las Opiniones Biológicas Devueltas sobre la Operación Coordinada de Largo Plazo del Proyecto del Valle Central y el Proyecto Estatal de Agua

Gracias por asistir a la reunión pública de hoy y ayudar con los primeros pasos para preparar una declaración de impacto ambiental para las Opiniones Biológicas Remitidas sobre la Operación Coordinada de Largo Plazo del Proyecto del Valle Central y el Proyecto Estatal de Agua Las Reuniones Públicas se realizan como parte del proceso de la declaración ambiental a través del cual una agencia ejecutora describe una propuesta de acción y el enfoque planeado para que sean analizados. Luego la agencia busca contribuciones de otras agencias, organizaciones y el público sobre los temas ambientales a considerarse, y posibles impactos y alternativas a la acción propuesta. Lo alentamos a que nos dé información sobre los temas que le preocupan. Por favor, visite nuestro sitio Web en www.usbr.gov/mp/BayDeltaOffice para mantenerse informado.

- **Visión General de la Presentación.** Representantes del *Bureau of Reclamation* describirán el propósito de la reunión y ofrecerán una visión general de los procesos de la declaración ambiental y la participación del público.
- **Sesión de Comentarios Públicos.** Además de sus comentarios por escrito, si desea hacer un comentario verbal, por favor complete la Tarjeta de Presentador de la Mesa de Bienvenida y entréguesela al Moderador. Los presentadores se llamarán en el orden en el que se hayan presentado las Tarjetas de Presentadores, con excepción de autoridades electas, que tendrán prioridad. Los comentarios serán grabados por un transcriptor que preparará un informe escrito de la Reunión Pública.
- **Sesión de Comentarios Individuales.** Después del período de comentarios públicos en esta reunión, los individuos pueden ofrecer comentarios verbales al transcriptor de manera más privada.

Programa de la Reunión Pública

Madera **miércoles** **25 de abril, 2012** **6:00 - 8:00 pm**	**Diamond Bar** **jueves** **26 de abril, 2012** **6:00 - 8:00 pm**	**Sacramento** **miércoles** **2 de mayo, 2012** **2:00 - 4:00 pm**	**Marysville** **jueves** **3 de mayo, 2012** **6:00 - 8:00 pm**
Madera County Main Library, Blanche Galloway Room 121 North G Street, Madera, CA 93637	South Coast Air Quality Management District, Room CC6 1865 Copley Drive, Diamond Bar, CA 91765	John E. Moss Federal Building, Stanford Room 650 Capitol Mall, Sacramento, CA 95814	Yuba County Govt Center, Board of Supervisors Chambers 915 Eighth Street, Marysville, CA 95901

Fact Sheet

Public Input During Scoping

What is Scoping?

The scoping process is an opportunity for the public to identify topics to be covered in the Environmental Impact Statement (EIS) and provide recommendations to Reclamation. Your input will help Reclamation to identify:

- Significant topics to be analyzed in the EIS.
- Topics that have already been adequately addressed in prior environmental reviews.
- Potential alternatives to develop the reasonable range of alternatives.
- Potential mitigation measures for the proposed action.
- People or organizations who are interested in the EIS.

How Can I Get Involved?

Reclamation encourages the public to be involved throughout the EIS process for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project. For this public scoping phase, comments are being accepted through May 29, 2012.

Ways to provide comments:

- Comment Card
- Verbal comments at Scoping Meetings, including verbal comments provided within the meeting, and individual comments to Transcriber at Scoping Meetings
- Mail/Email: Janice Piñero, Endangered Species Act Specialist, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814-2536 jpinero@usbr.gov

For additional information, please visit: www.usbr.gov/mp/BayDeltaOffice.

Making the Most of Your Comments

Develop your comments, taking the following into consideration:

- What topics are of greatest concern to you and why?
- Are there additional topics that should be evaluated?
- What alternatives or mitigation measures do you think would help to lessen or avoid impacts?
- Can you suggest information resources?

What Issues Might be Addressed in the EIS?

- Water resources, including groundwater, water quality, and climate change
- Land use, including agriculture
- Socioeconomics
- Biological resources, including fish, wildlife, and plant species
- Cultural and historic resources
- Air quality and greenhouse gas emissions
- Soils, geology, and mineral resources
- Visual, scenic, or aesthetic resources
- Transportation
- Recreation
- Indian Trust Assets
- Environmental justice

RECLAMATION
Managing Water in the West

Hoja de Datos

Contribución Pública durante la Reunión

¿Qué son las Reuniones Públicas?

Las reuniones son una oportunidad para que el público identifique temas a cubrirse en la Declaración de Impacto Ambiental y ofrezca recomendaciones al *Bureau of Reclamation* Su comentario le ayudará al *Bureau of Reclamation* a identificar:

- Tópicos importantes a analizarse en la Declaración de Impacto Ambiental
- Tópicos que ya se han tratado adecuadamente en revisiones ambientales previas
- Alternativas potenciales para desarrollar la gama razonable de alternativas
- Medidas atenuantes potenciales para la acción propuesta
- Individuos u organizaciones que estén interesados en la Declaración de Impacto Ambiental

¿Cómo Puedo Participar?

El *Bureau of Reclamation* alienta al público a que participe en el proceso de la Declaración de Impacto Ambiental para las Opiniones Biológicas Devueltas sobre la Operación Coordinada de Largo Plazo del Proyecto del Valle Central y el Proyecto Estatal del Agua. Para esta etapa de opiniones del público, los comentarios se recibirán hasta el 29 de mayo del 2012.

Formas para presentar los comentarios:

- Tarjeta de Comentarios
- Comentarios verbales durante las reuniones públicas, incluyendo los comentarios hechos en la reunión, y los comentarios individuales al Transcriptor en las reuniones
- Por correo/correo electrónico: Janice Piñero, especialista de la ley de especies en peligro de extinción, Oficina Bahía-Delta, 801 I Street, Suite 140, Sacramento, CA 95814-2536 jpinero@usbr.gov

Para mayor información, por favor visite: www.usbr.gov/mp/BayDeltaOffice.

Cómo Hacer sus Comentarios

Haga sus comentarios considerando lo siguiente:

- ¿Cuáles son los temas que más le preocupan y por qué?
- ¿Hay más tópicos que se deberían evaluar?
- ¿Qué alternativas o medidas atenuantes cree que ayudarían a disminuir o evitar impactos negativos?
- ¿Puede sugerir fuentes de información?

¿Qué Temas se Deberían Tratar en la Declaración de Impacto Ambiental ?

- Fuentes de agua, incluyendo agua subterránea, calidad de agua, y cambio climático
- Uso de la tierra, incluyendo agricultura
- Asuntos socioeconómicos
- Recursos biológicos, incluyendo peces, vida silvestre y plantas.
- Recursos culturales e históricos
- Calidad del aire y emisiones de gases de efecto invernadero
- Tierras, geología, y recursos minerales
- Recursos visuales, panorámicos, o recursos estéticos
- Transporte
- Recreación
- Bienes de fundaciones indígenas
- Justicia medioambiental

RECLAMATION

Managing Water in the West

Written Comments for

EIS for Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Written comments can be submitted at the scoping meetings, mailed to the Bureau of Reclamation (*mailing address on back of this card*), faxed to (916) 414-2439, or emailed to *jpinero@usbr.gov* by close of business on Tuesday, May 29, 2012. Thank you.

(Please print clearly)

Name ____

Organization and Address ____________________________________

Phone ____________________ Email _______________________

Date ______________________

All comments become part of the public record.

☐ I would like to receive project updates. My e-mail address is:

Place 41¢
Stamp Here

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

Attn: Janice Piñero

- -

Please fold, stamp, and mail

RECLAMATION
Managing Water in the West

Comentarios Escritos Para

Declaración de Impacto Ambiental para las Opiniones Biológicas Remitidas sobre la Operación Coordinada de Largo Plazo del Proyecto del Valle Central y el Proyecto Estatal de Agua

Los comentarios escritos se pueden presentar en las reuniones públicas, enviar por correo al *Bureau of Reclamation* (dirección del otro lado de esta tarjeta), por fax al (916) 414-2439, o por correo electrónico a *jpinero@usbr.gov* no después del martes 29 de mayo, 2012 Gracias.

(Por favor, imprima claramente)

Nombre ____

Organización y Dirección ____________________________________

____

____

Teléfono ____________ Correo electrónico ______________________

Fecha ______________________

____

____

____

____

____

Todos los comentarios son parte del récord público.

☐ Me gustaría recibir actualizaciones del proyecto. Mi dirección electrónica es:

____

Pegue aquí
una
estampilla

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

Attn: Janice Piñero

- - - - - - - - - - -- -- - - - - -- - -- - - - - - - - - - - - -- -

Doblar, poner estampilla y enviar

RECLAMATION
Managing Water in the West

Speaker Card for

EIS for Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Please fill out the card if you would like to make a verbal comment. Please note, verbal comments are weighted equally with written comments. Written comments also may be submitted at scoping meetings, mailed to the Bureau of Reclamation (*mailing address on back of this card*), faxed to (916) 414-2439, or emailed to *jpinero@usbr.gov* by close of business on Tuesday, May 29, 2012. Thank you.

(Please print clearly)

Name ____

Organization and Address ____

____

____

Phone ___________________________ Email ______________________________

Date _____________________________

Notes ____

____

____

____

____

____

Please read suggested speaker guidelines on the back side of this card.

☐ I would like to receive project updates. My e-mail address is:

____

Speaker Guidelines

1. Speaker Cards: Please hand your Speaker Card to one of the Facilitators. Speakers will be called toward the microphone in the order that the cards are received with the exception of elected officials, who will be called first.

2. Time: To allow enough time for all people who want to make a comment, please attempt to limit your comments to about 3 minutes. If there is time available after the last speaker provides their first comment, speakers can provide further comments.

3. All Comments will be Recorded: All comments will be recorded by a court transcriber and will be included in the public record through inclusion in the future Scoping Report.

4. Speakers' Role: The role of the speakers is to let Reclamation know what you would like to be studied during the environmental review.

5. Reclamation's Role: Reclamation will be listening to your comments tonight. There will be future public workshops and meetings during the preparation of the environmental document at which time Reclamation will be able to provide information about this project.

6. Courtesies:

- Please allow one speaker at a time.
- Do not add comments from the audience.
- Please put your cell phones on "silent" or "vibrate" modes.

7. Send Scoping Comments to:

- Janice Piñero, Endangered Species Act Specialist
  Bay-Delta Office
  801 I Street, Suite 140, Sacramento, CA 95814-2536

  jpinero@usbr.gov

For additional information, please visit: www.usbr.gov/mp/BayDeltaOffice.

RECLAMATION

Managing Water in the West

Environmental Impact Statement

Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

U.S. Department of the Interior
Bureau of Reclamation

Public Scoping Meetings Agenda

- Overview
- Scoping process
- Public comment forum

Purpose of Scoping

- **Invite public comments**
- **Obtain insights and specific local information related to issues for Environmental Impact Statement (EIS)**
- **Obtain input on alternatives to be considered in the EIS**
- **PLEASE PROVIDE WRITTEN COMMENTS, TOO!**

RECLAMATION

Why is Reclamation Preparing this EIS?

2008	• Reclamation issued a Biological Assessment on Long-Term Operations of the Central Valley Project & State Water Project • U.S. Fish and Wildlife Service (USFWS) Biological Opinion issued for delta smelt populations and their critical habitat • Reclamation accepted the Reasonable and Prudent Alternative (RPA)
2009	• National Marine Fisheries Service (NMFS) Biological Opinion issued for salmonids, green sturgeon, and Southern resident killer whale populations and their critical habitat • Reclamation accepted the RPA

2011	• Following several litigations, U.S. District Court ruled that:
	  • Portions of the USFWS and NMFS BOs remanded to USFWS and NMFS
	  • Reclamation should review potential impacts to human environment prior to accepting and implementing the RPAs
	• Reclamation is initiating a combined National Environmental Policy Act process to evaluate USFWS and NMFS RPAs or alternatives to the RPAs

RECLAMATION

What is a Biological Opinion?

- Section 7(a)(2) of the Endangered Species Act requires:
  - Federal agencies, in consultation with USFWS and/or the NMFS, to ensure that actions they authorize, fund, or implement are not likely to jeopardize the continued existence of federally-listed threatened or endangered species or result in the destruction or adverse modification of designated critical habitat of these species
- A BO is the technical document that evaluates the effects of the Federal action
- If jeopardy is likely, a BO may include a RPA

RECLAMATION

What is an EIS?

- Purpose of an EIS
  - To evaluate a reasonable range of alternatives
  - To identify potential benefits and adverse impacts, and propose mitigation to reduce/avoid impacts
  - To provide information for public review and comment
  - To support decision making process by the Federal agency
  - Prepared in accordance with NEPA
- An EIS addresses more issues than a BO
  - Water Resources
  - Other Physical Resources - such as Air Quality
  - Biological Resources - including non- federally-listed threatened or endangered species
  - Human Resources - including land use, socioeconomics, and cultural resources

What will this EIS Consider?

- This EIS will consider conditions through 2030
- This EIS will consider the operational components of the USFWS and NMFS RPAs or alternatives to the RPAs
- This EIS will include both site-specific and programmatic analyses based upon available definition of potential actions within the alternatives

RECLAMATION

When will the EIS be Complete?

- **March 2012** — **Initiate Scoping for EIS**

Deadlines in accordance with Court Orders

- **December 2013** — **Final EIS associated with USFWS BO**
- **April 2016** — **Final EIS associated with NMFS BO**

RECLAMATION

Public Input During Scoping Process

- Your input will help shape the EIS
  - What alternatives should be considered?
  - What environmental issues should be evaluated?
  - When and how would you like to be informed?
- What happens to comments?
  - Comments will be compiled in a Scoping Report which will be made available to the public on Reclamation's website

RECLAMATION

How Can You Provide Comments?

- **Comments for Scoping Report due May 29, 2012**
- **To provide comments today**
  - **Comment Cards**
  - **Verbal Comments**
  - **Individual comments to transcriber**
- **To provide comments after today until May 29, 2012**
  - **Email: *jpinero@usbr.gov* OR Fax: (916) 414-2439**
  - **Mail:**

    Janice Piñero, Endangered Species Act Specialist
    Bureau of Reclamation, Bay-Delta Office
    801 I Street, Suite 140
    Sacramento, CA 95814-2536

RECLAMATION

Scoping Meeting Guidelines

- Ensure everyone's participation
  - Meeting is structured to give everyone an opportunity to participate
- Respect each other's comments
  - Listen carefully to other participants
  - Place cell phones/pagers on vibrate and silent mode
- Honor time limits
  - Please keep comments concise so everyone has an opportunity to speak
- Identify yourself and your affiliation
  - This will help the transcriber, Reclamation staff, and the audience

RECLAMATION

Guidelines for Verbal Comments

- Fill out a Speaker Card and submit to facilitator
- Everyone will be heard
- Please be respectful
- Please limit comments to 3 minutes
- All comments will be recorded by a transcriber
- Please introduce yourself and affiliation to help the transcriber
- Reclamation is here to listen

RECLAMATION

For More Information

- www.usbr.gov/mp/BayDeltaOffice
- Sign up to receive periodic electronic updates on sign-in sheet
- Provide comments throughout preparation of EIS

RECLAMATION

Attachment D

Scoping Meeting Transcripts

Please see http://www.usbr.gov/mp/BayDeltaOffice/Documents/remand.html

Attachment E

Written Scoping Comments

Please see http://www.usbr.gov/mp/BayDeltaOffice/Documents/remand.html

Appendix 23B

Public Review of Draft Environmental Impact Statement

This appendix provides copies of documents associated with the public review of the Draft Environmental Impact Statement. These documents include:

- Notice of Availability from the Federal Register on July 31, 2015
- Newspaper advertisements of the public meetings
- Fact Sheets provided at the public meetings
- Display Boards provided at the public meetings
- Presentation presented at the public meetings
- Sign-in Sheets from the Public Meetings
- Transcripts – verbal comments were only provided to the court reporter at the public meeting held in Red Bluff, California.

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23B.1 Notice of Availability

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River Water'' in order for district to divert, treat, and deliver to Davis Dam the Davis Dam Secretarial Reservation amount of up to 100 acre-feet per year of Colorado River water.

Upper Colorado Region: Bureau of Reclamation, 125 South State Street, Room 8100, Salt Lake City, Utah 84138–1102, telephone 801–524–3864.

Discontinued contract action:

10. City of Santa Fe, San Juan-Chama Project, New Mexico: Contract to store up to 50,000 acre-feet of project water in Elephant Butte Reservoir. The proposed contract would have a 25- to 40-year maximum term, which due to ongoing consultations with the U.S. Fish and Wildlife Service, has been executed and extended on an annual basis. The Act of December 29, 1981, Public Law 97–140, 95 Stat. 1717 provides authority to enter into this contract.

Completed contract action:

29. Uintah Water Conservancy District; Jensen Unit, CUP; Utah: Jensen Unit M&I Block Notice No. 3 will be issued as required by a 1983 contract with Chevron USA, Inc., for 200 acre-feet of M&I water that is currently being pumped upstream of Red Fleet Reservoir. Contract executed May 19, 2015.

Great Plains Region: Bureau of Reclamation, P.O. Box 36900, Federal Building, 2021 4th Avenue North, Billings, Montana 59101, telephone 406–247–7752.

New contract actions:

61. Dugout Water Association; Lower Marias Unit, P–SMBP; Montana: Proposed renewal of 40-year contract for M&I water.

62. Garrison Diversion Conservancy District, Garrison Diversion Unit, P–SMBP, North Dakota: Consideration to enter into long-term water service contract for M&I use out of McClusky Canal.

63. Bryan Hauxwell, Frenchman Cambridge Project, Nebraska: Consideration of a long-term Warren Act contract.

Discontinued contract action:

9. Colorado River Water Conservation District, Colorado-Big Thompson Project, Colorado: Long-term exchange, conveyance, and storage contract to implement the Exhibit B Agreement of the Settlement Agreement on Operating Procedures for Green Mountain Reservoir Concerning Operating Limitations and in Resolution of the Petition Filed August 7, 2003, in Case No. 49–CV–2782 (*The United States* v. *Northern Colorado Water Conservancy District, et al.,* U.S. District Court for the District of Colorado, Case No. 2782 and Consolidated Case Nos. 5016 and 5017).

Completed contract actions:

13. Green Mountain Reservoir, Colorado-Big Thompson Project, Colorado: Consideration of a request for a contract for municipal-recreational purposes. Contract executed on April 2, 2015.

46. Galloway, Inc. (dba Blue Valley Ranch), Green Mountain Reservoir; Colorado-Big Thompson Project, Colorado: Consideration of a request to amend the existing contract. Contract executed on May 8, 2015.

47. Fort Clark ID; Fort Clark Unit; P–SMBP; North Dakota: Intent to enter into a new 5-year irrigation water service contract. Contract executed on May 12, 2015.

53. Grass Land Colony, Inc.; Canyon Ferry Unit, P–SMBP; Montana: Proposed 10-year contract for M&I water. Contract executed on May 22, 2015.

55. East Bench ID; East Bench Unit, Three Forks Division, P–SMBP; Montana: Consideration of a contract amendment, pursuant to Public Law 112–139; to extend the term of contract No. 14–06–600–3593 through December 31, 2019. Contract executed on May 26, 2015.

Dated: June 26, 2015.

Roseann Gonzales,

Director, Policy and Administration.

[FR Doc. 2015–18859 Filed 7–30–15; 8:45 am]

BILLING CODE 4332–90–P

DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

[RR02800000, 15XR0680A1, RX.17868946.0000000]

Notice of Availability of the Draft Environmental Impact Statement for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

AGENCY: Bureau of Reclamation, Interior.

ACTION: Notice.

SUMMARY: The Bureau of Reclamation has prepared and made available for public review and comment, the Draft Environmental Impact Statement (DEIS) on impacts of implementing the 2008 U.S. Fish and Wildlife Service Biological Opinion and the 2009 National Marine Fisheries Service Biological Opinion, including the Reasonable and Prudent Alternatives, for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project. This action will continue the operation of the Central Valley Project in coordination with the State Water Project. The DEIS was drafted in response to the November 16, 2009 United States Court of Appeals for the Ninth Circuit ruling that the Bureau of Reclamation must conduct a National Environmental Policy Act review to determine whether the associated 2008 U.S. Fish & Wildlife Service and 2009 National Marine Fisheries Service Reasonable and Prudent Alternatives cause a significant effect to the human environment.

DATES: Submit written comments on the DEIS on or before September 29, 2015.

Four public meetings will be held to receive oral and written comments:

- Wednesday, September 9, 2015, from 2 to 4 p.m., Sacramento, CA;
- Thursday, September 10, 2015, from 6 to 8 p.m., Red Bluff, CA;
- Tuesday, September 15, 2015, from 6 to 8 p.m., Los Banos CA; and
- Thursday, September 17, 2015, from 6 to 8 p.m., Irvine, CA.

Staff will be available to take comments and answer questions during this time.

ADDRESSES: Send written comments to Mr. Ben Nelson, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814–2536; fax to (916) 414–2439; or via email to *bcnelson@usbr.gov.*

Public meetings will be held at the following locations:

- Sacramento—Federal Building, 650 Capitol Mall, Stanford Room, Sacramento, CA 95814.
- Red Bluff—Red Bluff Community Center, 1500 S. Jackson Street, Red Bluff, CA 96080.
- Los Banos—Los Banos Community Center, Grand Room 645 7th Street, Los Banos, CA 93635.
- Irvine—Hilton Hotel Irvine/Orange County Airport, 18800 MacArthur Boulevard, Irvine, CA 92612.

The DEIS may be viewed at the Bureau of Reclamation's Web site at *http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=21883.*

To request a compact disc of the DEIS, please contact Mr. Ben Nelson as indicated above, or call (916) 414–2424.

FOR FURTHER INFORMATION CONTACT: Ms. Janice Piñero, Endangered Species Act Compliance Specialist, Bureau of Reclamation, via email at *jpinero@usbr.gov,* or by phone (916) 414–2428. For public involvement information, please contact Wilbert Moore via email at *wmoore@usbr.gov,* or phone at (916) 978–5102.

SUPPLEMENTARY INFORMATION:

I. Agencies Involved

We, the Bureau of Reclamation, are the lead Federal agency. We invited over 740 agencies to participate as cooperating agencies. Twenty-one agencies agreed to participate as cooperating agencies for preparation of the environmental impact statement in accordance with the National Environmental Policy Act (NEPA), including:

- U.S. Fish and Wildlife Service (USFWS),
- National Marine Fisheries Service (NMFS),
- U.S. Army Corps of Engineers,
- U.S. Environmental Protection Agency (EPA),
- Bureau of Indian Affairs,
- California Valley Miwok Tribe,
- California Department of Water Resources,
- California Department of Fish and Wildlife,
- State and Federal Contractors Water Agency,
- Friant Water Authority, and
- Eleven individual Central Valley Project (CVP) or State Water Project (SWP) water users.

II. Why We Are Taking This Action

The CVP is the largest Federal Reclamation project. We operate the CVP in coordination with the SWP, under the Coordinated Operation Agreement between the Federal government and the State of California (authorized by Pub. L. 99–546). In August 2008, the Bureau of Reclamation submitted a biological assessment to USFWS and NMFS for consultation.

In December 2008, USFWS issued a Biological Opinion (BO) analyzing the effects of the coordinated long-term operation of the CVP and SWP in California on delta smelt and its designated critical habitat. The 2008 USFWS BO:

- Concluded that ''the coordinated operation of the CVP and SWP, as proposed, [was] likely to jeopardize the continued existence of the delta smelt'' and ''adversely modify delta smelt critical habitat,'' and
- Included a Reasonable and Prudent Alternative (RPA) for CVP and SWP operations designed to allow the projects to continue operating without causing jeopardy or adverse modification.

On December 15, 2008, we provisionally accepted and then implemented the USFWS RPA.

In June 2009, NMFS issued a BO analyzing the effects of the coordinated long-term operation of the CVP and SWP on listed salmonids, green sturgeon, and southern resident killer whale and their designated critical habitats. This BO concluded that the long-term operation of the CVP and SWP, as proposed, was likely to:

- Jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Southern Distinct Population Segment of North American green sturgeon, and southern resident killer whales; and
- Destroy or adversely modify critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and the Southern Distinct Population Segment of North American green sturgeon.

The NMFS BO included an RPA designed to allow the projects to continue operating without causing jeopardy to the analyzed species or adverse modification of their designated critical habitat. On June 4, 2009, we provisionally accepted and then implemented the NMFS RPA.

Several lawsuits were filed in the United States District Court for the Eastern District of California (District Court) challenging various aspects of the USFWS and NMFS BOs and acceptance and implementation of the associated RPAs.

III. Results of Litigation

The results of the above lawsuits were as follows.

- On November 16, 2009, the Court ruled that we violated NEPA by failing to conduct a NEPA review of the potential impacts to the human environment before provisionally accepting and implementing the 2008 USFWS BO, including the RPAs.
- On December 14, 2010, the Court found certain portions of the USFWS BO to be arbitrary and capricious, and remanded those portions of the BO to USFWS. The Court ordered us to review the BO and RPA in accordance with NEPA.
- The decision of the District Court related to the USFWS BO was appealed to the United States Court of Appeals for the Ninth Circuit (Appellate Court). On March 13, 2014, the Appellate Court reversed the District Court and upheld the BO. Therefore, the remand order related to the USFWS BO was rescinded. However, the Appellate Court ruled that we were obligated to comply with NEPA and affirmed the judgment of the District Court with respect to the NEPA claims.
- A mandate of the Appellate Court was issued on September 16, 2014. Petitions for Writ of Certiorari were submitted to the U.S. Supreme Court; however, the U.S. Supreme Court decided to not hear the cases.
- On March 5, 2010, the Court held that we violated NEPA by failing to undertake a NEPA analysis of potential impacts to the human environment before accepting and implementing the RPA in the 2009 NMFS BO.
- On September 20, 2011, in the Consolidated Salmonid Cases, the District Court remanded the NMFS BO to NMFS.
- The decisions of the District Court related to the NMFS BO were appealed to the Appellate Court. On December 22, 2014, the Appellate Court reversed the District Court and upheld the BO. Therefore, the remand order related to the NMFS BO was rescinded. A mandate of the Appellate Court was issued on February 17, 2015.

In response to these requirements, we have prepared a combined NEPA process addressing both the USFWS and NMFS RPAs and alternatives.

IV. Purpose and Need for Action

The purpose of the action is to continue the operation of the CVP, in coordination with the SWP, for its authorized purposes, in a manner that:

- Is similar to historic operational parameters with certain modifications;
- Is consistent with Federal Reclamation law; other Federal laws; Federal permits and licenses and; State of California water rights, permits, and licenses; and
- Enables the Bureau of Reclamation and the Department of Water Resources to satisfy their contractual obligations to the fullest extent possible.

Continued operation of the CVP and the SWP is needed to provide river regulation, improvement of navigation; flood control; water supply for irrigation and domestic uses; fish and wildlife mitigation, protection, and restoration; fish and wildlife enhancement; and power generation. The CVP and SWP facilities also are operated to provide recreation benefits and in accordance with the water rights and water quality requirements adopted by the State Water Resources Control Board.

Even though the coordinated operation of the CVP and SWP provides these benefits, the USFWS and NMFS concluded in their 2008 and 2009 BOs, respectively, that the coordinated operation of the CVP and SWP, as described in the 2008 Bureau of Reclamation Biological Assessment, does not comply with the requirements of section 7(a)(2) of ESA. To remedy this, USFWS and NMFS provided RPAs in their BOs. The Appellate Court confirmed the District Court's ruling that the Bureau of Reclamation must conduct a NEPA review to determine whether the RPA actions cause a significant effect to the human environment. Concepts associated with potential modifications to the coordinated operation of the CVP and SWP included in the NEPA process should be consistent with the intended purpose of the action, within the scope of our legal authority and jurisdiction, economically and technologically feasible, and avoid the likelihood of jeopardizing listed species or resulting in the destruction or adverse modification of critical habitat in compliance with the requirements of section 7(a)(2) of ESA.

V. Project Area

The project area includes the CVP and SWP Service Areas and facilities, as described in this section.

A. CVP Facilities. The CVP facilities include reservoirs on the Trinity, Sacramento, American, Stanislaus, and San Joaquin rivers.

- A portion of the water from Trinity River is stored and re-regulated in Trinity Lake, Lewiston Reservoir, and Whiskeytown Reservoir, and diverted through a system of tunnels and powerplants into the Sacramento River. Water is also stored and re-regulated in Shasta and Folsom lakes. Water from these reservoirs and other reservoirs owned and/or operated by the SWP flows into the Sacramento River.
- The Sacramento River carries water to the Sacramento-San Joaquin Delta (Delta). The Jones Pumping Plant at the southern end of the Delta lifts the water into the Delta Mendota Canal (DMC). This canal delivers water to CVP contractors, whom divert water directly from the DMC, and exchange contractors on the San Joaquin River, whom divert directly from the San Joaquin River and the Mendota Pool. CVP water is also conveyed to the San Luis Reservoir for deliveries to CVP contractors through the San Luis Canal. Water from the San Luis Reservoir is also conveyed through the Pacheco Tunnel to CVP contractors in Santa Clara and San Benito counties.
- The CVP provides water from Millerton Reservoir on the San Joaquin River to CVP contractors located near the Madera and Friant-Kern canals. Water is stored in the New Melones Reservoir for water rights holders in the Stanislaus River watershed and CVP contractors in the northern San Joaquin Valley.

B. State Water Project Facilities. The California Department of Water Resources operates and maintains the SWP, which delivers water to agricultural and municipal and industrial contractors in northern California, the San Joaquin Valley, the San Francisco Bay Area, the Central Coast, and southern California.

- SWP water is stored and re-regulated in Lake Oroville and released into the Feather River, which flows into the Sacramento River.
- SWP water flows in the Sacramento River to the Delta and is exported from the Delta at the Banks Pumping Plant. The Banks Pumping Plant lifts the water into the California Aqueduct, which delivers water to the SWP contractors and conveys water to the San Luis Reservoir.
- The SWP also delivers water to the Cross-Valley Canal, when the systems have capacity, for CVP water service contractors.

VI. Alternatives Considered

As required by NEPA, we developed a reasonable range of alternatives, including a No Action Alternative. Development of the alternatives included discussions with the Department of Water Resources. Development of the alternatives also was informed by comments submitted to us during the scoping process and the subsequent public involvement process.

The DEIS analyzes five alternatives, in addition to the No Action Alternative, that consider modifications to operational components of the 2008 USFWS and the 2009 NMFS RPAs. All alternatives addressed continued operation of the CVP, in coordination with the SWP.

The No Action Alternative assumes continuation of existing policy and management direction in Year 2030, including implementation of the RPAs included in the 2008 USFWS and 2009 NMFS BOs. Many of the RPAs were implemented prior to 2009 under other programs, such as Central Valley Project Improvement Act implementation, or are currently being implemented in accordance with the 2008 USFWS and 2009 NMFS BOs.

In response to scoping comments, the DEIS also includes a Second Basis of Comparison that assumes coordinated operation of the CVP and SWP as if the 2008 USFWS and 2009 NMFS BOs had not been implemented. The Second Basis of Comparison includes several actions that were included in the RPAs of the 2008 USFWS and 2009 NMFS BOs and that would have occurred without the BOs, including projects that were being initiated prior to 2009 (*e.g.,* Red Bluff Pumping Plant; Battle Creek restoration; and Suisun Marsh Habitat Management, Preservation, and Restoration Plan), legislatively mandated projects (*e.g.,* San Joaquin River Restoration Program), and projects with substantial progress that would have occurred without implementation of the BOs (*e.g.,* Yolo Bypass Salmonid Habitat Restoration and Fish Passage).

Alternative 1 was informed by scoping comments from CVP and SWP water users. Alternative 1 is identical to the Second Basis of Comparison and provides an opportunity for us to select an alternative with the same assumptions as the Second Basis of Comparison as the preferred alternative.

Alternative 2 is similar to the No Action Alternative because it includes the RPA actions, except for actions that consist of projects to be evaluated for future implementation. For example, Alternative 2 does not include fish passage programs to move fish from the Sacramento River downstream of Keswick Dam to the Sacramento River upstream of Shasta Dam.

Alternative 3 was informed by scoping comments from CVP and SWP water users. Alternative 3 is similar to the Second Basis of Comparison and Alternative 1 because it generally does not include the RPA actions, but it includes additional restrictions on CVP and SWP Delta exports to reduce negative flows in the south Delta during critical periods for aquatic resources. Alternative 3 also includes provisions to reduce losses to fish that use the Delta due to predation, commercial and sport fishing ocean harvest, and fish passage through the Delta.

Alternative 4 was informed by scoping comments from CVP and SWP water users. Alternative 4 is similar to the Second Basis of Comparison and Alternative 1 because it generally does not include the RPA actions, but it includes provisions to reduce losses to fish that use the Delta due to predation, commercial and sport fishing ocean harvest, and fish passage through the Delta.

Alternative 5 was informed by scoping comments from environmental interest groups. Alternative 5 includes assumptions similar to the No Action Alternative regarding the incorporation of RPA actions, with additional provisions to provide for positive Old and Middle River (OMR) flows and increased Delta outflow from reduced exports in April and May; and modified operations for New Melones Reservoir.

The DEIS does not identify a preferred alternative. Following receipt and evaluation of public comments on the DEIS, we will determine which alternative or combinations of features within the alternatives will become the preferred alternative. A discussion of the decision-making process used to define the preferred alternative will be included in the Final EIS.

VII. Statutory Authority

NEPA [42 U.S.C. 4321 *et seq.*] requires that Federal agencies conduct an environmental analysis of their proposed actions to determine if the actions may significantly affect the human environment. In addition, as required by NEPA, the Bureau of Reclamation analyzed the potential direct, indirect, and cumulative environmental effects that may result from the implementation of the alternatives, which may include, but are not limited to, the following areas of potential impact:

a. Surface water and groundwater;
b. Energy generation and use by CVP and SWP;
c. Biological resources, aquatic and terrestrial resources;
d. Land use, including agriculture;
e. Recreation.
f. Socioeconomics;
g. Environmental justice;
h. Air quality;
i. Soils and geology;
j. Visual resources;
k. Cultural resources;
l. Public health; and
m. Indian trust assets.

All alternatives and the Second Basis of Comparison were analyzed assuming conditions at Year 2030 with associated climate change and sea level rise.

VIII. Public Review of DEIS

The notice of availability of the DEIS is being distributed to interested agencies, stakeholder organizations, and individuals that participated in the scoping process and subsequent public involvement activities. This distribution provides an opportunity for interested parties to express their views regarding the environmental effects of the project, and to ensure that the information pertinent to implementation of the project is provided to cooperating agencies. Copies of the DEIS are available for public review at the Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814–2536; and Bureau of Reclamation, Mid-Pacific Region, Regional Library, 2800 Cottage Way, Sacramento, CA 95825.

IX. How To Request Reasonable Accommodation

If special assistance is required to participate in the public meeting, please contact Mr. Ben Nelson at (916) 414–2424, or via email at *bcnelson@usbr.gov,* or Wilbert Moore at (916) 978–5102, or via email at *wmoore@usbr.gov,* at least five working days before the meetings. If a request cannot be met, the requestor will be notified. A telephone device for the hearing impaired (TTY) is available at (800) 877–8339. The electronic version of the DEIS is published in accordance with the provisions of Section 508 of the Rehabilitation Act of 1973.

X. Public Disclosure

Before including your address, phone number, email address or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Dated: July 2, 2015.

Pablo R. Arroyave,

Deputy Regional Director, Mid-Pacific Region.

[FR Doc. 2015–18307 Filed 7–30–15; 8:45 am]

BILLING CODE 4332–90–P

DEPARTMENT OF LABOR

Office of the Secretary

Agency Information Collection Activities; Submission for OMB Review; Comment Request; Occupational Noise Exposure

ACTION: Notice.

SUMMARY: The Department of Labor (DOL) is submitting the Mine Safety and Health Administration (MSHA) sponsored information collection request (ICR) titled, ''Occupational Noise Exposure,'' to the Office of Management and Budget (OMB) for review and approval for continued use, without change, in accordance with the Paperwork Reduction Act of 1995 (PRA), 44 U.S.C. 3501 *et seq.* Public comments on the ICR are invited.

DATES: The OMB will consider all written comments that agency receives on or before August 31, 2015.

ADDRESSES: A copy of this ICR with supporting documentation; including a description of the likely respondents, proposed frequency of response, and estimated total burden may be obtained free of charge from the RegInfo.gov Web site at *http://www.reginfo.gov/public/do/PRAViewICR?ref_nbr=201507-1219-001* (this link will only become active on the day following publication of this notice) or by contacting Michel Smyth by telephone at 202–693–4129, TTY 202–693–8064, (these are not toll-free numbers) or by email at *DOL_PRA_PUBLIC@dol.gov.*

Submit comments about this request by mail or courier to the Office of Information and Regulatory Affairs, Attn: OMB Desk Officer for DOL–MSHA, Office of Management and Budget, Room 10235, 725 17th Street NW., Washington, DC 20503; by Fax: 202–395–5806 (this is not a toll-free number); or by email: *OIRA_submission@omb.eop.gov.* Commenters are encouraged, but not required, to send a courtesy copy of any comments by mail or courier to the U.S. Department of Labor—OASAM, Office of the Chief Information Officer, Attn: Departmental Information Compliance Management Program, Room N1301, 200 Constitution Avenue NW., Washington, DC 20210; or by email: *DOL_PRA_PUBLIC@dol.gov.*

FOR FURTHER INFORMATION CONTACT: Michel Smyth by telephone at 202–693–4129, TTY 202–693–8064, (these are not toll-free numbers) or by email at *DOL_PRA_PUBLIC@dol.gov.*

SUPPLEMENTARY INFORMATION:

Authority: 44 U.S.C. 3507(a)(1)(D).

This ICR seeks to extend PRA authority for the Occupational Noise Exposure information collection requirements codified in regulations 30 CFR part 62. Noise is a harmful physical agent and one of the most pervasive health hazards in mining. Repeated exposure to high levels of sound over time causes occupational noise-induced hearing loss (NIHL), a serious and often profound physical impairment in mining, with far-reaching psychological and social effects. NIHL can be distinguished from aging and other factors that can contribute to hearing loss, and it can be prevented. According to the National Institute for Occupational Safety and Health, NIHL is among the top ten leading occupational illnesses and injuries.

Records of miner exposures to noise are necessary so that mine operators and the MSHA can evaluate the need for and effectiveness of engineering controls, administrative controls, and personal protective equipment to protect miners from harmful levels of noise that can result in hearing loss. The Agency believes, however, that extensive records are not needed for this purpose. The subject information collection requirements are part of a performance-oriented approach to monitoring. Miner hearing examination records enable mine operators and the MSHA to ensure controls in use are effective in preventing NIHL for individual miners. Training records confirm miners receive information necessary to become active participants in hearing conservation efforts. Federal Mine Safety and Health

23B.2 Newspaper Advertisements

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Palestinian hunger striker put Israeli laws to pivotal test

BY DIAA HADID
The New York Times

AINABOUS, WEST BANK

A band of Palestinian gunmen burst into the apartment Mohammad Allan was renting while in law school in the West Bank city of Jenin a decade ago. They blindfolded him, beat him and fired their assault rifles at the floor near his feet.

The gunmen, who were loyal to a Fatah militant leader, Jamal Abu Rabb, tried for an entire day to force Allan to hand over his property to them, but he remained defiant.

"He didn't back down," recalled Allan's friend, Nafiz Hussein, who said that the gunmen eventually gave up after they realized Allan would not be intimidated. Rabb, then a fearsome figure in the West Bank, even apologized.

During that standoff 10 years ago, Allan showed some of the fortitude he would demonstrate this summer when he nearly starved himself to death during a two-month hunger strike to protest his incarceration by the Israeli authorities without charges.

Allan, a 31-year-old lawyer and member of the militant group Islamic Jihad, began his strike on June 16, and for more than 60 days he refused all food. It was one of the longest hunger strikes conducted by a Palestinian prisoner in years, and the most severe – Allan lost consciousness, and his doctors have said that he may have suffered brain damage. He was released last week when the Israeli Supreme Court said his health had so deteriorated during his fast that he no longer posed a threat.

The case exposed flaws in a new Israeli law that would allow for the force-feeding of prisoners in extreme circumstances, and it confounded members of Israel's hawkish governing coalition, who said Allan had held them hostage with his hunger strike, and eroded their ability to deter militants.

Allan joined Islamic Jihad when he was studying law at the Arab American University in Jenin, said his father, Nasser El-Deen, a 68-year-old folk healer. He said his son was energized by the fight against Israel during the second Palestinian intifada.

Allan was first jailed by Israel in 2006 for trying to recruit a suicide bomber to carry out an attack in Israel, and he was held for three years. He was briefly detained a second time by Israel in 2011, without charges, and soon after he was released he was detained by Palestinian intelligence officials.

Hussein, his friend and business partner, said that Allan was tortured when he was arrested by his fellow Palestinians, and he emerged from his detentions even more defiant of authority, frequently mocking Israeli and Palestinian officials on social media.

"Every imprisonment made him a harder person," Hussein said.

Allan's father said his son had on social media supported the Islamic State, as defenders of oppressed Sunni Muslims, but it never went beyond online missives. Allan claimed to support the brutal militant group, also known as ISIS or ISIL, only to be provocative, Hussein said.

Allan lived with his mother, Masouza Odeh, in a boxy home in Ainabous, a sleepy hillside village in the West Bank, when he was arrested last November. He was held in administrative detention, a contentious practice in Israel, in which a person is held indefinitely without public charges.

In prison, Allan found common cause with a fellow prisoner, Khader Adnan, another Islamic Jihad activist, who conducted a 66-day hunger strike in 2012 and began another one this year to protest his latest detention.

After Adnan was released in June after 55 days without eating, Allan, days into his own fast, decided to stare down the Israeli authorities alone. He refused all food and nutrients, and took only water. The Israeli authorities considered force-feeding him, but no doctor would agree to examine him, a requirement of the law passed last month.

"He was sure, if he was victorious in this battle, he would have gained a great victory for his people," Hussein said. "It was like somebody going with a belt and blowing himself up," he said, referring to Palestinian suicide bombers. "But he did it with his stomach."

Avi Dichter, a former head of Israel's domestic security and a hawkish government minister, suggested recently in a post on Facebook that Allan had been held in administrative detention because he was preparing a suicide attack on Israel.

A video of Allan that was released after he ended his hunger strike last week showed a shrunken man with a full beard wrapped in a blanket.

"This victory is because of God," he said, before thanking his family and others who supported him. He spoke softly, taking quick, shallow breaths, and he appeared to stumble over some words.

Allan had been on a respirator for four days, and received salts and fluids intravenously to keep him alive before the court ruled to suspend his detention last week. At the time, doctors indicated that he might have some brain damage as a result of his extreme fast.

Odeh said that her son supported her financially. "Without him, I'll be on the streets, or roaming a mountaintop," she said in an interview outside Barsilai Medical Center in Ashkelon, Israel, where her son was being treated.

Smithsonian National Zoo

A giant panda cub, which has a twin, is examined by veterinarians after being born at Smithsonian's National Zoo on Saturday in Washington.

Citizenship doesn't apply to U.S. pandas on loan from China

BY NOAH BIERMAN
Tribune Washington Bureau

WASHINGTON

Zookeepers call pandas their sexiest animals. They fawn over their inclination to make even laziness look so darned cute and covet their ability to draw thousands of visitors who buy plush toys and faux panda ears.

But even as excitement swelled over the birth of twin pandas at the Smithsonian's National Zoo in Washington on Saturday, the cubs themselves are only temporary residents in the nation's capital. Unlike humans born on U.S. territory, the pandas are not birthright citizens.

If they survive a tenuous period of infancy and reach sexual maturity in three or four years, there is a good chance the Chinese government will summon them home to breed.

China, which makes millions of dollars a year for its breeding programs by sending pandas to zoos around the world, controls their whereabouts.

The cuddly looking bears' popularity, the millions it costs to house and feed them, and the Chinese government's ability to control their whereabouts, make pandas one of the most complex animals for a zoo to keep.

"At the end of the day, it's a huge business deal for China," said Ron Magill, who has served for 36 years as the communications director for Zoo Miami, which does not have pandas.

The National Zoo and the three others that house pandas – San Diego, Memphis and Atlanta – say they do not make money keeping the fuzzy animals that have become a leading icon of conservationists, though it is difficult to pinpoint how much their presence boosts overall attendance and donations. Zoo Atlanta openly flirted with ending its panda program several years ago before the Chinese government agreed to renegotiate its contract terms, dropping the price from more than $1 million a year to $575,000.

Zoos in San Diego, Washington and Memphis have negotiated similar terms in recent years. The payments are earmarked for Chinese government conservation programs. Attempts to reach Chinese government officials were unsuccessful.

"They've become a loss leader. Yes, they are expensive to maintain and exhibit, but they are a tremendous draw," said David Walsh, president of Zoo Advisors, who has consulted for more than 50 zoos, including Atlanta.

The San Diego Zoo, often ranked among the world's best, says it has spent more than $40 million maintaining giant pandas since 1996, plus $5.8 million on a panda exhibit. The maintenance costs include fees to China and other expenses, including food, which can run tens of thousands of dollars a year.

"You have to grow bamboo. If you can't grow bamboo you have to source bamboo from someplace," said Jenny Mehlow, spokeswoman for the San Diego Zoo, which grows most of its bamboo and harvests some from local producers, noting that pandas will reject it if not fresh.

All four zoos that keep pandas say they believe they are good for their institutions and good for conservation missions, even if it is a little painful to see them flown back to China on jumbo jets when they reach sexual maturity.

"We don't have them as a money maker," said Stephanie Braccini, the curator of mammals at Zoo Atlanta, who combines scientific terms with words like hilarious, adorable and cute to talk about the animals. "We have them as an opportunity to have that conservation message and to help the overall population."

The Atlanta zoo broke attendance records in the first full year it had pandas, 2000, drawing more than 1 million visitors. Attendance spiked again, by 25 percent, in 2007 after the first cub, Mei Lan, was born. But two subsequent cubs did not affect attendance, said Rachel Davis, spokeswoman for Zoo Atlanta. And the bump after the birth of twins two years ago contributed to a modest 6 percent rise in attendance.

Admission to the National Zoo, part of the federally supported Smithsonian, is free. But the panda logo is everywhere on the park property, a major piece of the zoo's fundraising and merchandising business. Mei Xiang's suspected pregnancy had made headlines for weeks and the surprise birth of twins Saturday stirred the panda frenzy.

The newest unnamed panda cubs, whose genders won't be known for several weeks, are only the third set of twins born in the United States. The first set, also born at the National Zoo, did not survive. The second set, born in Atlanta, did.

"It's a very risky and challenging time," said Pamela Baker-Masson, associate director of communications at the National Zoo.

Because Mei Xiang cannot care for both cubs at once, zookeepers are attempting to take care of one baby at a time, swapping them out every few hours so they get equal attention from their mother. They've already had some trouble.

Sunday night, Mei Xiang refused to give one of the cubs up, leaving the second cub in the hands of zoo staff for about eight hours. The cub would not take a bottle and had to be fed from a tube, Baker-Masson said.

Outside the panda exhibit this week, three signs were hoisted on barricades informing visitors that the panda house was closed – but just the birth announcement drew a few visitors. It will be several months before the new cubs make a public appearance.

Sunday was the second birthday of Bao Bao, one of the pandas born at the zoo – and a celebration drew a crowd of panda-lovers.

But it was also a reminder that Bao Bao may have already spent half her time at the zoo. Tai Shan, another panda born at the National Zoo, was sent to China in 2010, along with a cub from Atlanta. San Diego has also sent pandas to China. Memphis has not had any births. China does not generally recall adult pandas – which can live about 20 years – but it has that right when contracts expire every five or 10 years.

American zookeepers say the move to China will improve the species' survival, because potential breeding partners in U.S. zoos are related to each other.

Iran deal gaining support

It will take 41 senators to block disapproval effort

By Erica Werner
Associated Press

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"We feel good about the fact that after two-thirds of the Democratic caucus has committed that we have substantial support for the president with only two dissenters," Sen. Dick Durbin, D-Ill., who's leading the whip operation in favor of the deal, said in an interview. But Durbin declined to predict success, saying, "We continue to work it."

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Trooper's accused killer had long record

By Melinda Deslatte and Janet McConnaughey
Associated Press

Daigle

BATON ROUGE, La. — The man accused of gunning down a Louisiana state trooper who stopped to offer him roadside assistance spent much of the past two decades in and out of prison, including a stint for setting his mother's house on fire.

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Scientists closer to universal flu vaccine

Drugs could eliminate annual shot some day

By Eryn Brown
Los Angeles Times

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DAVID CARSON/ST. LOUIS POST-DISPATCH VIA ASSOCIATED PRESS ARCHIVES

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Gun thefts from vehicles, crimes involving them rise

Experts say more weapons around overall, move easy

By Jim Salter
Associated Press

JEFF ROBERSON/ASSOCIATED PRESS ARCHIVES

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Numerous city-dwellers, too, own firearms. But once they arrive at their destination, they often have to leave their guns behind.

"When they go to a baseball game or an event at the convention center ... they can't take their weapons in with them and they leave them in cars," Dotson said. "Criminals know there are guns in cars and they break into cars."

More guns are around overall. Both sales and applications for concealed-carry permits have spiked in the St. Louis region in the past year, after unrest that followed the death of 18-year-old Michael Brown led to safety concerns. Brown, who was black and unarmed, was fatally shot by a white officer last summer, leading to protests, some looting, fires and violence. When a grand jury declined to indict the officer in November, violence sparked again.

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Setting the record straight

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Public Meetings Planned on Environmental Impact Statement for the Coordinated Long term Operation of the Central Valley Project and State Water Project

Public meetings will be held to gather input on the Draft Environmental Impact Statement (EIS) for the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP). The Draft EIS analyzes the impacts of implementing the 2008 U.S. Fish and Wildlife Service and 2009 National Marine Fisheries Service Biological Opinions associated with the coordinated long-term operation of the CVP and SWP.

Four public meetings will be held at the following locations:

- **Sacramento: Wednesday, September 9, 2015, 2–4 p.m.,** John E. Moss Federal Building, Stanford Room, 650 Capitol Mall, Sacramento, CA 95814.
- **Red Bluff: Thursday, September 10, 2015, 6–8 p.m.,** Red Bluff Community Center, Westside Room, 1500 S. Jackson Street, Red Bluff, CA 96080.
- **Los Banos: Tuesday, September 15, 2015, 6–8 p.m.,** Los Banos Community Center, Grand Room, 645 7th Street, Los Banos, CA 93635.
- **Irvine: Thursday, September 17, 2015, 6–8 p.m.,** Hilton Hotel Irvine/Orange County Airport, Catalina Ballroom, 18800 MacArthur Boulevard, Irvine, CA 92612.

Written comments are due by close of business, Tuesday, September 29, 2015. You may mail your comments to Ben Nelson, Natural Resources Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814-2536. Comments may also be emailed to bcnelson@usbr.gov or faxed to (916) 414-2439.

For additional information, please contact Theresa Olson, Conservation and Conveyance Division Chief, Bay-Delta Office, Bureau of Reclamation at tolson@usbr.gov, or by phone at 916-414-2433 (TTY 800-877-8339).

Setting the record straight

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Iran deal gaining support

It will take 41 senators to block disapproval effort

By Erica Werner
Associated Press

WASHINGTON — Supporters of the Iran nuclear deal see growing momentum on their side in the Senate, raising the possibility they'll be able to block a disapproval resolution and protect President Barack Obama from having to use his veto pen.

Such an outcome — which looked all but inconceivable in the days after the deal was signed July 14 — remains a long shot. It would be a major victory for Obama, who is staking his foreign policy legacy largely on the agreement struck by the U.S., Iran and five world powers to dismantle most of Iran's nuclear program in exchange for billions in sanctions relief.

It would take 41 senators to block the disapproval resolution scheduled for a vote next month; only 34 lawmakers would be required to uphold an Obama veto of such a resolution.

Sen. Patty Murray, D-Wash., on Tuesday, became No. 29 on the list of Democrats and independents who have publicly announced their support of the deal.

"This is not a perfect deal, and there are several elements I would like to be stronger," Murray said. "But after working my way through the details and the alternatives, losing a lot of sleep, and having a lot of good conversations with so many people, I am convinced that moving forward with this deal is the best chance we have at a strong diplomatic solution. It puts us in a stronger position no matter what Iran chooses to do, and it keeps all of our options on the table if Iran doesn't hold up their end of the bargain."

Two Senate Democrats — New York's Chuck Schumer and New Jersey's Bob Menendez — have announced that they will vote against the agreement. But supporters feel confident that they can get to 34 votes, and some have begun to say in private that 41 votes may even be within reach.

Many caution it remains a remote possibility with Republicans unanimously opposed and Israeli officials arguing vehemently against a deal they say could empower enemies sworn to their destruction. And yet predictions that Republican opponents and the powerful-pro-Israel lobby would use Congress' August recess to make the deal politically toxic have not come to pass.

Although polls register significant public concerns about the agreement, undeclared Democratic senators have increasingly broken in favor. In addition to Murray, who's a member of the Senate's Democratic leadership, Minority Leader Harry Reid of Nevada announced his support over the weekend, and Sen. Debbie Stabenow of Michigan followed on Monday.

"We feel good about the fact that after two-thirds of the Democratic caucus has committed that we have substantial support for the president with only two dissenters," Sen. Dick Durbin, D-Ill., who's leading the whip operation in favor of the deal, said in an interview. But Durbin declined to predict success, saying, "We continue to work it."

Reid told reporters in Las Vegas attending a clean energy conference Monday that he expects to see a couple more "yes" votes in the next couple of days.

"I know it's a long shot, I hope that it can be done," he said of prospects for blocking the disapproval resolution. "We'll just have to see. Because right now, it's based on a whole lot of uncounted votes."

Trooper's accused killer had long record

By Melinda Deslatte and Janet McConnaughey
Associated Press

Daigle

BATON ROUGE, La. — The man accused of gunning down a Louisiana state trooper who stopped to offer him roadside assistance spent much of the past two decades in and out of prison, including a stint for setting his mother's house on fire.

Burglary. Assault. Arson. A string of DWIs. Kevin Daigle's criminal history, provided to The Associated Press by law enforcement officials across two parishes in southwest Louisiana, was lengthy. He'd only been out of jail since March.

Alcohol was the switch, according to Daigle's sister-in-law.

"Kevin was a good person until he started drinking. When he started drinking, he went bonkers," said Diane Daigle. "All his life he was like that. The first drink he took in his mouth, it took everything out of him and he became like a Jekyll and a Hyde."

Police suspect Daigle, 53, had been drinking when they say he shot Senior Trooper Steven Vincent on Sunday evening. Vincent had stopped to offer Daigle help because his truck was in a ditch, but authorities say dashboard camera footage shows Daigle came out with a shotgun when approached. Vincent died from the gunshot wound on Monday.

Daigle also is suspected by officials in the death of another man with whom he was staying for the past few months.

By the time he was taken into custody in Vincent's shooting death, Daigle had been well known by law enforcement across Calcasieu and Jefferson Davis parishes in southwest Louisiana.

He'd been arrested a dozen times. He'd been accused of criminal damage to property back in 1997; burglarizing a church in 2001; assaulting a police officer in 2003; multiple counts of driving while intoxicated over the years; and disturbing the peace and arson in 2012, according to criminal records.

Scientists closer to universal flu vaccine

Drugs could eliminate annual shot some day

By Eryn Brown
Los Angeles Times

Someday, patients may no longer have to get a new flu shot each year, tailored to the particular strains expected to dominate in a given season. That's because scientists are homing in on new methods of formulating vaccines that will be able confer immunity against multiple varieties of influenza — a feat they haven't been able to achieve in the past.

On Monday, two teams reported independently that they had mimicked a tiny portion of the flu virus known as a hemagglutinin stem, helping them develop experimental vaccines that protected animals against several flu types.

"This is an early step," said Barney Graham, deputy director of the Vaccine Research Center at the National Institute of Allergy and Infectious Diseases in Bethesda, Md. and senior author of one of the research papers outlining the advances. "But it is promising."

One reason it's been hard to formulate a universal flu vaccine that works against all strains of the virus is that influenza is a shape shifter that mutates rapidly and often. Even if a person develops immunity against a particular flu from immunization or from having been sickened by it, he or she won't necessarily have immunity to a similar flu that has evolved to be slightly different.

A universal flu vaccine won't be available right away, Grant said. If it does become a reality one day, he said, it would probably be similar to the tetanus vaccine, which requires a booster shot every 10 years — rather than like vaccines received only during childhood.

DAVID CARSON/ST. LOUIS POST-DISPATCH VIA ASSOCIATED PRESS ARCHIVES

St. Louis police gather at the scene of a fatal officer-involved shooting Aug. 19 where police sought to execute a search warrant at a home in St. Louis.

Gun thefts from vehicles, crimes involving them rise

Experts say more weapons around overall, move easy

By Jim Salter
Associated Press

JEFF ROBERSON/ASSOCIATED PRESS ARCHIVES

In Bridgeton, Missouri, gun sales have spiked in the region in the past year, and so have applications for concealed-carry permits. Experts say with more guns come more gun thefts.

ST. LOUIS — In what's been a violent year in St. Louis, a common theme has emerged: The gun used in any given crime was probably stolen.

The city is on pace for about 200 homicides in 2015, the most in 20 years. Meanwhile, reports of gun thefts are up nearly 70 percent, police Chief Sam Dotson said. But it's not homes, gun stores or pawn shops that thieves are targeting, Dotson said: It's cars and trucks.

More than 170,000 Missouri residents hold concealed-carry permits and many bring guns when they venture to high-crime areas like St. Louis.

Numerous city-dwellers, too, own firearms. But once they arrive at their destination, they often have to leave their guns behind.

"When they go to a baseball game or an event at the convention center ... they can't take their weapons in with them and they leave them in cars," Dotson said. "Criminals know there are guns in cars and they break into cars."

More guns are around overall. Both sales and applications for concealed-carry permits have spiked in the St. Louis region in the past year, after unrest that followed the death of 18-year-old Michael Brown led to safety concerns. Brown, who was black and unarmed, was fatally shot by a white officer last summer, leading to protests, some looting, fires and violence. When a grand jury declined to indict the officer in November, violence sparked again.

Experts say that, inevitably, with more guns come more gun thefts. Remy Cross, a professor at Webster University in suburban St. Louis, said those who steal guns often sell them to other criminals.

"It's easy to move them," he said. "If you have a gun and don't intend to use it yourself, because of the loopholes in laws around gun shows and resale, it's relatively easy to get these guns into criminals' hands."

Police say stolen and illegal guns are at the root of violence across the country.

In San Francisco, the gun used to kill Kate Steinle, who was fatally shot in July as she walked with her father along a scenic pier, was stolen. Chicago has already seized nearly 4,700 guns — nearly all of them stolen — this year. Police spokesman Anthony Guglielmi said that's seven times more guns seized than New York City, and three times the number in Los Angeles.

"They're the engine of violence in Chicago," Guglielmi said. "These are guns that are on the streets used to fuel the violence in Chicago."

In Jacksonville, Florida, gun thefts from cars are so common that police have launched a social media campaign to persuade people to keep their weapons at home.

Setting the record straight

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Officials at State have sent secrets for years

Classifying in hindsight proves common

By Ken Dilanian
Associated Press

WASHINGTON — The transmission of now-classified information across Hillary Rodham Clinton's private email is consistent with a State Department culture in which diplomats routinely sent secret material on unsecured email during the past two administrations, according to documents reviewed by The Associated Press.

Clinton's use of a home server makes her case unique and has become an issue in her front-running campaign for the Democratic presidential nomination. But it's not clear whether the security breach would have been any less had she used department email. The department only systematically checks email for sensitive or classified material in response to a public records request.

In emails about the 2012 attack on a U.S. diplomatic facility in Benghazi, Libya, department officials discuss sensitive matters in real time, including the movement of Libyan militias and the locations of key Americans. The messages were released last year under the Freedom of Information Act and are posted on the State Department's website.

An email from diplomat Alyce Abdalla, sent the night of the attack, appears to report that the CIA annex in Benghazi was under fire. The email has been largely whited out, with the government citing the legal exemption for classified intelligence information. The existence of that facility is now known; it was a secret at the time.

In an email sent at 8:51 p.m. on Sept. 11, 2012, Eric J. Pelofsky, a senior adviser to then-U.N. Ambassador Susan Rice, gives an update on efforts to locate U.S. Ambassador Chris Stevens, who died in the attack.

The email was marked unclassified when sent. Later, part of it was deemed classified and censored before its release.

In five emails that date to Condoleezza Rice's tenure as secretary of state during the George W. Bush administration, large chunks are censored on the grounds that they contain classified national security or foreign government information.

These emails also are posted on the State Department website's reading room.

In a December 2006 email, diplomat John J. Hillmeyer appears to have pasted the text of a confidential cable from Beijing about China's dealings with Iran and other sensitive matters. Large portions of the email were marked classified and censored before release.

Clinton insists she didn't send or receive classified information. But government officials have found material they deem classified in several dozen of

ASSOCIATED PRESS

Democratic Hillary Rodham Clinton speaks Wednesday in Iowa, where she said: "My use of personal email was allowed by the State Department. It clearly wasn't the best choice."

30,000 emails that the former secretary of state has turned over, an unfolding saga that has dogged her 2016 campaign.

Many of the emails to Clinton containing classified information were forwarded to her by a close aide, Huma Abedin. Most, however, originated with diplomats who have access to confidential material. Some emails sent by Clinton have since been censored.

Such slippage of classified information into regular email is "very common, actually," said Leslie McAdoo, a lawyer who frequently represents government officials and contractors in disputes over security clearances and classified information.

What makes Clinton's case different is that she exclusively sent and received emails through a home server in lieu of the State Department's unclassified email system. Neither would have been secure from hackers or foreign intelligence agencies, so it would be equally problematic whether classified information was carried over the government system or a private server, experts say.

In fact, the State Department's unclassified email system has been penetrated by hackers believed linked to Russian intelligence.

Many of the emails to Clinton came from state.gov email accounts, noted Steven Aftergood, an expert on classification at the Federation of American Scientists. "So if there is routine security screening and monitoring of incoming and outgoing State Department emails, anything that is classified should have been flagged. That does not seem to have happened. I think it's the State Department culture."

That may be true, but it would not save a rank-and-file official with a security clearance who was caught sending classified information over email, said Bradley Moss, a lawyer who frequently represents intelligence officers. That person could lose his job, his clearance, or both.

"In real life, the 'everybody does it defense' doesn't fly," Moss said.

In a statement, State Department spokesman Alec Gerlach said it's not uncommon — across each agency — that when considering information for release, "certain information must later be upgraded even if it had not previously been classified."

"Classifying information ahead of a release doesn't necessarily mean information was mishandled, but it certainly does reflect the seriousness with which we take our obligations and the fact that over time, some of the circumstances in which information is being digested can and do change," Gerlach said.

Clinton, speaking to reporters after an event in Iowa, said: "My use of personal email was allowed by the State Department. It clearly wasn't the best choice. I should have used two emails, one personal, one for work. And I take responsibility for that decision."She added, "I'm confident that this process will prove that I never sent nor received any email that was marked classified."

The AP has asked the State Department to turn over records reflecting any concerns by agency computer staff or security officials over Clinton's use of a private email server, but has received no responsive documents.

There is no indication that any information in Clinton emails was marked classified at the time it was sent. But critics have said Clinton and her aides should have known not to discuss anything remotely secret over unsecured email. The emails show they were cognizant of security, routinely communicating over secure phone and fax lines.

Clinton also had access to a classified messaging system, but it's not widely used at the State Department. Most department officials in Washington and at embassies have on their desktops a classified network that goes up to "secret" level. A small number of State officials, including the secretary, can use a third system that goes up to "top secret" level in special secure rooms.

But even the middle-tier "secret" network is cumbersome for many in the agency, said officials who would not be quoted when discussing internal security policies.

Appeals court upholds gay marriage ruling in Kentucky

Judge denies county clerk request for stay

By Claire Galofaro and Adam Beam
Associated Press

MOREHEAD, Ky. — A federal appeals court has upheld a ruling ordering a Kentucky county clerk to issue marriage licenses to gay couples.

Rowan County Clerk Kim Davis objects to same-sex marriage for religious reasons. She stopped issuing marriage licenses the day after the U.S. Supreme Court overturned state bans on same-sex marriage.

Two straight couples and two gay couples sued her. A U.S. district judge ordered Davis to issue the marriage licenses, but later delayed his order so that Davis could have time to appeal to the 6th circuit. Wednesday, the appeals court denied Davis' request for a stay.

"It cannot be defensibly argued that the holder of the Rowan County Clerk's office, apart from who personally occupies that office, may decline to act in conformity with the United States Constitution as interpreted by a dispositive holding of the United States Supreme Court," judges Damon J. Keith, John M. Rogers and Bernice B. Donald wrote for the court. "There is thus little or no likelihood that the Clerk in her official capacity will prevail on appeal."

April Miller and Karen Roberts were one of the gay couples who sued Davis. Miller read the ruling on her phone in the living room of the house they share down a country road on the outskirts of Morehead. Roberts, her partner for more than a decade, peered over her shoulder, smiling, humming, tears welling up under her glasses.

The news flashed across their TV screen and they hugged, and their hug turned into a brief slow dance on the living room rug. The phone started ringing, but they ignored it for a minute.

They felt vindicated, they said. They got out the boxes holding their matching wedding bands, bought days after the Supreme Court's decision in June. They are simple white gold bands, ringed in diamonds.

"One step closer," Miller said. "We might be able to get married in September."

Mat Staver, an attorney for Davis, said he was disappointed with the ruling. He said he plans to discuss options with Davis, including an appeal to the U.S. Supreme Court.

"The court of appeals did not provide any religious accommodation rights to individuals, which makes little sense because at the end of the day it's individuals that are carrying out the acts of the office," Staver said. "They don't lose their individual constitutional rights just because they are employed in a public office."

It's unclear how Davis will react if she were to ultimately lose her appeals. She testified in federal court last month she would "deal with that when the time comes." Saturday, she spoke to thousands of supporters at a religious freedom rally at the state capitol, saying: "I need your prayers ... to continue to stand firm in what we believe."

"Regardless of what any man puts on a piece of paper, the law of nature is not going to change," Davis told the crowd.

Miller and Roberts said they know the legal fight will stretch on. Davis continued to refuse to issue marriage licenses after other judges' rulings. And they suspect she will continue to refuse after this one.

"We get all excited. But we know a letdown is coming again," Miller said. "It's going to keep going. It's gonna be a long haul."

"But it felt so good for a minute," Roberts chimed in.

U.S.:'Belligerent' journalists could be held

By Wendy Benjaminson
Associated Press

WASHINGTON — New Defense Department guidelines allow commanders to punish journalists and treat them as "unprivileged belligerents" if they believe journalists are sympathizing or cooperating with the enemy.

The Law of War manual, updated to apply for the first time to all branches of the military, contains a vaguely worded provision that military commanders could interpret broadly, experts in military law and journalism say. Commanders could ask journalists to leave military bases or detain journalists for any number of perceived offenses.

"In general, journalists are civilians," the 1,180 page manual says, but it adds that "journalists may be members of the armed forces, persons authorized to accompany the armed forces, or unprivileged belligerents."

A person deemed "unprivileged belligerent" is not entitled to the rights afforded by the Geneva Convention so a commander could restrict from certain coverage areas or even hold indefinitely without charges any reporter considered an "unprivileged belligerent."

The manual adds, "Reporting on military operations can be very similar to collecting intelligence or even spying. A journalist who acts as a spy may be subject to security measures and punished if captured." It is not specific as to the punishment or under what circumstances a commander can decide to "punish" a journalist.

Defense Department officials said the reference to "unprivileged belligerents" was intended to point out that terrorists or spies could be masquerading as reporters, or warn against someone who works for jihadi websites or other publications, such as al-Qaida's "Inspire" magazine, that can be used to encourage or recruit militants.

Another provision says that "relaying of information" could be construed as "taking a direct part in hostilities." Officials said that is intended to refer to passing information about ongoing operations, locations of troops or other classified data to an enemy.

Army Lt. Col. Joe Sowers, a Pentagon spokesman, said it was not the Defense Department's intent to allow an overzealous commander to block journalists or take action against those who write critical stories.

"The Department of Defense supports and respects the vital work that journalists perform," Sowers said. "Their work in gathering and reporting news is essential to a free society and the rule of law." His statement added that the manual is not policy and not "directive in nature."

But Ken Lee, an ex-Marine and military lawyer who specializes in "law of war" issues and is now in private practice, said it was worrisome that the detention of a journalist could come down to a commander's interpretation of the law.

If a reporter writes an unflattering story, "does this give a commander the impetus to say, now you're an unprivileged belligerent? I would hope not," Lee said.

COREY PRIDE cpride@losbanosenterprise.com

Green Valley Charter School kindergartners play with logs during recess Wednesday.

FROM PAGE 1A

CHARTER

dergartners. Green Valley's first through sixth grades remain at Miano. The charter school, which plans to be a kindergarten through eighth-grade facility by the 2017-18 school year, has increased from 75 students when it opened in 2012 to 178 students this week.

"As far as the Miano site, we always knew we could only grow so much without being intrusive to the district," Blackwood-Freitas said.

She said she is still searching for commercial sites where Green Valley can be relocated until funding becomes available for the charter school to build a facility.

The converted oversized classroom on Center Avenue is working well, according to kindergarten teacher Julia Capocelli.

"The children have their own space without the hustle and bustle of the older grades; it's very peaceful," Capocelli said.

According to the school's kindergarten curriculum, before the school year ends the children will learn qualities of numbers, measuring through baking and cooking exercises, and arts and crafts skills. They also will be introduced to Spanish.

Green Valley Charter School has tried to blend in with the community since it opened. A little more than a year ago the school opened an office in the downtown area on Sixth Street. Blackwood-Freitas said the off-campus office gives her more space to work and provides an opportunity for the school to be more visible to the public.

The school's charter petition will be up for renewal next year. Blackwood-Freitas said at that time Green Valley Charter School will have to prove to the Los Banos Unified School District that it has met the goals it listed when its initial petition was approved.

> **"THE CHILDREN HAVE THEIR OWN SPACE WITHOUT THE HUSTLE AND BUSTLE OF THE OLDER GRADES; IT'S VERY PEACEFUL.**
>
> *Julia Capocelli, teacher*

Blackwood-Freitas said she will provide the district with all the information it needs, but increasing enrollment figures by themselves are persuasive.

"The children are speaking for themselves; the growth is speaking," she said.

Green Valley Charter School is planning an open house for its kindergarten facility Oct. 30.

Car show set Sept. 6

The fifth annual Maxx-limit Cars and Burgers Car Show will be held Sept. 6 from noon until 3 p.m. at Les Schwab Tire Center, 1500 East Pacheco Blvd. Registration for participants in the car show will be held from 10 a.m. until noon. The entry fee is $25 and vendor spaces are available for $39. For more information call (209) 435-0724 or (209) 605-0811.

Free driver safety class scheduled

A free driver safety class for teenagers and their parents will be offered by the California Highway Patrol's Los Banos office Sept. 9 from 6:30 to 8:30 p.m. The "Start Smart" class is designed for newly licensed and prospective drivers ages 15 to 19. Parents and guardians may sign up for the class by emailing Officer Dean Emehiser at demehiser@chp.ca.gov or calling (209) 826-3811.

ERIC PAUL ZAMORA ezamora@fresnobee.com

Zackeria Lovick, at left in the foreground, delivers backpacks with school supplies to students at Del Mar Elementary School in Fresno on Monday.

Fresno boy, 7, begins school supplies drive for students in need

BY CARMEN GEORGE
cgeorge@fresnobee.com

VIDEO
Watch as Del Mar Elementary students receive backpacks and school supplies from Zackeria Lovick at **www.fresnobee.com/video**

Seven-year-old Zackeria Lovick recently learned something startling while shopping for school supplies with his mom.

As he picked out items to use in class as a second-grader at Figarden Elementary School in northwest Fresno, his mom Malarie Silos asked, "What about the kids who can't afford it?"

His response: "Wait, what?!"

That led to a discussion and plan. Zackeria would collect backpacks and supplies for a different school within Fresno Unified School District each month through May. After that, he hopes to continue collecting items over the summer for a back-to-school giveaway next fall.

He gave away his first 17 packs stuffed with supplies for children in need on Monday afternoon at Del Mar Elementary in central Fresno.

"I just want to help kids so that they have everything they need," Zackeria said.

Nine-year-old Katrina Haemkeo was among a small group of students from first through fifth grade who met with Zackeria at Del Mar. She was excited and surprised to receive a new black backpack with supplies. She thinks what Zackeria did is "really cool."

Del Mar Principal Nicole Woods agrees.

"I think it's great for our students, obviously, to receive something so wonderful, but also for them to see someone their age gathering and giving beyond themselves," Woods said.

"It may inspire our own students to do something similar. ... It's just a positive way to start the school year."

A certificate of recognition from Fresno City Council Member Esmeralda Soria also was presented to Zackeria, calling him an "inspiration to the youth in our community!"

Zackeria is now working to collect more items so he can give to students at another school, which hasn't been chosen yet. His mom is proud of his enthusiasm for the project and initiative.

"He's kind of been taking over, which is fun to see."

Carmen George: 559-441-6386, @CarmenGeorge

Teammates remember Hanford teen who died

BY LEWIS GRISWOLD
lgriswold@fresnobee.com

Nolan Eggert was riding bicycle when he crossed in front of car

Eggert was on Sierra Pacific High's water polo team

Candlelight vigils held at two schools

HANFORD

When the voice over the loudspeaker at Sierra Pacific High on Monday said every member of the boys water polo team must report to a team meeting immediately, everyone on campus knew what it was about.

Nolan Eggert, 16, a sophomore and the goalie on the water polo junior varsity squad, died Friday night in a tragic accident.

A candlelight vigil in his honor was held Monday night at the high school, following one Sunday at Woodrow Wilson Junior High, where his father is the principal.

Nolan was struck by a car while crossing the road on his bicycle a few blocks from his home west of Hanford.

The accident happened about 9:40 p.m. Friday. The CHP said the boy rode his bike into the north lane of 14th Street, north of School Street, and was hit by a 1999 Camry. He was not wearing a helmet.

The driver, Felix Gonzalez-Hernandez, 25, stopped and called 911. Alcohol or drugs do not appear to be a factor, the CHP said.

Nolan Eggert

An ambulance took Nolan to the hospital in Hanford, and a helicopter took him to Community Regional Medical Center in Fresno.

Nolan's father, Kenny Eggert, was at the hospital in Fresno when his son died.

"I went in, I said a prayer, I grabbed his hand," Eggert said. "His hand squeezed back. I know it was God saying I've taken your son home."

School counselors and pastors were at the high school Monday to talk with students as needed, said Principal Greg Henry.

At the water polo team meeting, coach Kevin Jauregui told team members they were confronting a unique situation – the death of one their own.

Nolan was new to the position of goalie, but immediately became an inspiration to the team, teammates said. Every time he blocked a shot, they would yell "Nolan!"

"Nolan was genuinely a great person – nice and fair and respectful," said John Mello, 15, a sophomore. "I'll remember his great sense of humor – he could make everyone smile."

"He was always trying his hardest," said Michael Hollar, 17, a senior.

The sports department said plans are in the works for a Nolan Eggert Award to be given to a senior water polo player, boy or girl, who best exemplifies Nolan's team player spirit.

His father said when the coach assigned him to be goalie, "he had the best game of his life."

Nolan had a gift for making friends, his father said. When he switched schools in eighth grade to attend Woodrow Wilson Junior High, "he didn't know anybody. At the end, he knew 600. Nolan did not have an enemy."

Even though he was only 16, he had a job helping make kettle corn at the Thursday night farmers market in Hanford.

Nolan loved camping, hunting and fishing.

"His lifelong goal was to become a fish and game warden to protect our resources for future use," his father said.

Family friend Karen McConnell said she liked "his mischievous smile, no question."

"He was a very, very sweet boy," said family friend Carolyn Nunes. "He had so many friends."

Survivors include his father, mother Stephanie Eggert, vice principal at Frontier Elementary School, and brother Martin, 18, a student at the University of North Dakota.

Lewis Griswold: 559-441-6104, @fb_LewGriswold

Photographs by VINCENT BEVINS For The Times

FOREST AREAS scraped bare. A researcher speculated that a recent deal to open the U.S. market to Brazilian fresh beef imports, in addition to processed beef already imported, may be contributing to deforestation.

Deforestation rate rises

Almost 2,000 square miles of the Brazilian Amazon has been razed in the last 12 months. The increase might be linked to U.S. beef imports.

By Claire Rigby

SAO PAULO, Brazil — Figures released this week point to an apparent rise in deforestation in the Brazilian Amazon over the last year, an ominous development that one researcher attributed to an increase in cattle ranching aimed at the U.S. market.

The newly lost forest, nearly 2,000 square miles, amounts to an area about the size of Delaware.

The report was published by Brazil's National Institute for Space Research and is based on satellite data used to monitor day-to-day changes in Amazon forest cover. The figures represent the largest loss of forest recorded by the system in six years.

A NATURAL RESOURCES officer at a deforestation site. A chain saw instead of heavy equipment was used, which makes it easier for the violators to flee quickly.

Deforestation in the Brazilian Amazon peaked in 2003-04, when the loss of a devastating 10,700 square miles was recorded, but the losses fell to less than 2,000 square miles annually following strategies put in place in 2008 by then-President Luiz Inacio Lula da Silva. Official figures have shown a steady decline since then, hitting a low in 2012 of 1,764 square miles.

This week's figures, however, indicate an increase to 1,977 square miles over the last 12 months.

The increase, if confirmed when Brazil's official deforestation rate is published in November, will mark an inauspicious start to Brazil's part in the upcoming Paris climate change talks.

During a visit by German Chancellor Angela Merkel in August, Germany pledged support for environmental initiatives amounting to $618 million, much of it earmarked for the preservation of tropical forest, and President Dilma Rousseff reiterated Brazil's commitment to eliminating illegal Amazon deforestation by 2030.

Greenpeace Brazil criticized that commitment as showing a "lack of ambition," and called for an end to all deforestation, not only the illegal variety.

Paulo Barreto, a senior researcher at Imazon, a nonprofit research group, speculated in the Brazilian news magazine Epoca that a recent agreement to open the U.S. market to Brazilian fresh beef imports, in addition to processed beef already imported from Brazil, may be contributing to deforestation. Since that agreement was reached in June, he said, "farmers have been encouraged by the prospect of increased sales, and may have begun to prepare the ground for more cattle."

Experts urge caution in interpreting the latest deforestation figures, which do not represent Brazil's official rate; that is generated using more precise satellite images.

The figures issued this week are based on a "rapid response" system whose accuracy is compromised by the lower range and resolution of its images, and by heavy cloud cover.

However, Gustavo Faleiros, editor of data-journalism organization InfoAmazonia, said the only doubt is about the precision of the deforestation figures.

"There's no question that it is taking place," he said.

Rigby is a special correspondent.

For the record

If you believe that we have made an error, or you have questions about The Times' journalistic standards and practices, you may contact Deirdre Edgar, readers' representative, by email at readers.representative @latimes.com, by phone at (877) 554-4000, by fax at (213) 237-3535 or by mail at 202 W. 1st St., Los Angeles, CA 90012. The readers' representative office is online at latimes.com/ readersrep.

Senator's vote helps seal deal

[Iran, from A1]

Another factor, said one frustrated Republican on Capitol Hill: "Trump happened."

The GOP leadership aide, granted anonymity to discuss the setback, said billionaire Donald Trump's attention-grabbing presidential campaign, along with scrutiny of Hillary Rodham Clinton's email server, overshadowed other issues this summer, making it harder for the Republicans' message to attract attention.

Cliff Kupchan, an Iran specialist and chairman of the Eurasia Group risk advisory consulting firm, said the deal "turned out to be good enough" to survive the political market.

"The administration was effective in raising the question 'What's the alternative?' " Kupchan said. "They beat back the arguments that pushing for an extension of sanctions on Iran would produce a better deal."

The agreement between Iran and six world powers — the U.S., Britain, France, Russia, China and Germany — will ease international economic sanctions on Iran in exchange for limits on its ability to enrich uranium and conduct other nuclear activities for at least 15 years.

Among the losers in the political arena is the American Israel Public Affairs Committee. Known as AIPAC, the powerful pro-Israel lobby helped raise tens of millions of dollars for an advertising campaign intended to sway public opinion — and wavering Democrats — to oppose the deal.

AIPAC instead is facing a rare political defeat — arguably its most significant since the Reagan administration in the early 1980s — and has damaged its image as the leading bipartisan voice for Americans who strongly support Israel.

"We're certainly not at the place the opponents of this agreement projected us to be," said Victoria Kaplan, who led a pro-deal campaign for the advocacy group MoveOn.org.

In a letter to her colleagues Wednesday, House Minority Leader Nancy Pelosi (D-San Francisco) also vowed veto-proof support in that chamber.

"I am confident we will sustain the president's veto in both houses of Congress," she said.

Democrats have felt free to back the deal in part because they heard from many in the American Jewish community who split from the more hawkish AIPAC.

The dozen or so Democratic opponents in Congress come mainly from parts of New York, New Jersey and Florida with large politically conservative Jewish populations. But the opponents failed to mount a serious effort to persuade other lawmakers to buck the White House.

The most important Democratic defector, Sen. Charles E. Schumer of New York, is poised to become the next party leader, but he publicly declined to pressure colleagues to join him. Only one other Democratic senator, Robert Menendez of New Jersey, has lined up with Schumer, although others may yet join them.

Some Democrats quickly lined up behind the president, but others have claimed to be deeply conflicted and may not reveal their decisions until the vote, which is expected by Sept. 17, the self-imposed deadline for congressional review. Some have written lengthy explanations and delivered their decisions in solemn speeches.

Mikulski, who will retire after next year as the longest-serving woman in Congress, called the vote "among the most serious" of her career.

Both sides had launched intense lobbying campaigns. The administration organized classified briefings, and Obama phoned or met numerous House and Senate members, or wrote personal letters to them. He reached across the aisle at times, inviting Sen. Jeff Flake (R-Ariz) aboard Air Force One on a recent trip to Africa in hope of winning his support. Flake ultimately opposed the deal, and no Republicans are likely to back it.

Disappointed opponents insist that the White House is enjoying what the GOP leadership aide called a "high-water mark" for a flawed deal.

Opponents and several Republican presidential candidates vow to dismantle the in the future, much as foes had promised to repeal and replace Obamacare.

Far from conceding defeat, AIPAC spokesman Marshall Wittmann said that a bipartisan majority in Congress still opposes the deal, and that no major arms control agreement has been approved by only a minority.

Speaking to reporters traveling with Obama in Alaska, White House Press Secretary Josh Earnest took a more optimistic view.

"The administration is encouraged that more than a third of the United States Senate has now indicated that they'll support the successful implementation of the international diplomatic agreement to prevent Iran from obtaining a nuclear weapon," he said.

"This strong support is a validation of the outreach that the president and his team have organized to make sure that every member of the Senate understands exactly what's included in this agreement."

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23B.3 Fact Sheets – English

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RECLAMATION
Managing Water in the West

Fact Sheet September 2015

Coordinated Long-term Operation of the Central Valley Project and State Water Project

The Draft Environmental Impact Statement (Draft EIS) prepared for the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP) analyzes the impacts of implementing the 2008 U.S. Fish and Wildlife Service (USFWS) and 2009 National Marine Fisheries Service (NMFS) Biological Opinions (BOs), including their Reasonable and Prudent Alternatives (RPAs).

Background

In August 2008, the Bureau of Reclamation (Reclamation) submitted a biological assessment to the USFWS and NMFS for consultation on the environmental impacts of the coordinated long-term operation of the CVP and SWP. The USFWS and NMFS concluded in their BOs, respectively, that the
that the coordinated operation of the CVP and SWP, as proposed, were likely to jeopardize the continued existence of the delta smelt, listed salmonid species, green sturgeon, and resident killer whale. To remedy the jeopardy opinions, the USFWS and NMFS provided RPAs in their respective BOs. Lawsuits were filed challenging Reclamation's acceptance and implementation of the associated RPAs. The District Court for the Eastern District ruled that Reclamation must conduct an environmental review to determine whether implementing the RPAs causes a significant effect to the human environment.

Draft Environmental Impact Statement

Reclamation held five scoping meetings in 2012 throughout California to collect input on topics and alternatives to be addressed in the EIS. Comments received at the scoping meetings, in addition to other public comments, helped inform the alternative decision development process. The Draft EIS (published on July 31, 2015) analyzes five alternatives that consider modifications to RPA operational components of the CVP and SWP. All of the alternatives address the coordinated operation of the CVP and SWP, and applicable water rights and water quality requirements. Continued operation of the CVP and the SWP is necessary to provide river regulation; improvement of navigation; flood control; water supply for irrigation and domestic uses; fish and wildlife mitigation, protection, and restoration; fish and wildlife enhancement and power generation. The CVP and SWP facilities also provide recreation benefits.

Review of the Draft EIS

Reclamation invites the public and agency comments on the Draft EIS. To view or download the Draft EIS, go to
http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=21883.

RECLAMATION
Managing Water in the West

If you encounter problems accessing the documents, please call 916-978-5100 or email mppublicaffairs@usbr.gov.

Hard copies of the Draft EIS are located at:

Bureau of Reclamation
Mid-Pacific Regional Office
2800 Cottage Way, Sacramento CA 95825

Bureau of Reclamation
Bay-Delta Office
801 I Street, Suite 140, Sacramento, CA 95814
For access, please call 916-414-2424

Comments on the Draft EIS

Written comments from the public, reviewing agencies, and stakeholders will be accepted through September 29, 2015.

Please send your comments using one of the following methods:

- Ben Nelson, Natural Resources Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814-2536
- bcnelson@usbr.gov
- Fax: (916) 414-2439

Public Meetings

You are invited to learn more about the Draft EIS and submit comments during Public Meetings at the following locations:

Sacramento	Red Bluff	Los Banos	Irvine
Wednesday, September 9, 2015 2:00 to 4:00 pm	Thursday, September 10, 2015 6:00 to 8:00 pm	Tuesday, September 15, 2015 6:00 to 8:00 pm	Thursday, September 17, 2015 6:00 to 8:00 pm
John E. Moss Federal Building, Stanford Rm. 650 Capitol Mall Sacramento, CA 95814	Red Bluff Community Center 1500 S. Jackson St. Red Bluff, CA 96080	Los Banos Community Center 645 7th St. Los Banos, CA 93635	Hilton Hotel Irvine/Orange County Airport 18800 MacArthur Blvd. Irvine, CA 92612

Next Steps

A preferred alternative will be selected an a Final EIS will be prepared that will include responses to all substantial comments on the Draft EIS. Reclamation will make the Final EIS available for 30 days before finalizing the Record of Decision (ROD). The ROD will document Reclamation's decision on which actions, if any, to take to address the purpose and need; and describe any mitigation plans, and factors that were considered when making the final decision.

For additional information, please contact Theresa Olson, Conservation and Conveyance Division Chief, Bay-Delta Office, Bureau of Reclamation at tolson@usbr.gov, or by phone at 916-414-2433 (TTY 800-877-8339).

23B.4 Fact Sheets – Spanish

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Ficha técnica Septiembre de 2015

Operación coordinada a largo plazo del Proyecto del Valle Central de California y el Proyecto Hídrico Estatal

El Borrador de la Declaración de Impacto Ambiental (Draft Environmental Impact Statement, EIS) preparado para la Operación coordinada a largo plazo del Proyecto del Valle Central de California (Central Valley Project, CVP) y el Proyecto Hídrico Central (State Water Project, SWP) analiza los impactos de implementar las opiniones biológicas (Biological Opinions, BO) del Servicio de Pesca y Fauna Silvestre de los Estados Unidos de 2008 (U.S. Fish and Wildlife Service, USFWS) y del Servicio Nacional de Pesca Marina de 2009 (National Marine Fisheries Service, NMFS), incluidas sus Alternativas Razonables y Prudentes (Reasonable and Prudent Alternatives, RPA).

Antecedentes

En agosto de 2008, el Departamento de Recuperación (Recuperación) emitió una evaluación biológica al USFWS y NMFS para la consulta del impacto ambiental de la operación coordinada a largo plazo de CVP y SWP. El USFWS y el NMFS concluyeron en sus BO, respectivamente, que la operación coordinada del CVP y el SWP, según lo propuesto, podía poner en riesgo la continua existencia del eperlano del delta, especies enumeradas de salmónidos, el esturión verde y la orca residente. Para remediar las opiniones de riesgo, el USFWS y el NMFS proporcionaron sus RPA en las respectivas BO. Se presentaron demandas que impugnan la aceptación e implementación de las RPA por parte de Recuperación. El Tribunal del Distrito del Este determinó que Recuperación debe llevar a cabo una revisión ambiental para determinar si implementar las RPA causará un efecto significativo sobre el entorno humano.

Declaración de impacto ambiental

Recuperación celebró cinco reuniones de exploración en 2012 en toda California para obtener aportes sobre temas y alternativas a ser abordados en la EIS. Los comentarios recibidos en las reuniones de exploración, además de otros comentarios públicos, ayudaron a informar el proceso de desarrollo de la decisión alternativa. El borrador de la EIS (publicado el 31 de julio de 2015) analiza cinco diferentes alternativas que consideran modificaciones a componentes operativos RPA del CVP y el SWP. Todas las alternativas abarcan la operación coordinada del CVP y el SWP, y los actuales derechos al agua y requerimientos de calidad del agua. La operación continua del CVP y el SWP es necesaria para la regulación de los ríos; la mejora de la navegación; el control de las inundaciones; el suministro de agua para riego y usos domésticos; el alivio, la protección y la restauración de los peces y la vida silvestre; la mejora de los peces y la vida silvestre, y la generación de energía. Las instalaciones del CVP y SWP también proporcionan beneficios de recreación.

RECLAMATION
Managing Water in the West

Revisión del borrador de la EIS

Recuperación invita al público y las agencias a comentar el borrador de la EIS Para ver o descargar el borrador de la EIS, ingrese a http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=21883.

Si tiene algún problema para acceder a este documento, llame al 916-978-5100 o envíe un correo electrónico a mppublicaffairs@usbr.gov.

Hay copias impresas del borrador de la EIS en:

Departamento de Recuperación
Oficina Regional del Centro del Pacífico

2800 Cottage Way, Sacramento CA 95825

Oficina de Recuperación

Oficina de la Bahía y del Delta

801 I Street, Suite 140, Sacramento, CA 95814

Para obtener acceso, llame al 916-414-2424

Comentarios sobre el Borrador de la EIS

Los comentarios escritos del público, de las agencias revisoras y de las partes interesadas se recibirán hasta el 29 de septiembre de 2015.

Envíe sus comentarios a través de uno de los siguientes métodos:

- Ben Nelson, Especialista en Recursos Naturales, Departamento de Recuperación, Oficina de la Bahía y del Delta, 801 I Street, Suite 140, Sacramento, CA 95814-2536
- bcnelson@usbr.gov
- Fax: (916) 414-2439

Juntas públicas

Está invitado a obtener más información sobre el borrador de la EIS y a emitir sus comentarios durante las juntas públicas en las siguientes localidades:

Sacramento	Red Bluff	Los Banos	Irvine
Miércoles, 9 de septiembre de 2015 De 2:00 a 4:00 p. m.	Jueves, 10 de septiembre de 2015 De 6:00 a 8:00 p. m.	Martes, 15 de septiembre de 2015 De 6:00 a 8:00 p. m.	Jueves, 17 de septiembre de 2015 De 6:00 a 8:00 p. m.
Edificio federal John E. Moss, Stanford Rm. 650 Capitol Mall Sacramento, CA 95814	Centro comunitario de Red Bluff 1500 S. Jackson St. Red Bluff, CA 96080	Centro comunitario de Los Banos 645 7th St. Los Banos, CA 93635	Hotel Hilton Irvine/Aeropuerto del Condado de Orange 18800 MacArthur Blvd. Irvine, CA 92612

Siguientes pasos

Se elegirá una alternativa preferida y se preparará una EIS final que incluirá respuestas a todos los comentarios sustanciales del Borrador de la EIS. Recuperación pondrá a disposición la EIS final durante un periodo de 30 días antes de que finalice el registro de decisión (Record of Decision, ROD). El ROD documentará la decisión de Recuperación sobre qué acciones deberán tomarse para cumplir el propósito y la necesidad del proyecto; y describir cualquier plan de mitigación o factor considerado al tomar la decisión final.

Para obtener información adicional, contacte a Theresa Olson, Jefa de la División de Conservación y Traspaso, Oficina de la Bahía y del Delta, Departamento de Recuperación a tolson@usbr.gov, o por teléfono al 916-414-2433 (TTY 800-877-8339).

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1 ## 23B.5 Display Boards – English

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RECLAMATION

Managing Water in the West

Draft Environmental Impact Statement

Coordinated Long-term Operation of Central Valley Project (CVP) and State Water Project (SWP)

Public Meeting

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

U.S. Department of the Interior
Bureau of Reclamation

Public Meeting Format

- Open House to answer questions on Draft Environmental Impact Statement (Draft EIS)
- Explore the Open House displays and talk with staff
- Brief presentation (will start 30 minutes after Open House begins)
- Provide comments for the record today either in writing by submitting a Comment Card or by meeting with the Court Reporter to record your verbal comments

RECLAMATION

Purpose of the Project

- To continue the operation of the Central Valley Project (CVP), in coordination with operation of the State Water Project (SWP), for the authorized purposes, in a manner that:
  - Is similar to historical operational parameters with certain modifications;
  - Is consistent with Federal Reclamation law; other Federal laws and regulations; Federal permits and licenses; and State of California water rights, permits, and licenses; and
  - Enables the Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) to satisfy their contractual obligations to the fullest extent possible.

RECLAMATION

Need for Continued Operations of the CVP and SWP

- **Continued operation of the CVP provides:**
  - River regulation; improvement of navigation; flood control; water supply for irrigation and domestic uses; fish and wildlife mitigation, protection, and restoration; fish and wildlife enhancement; and power generation.
- **Continued operation of the CVP and SWP provides:**
  - Water supply operations in accordance with the water rights and water quality requirements adopted by Federal and State agencies, including the State Water Resources Control Board.
  - Recreation benefits.

RECLAMATION

Need for the Project

- CVP and SWP are operated per Federal and State regulations, including the U.S. Fish and Wildlife Service (USFWS) 2008 Biological Opinion (BO) and the National Marine Fisheries Service (NMFS) 2009 BO, including the Reasonable and Prudent Alternatives (RPAs) to avoid jeopardizing continued existence of listed species and adversely modifying their critical habitat.
  - The District Court for the Eastern District of California ruled that Reclamation must conduct environmental analyses to determine whether operation of the CVP and SWP with the BOs (and RPAs) would cause significant adverse impacts to the environment.

CVP, SWP, and Other Major Water Facilities in California

RECLAMATION

Surface Water Resources

- Surface Water/Water Supply Resources (Chapter 5)
  - Changes in reservoir and river conditions
  - Changes in CVP and SWP water deliveries
- Surface Water Quality (Chapter 6)
  - Changes in temperature, salinity, methylmercury, selenium
- Geographic Focus of Analysis
  - CVP and SWP reservoirs and streams below the reservoirs
  - Delta
  - Areas that Use CVP & SWP Water
    - Central Valley
    - San Francisco Bay Area
    - Central Coast (San Luis Obispo & Santa Barbara Counties)
    - Southern California

RECLAMATION

Groundwater Resources

- Groundwater Resources and Quality (Chapter 7)
  - Changes in groundwater use and elevations
  - Potential for reduction in groundwater quality
- Geographic Focus of Analysis
  - Areas that Use CVP & SWP Water
    - Central Valley
    - San Francisco Bay Area
    - Central Coast (San Luis Obispo & Santa Barbara Counties)
    - Southern California

RECLAMATION

Aquatic Resources

- Fish and Aquatic Resources (Chapter 9)
  - Changes in habitat conditions for fish in CVP and SWP reservoirs
  - Changes in habitat conditions for fish in streams downstream of CVP and SWP reservoirs and the Delta
    - Salmonids (including Coho Salmon; winter-run, spring-run, fall-run, and late-fall run Chinook Salmon; and steelhead)
    - Green and White Sturgeon
    - Pacific Lamprey
    - Sacramento Splittail
    - Delta Smelt
    - Longfin Smelt
    - Striped Bass
    - American Shad
    - Hardhead

RECLAMATION

Wildlife and Botanical Resources

- Terrestrial Biological Resources (Chapter 10)
  - Changes in habitat conditions along rivers downstream of CVP and SWP reservoirs
  - Changes in habitat conditions along river and Delta floodplains
  - Changes in habitat conditions in the Yolo Bypass
  - Changes in Delta habitat due to salinity conditions

RECLAMATION

Socioeconomics

- Agricultural Resources (Chapter 12)
  - Changes in agricultural production and employment
- Socioeconomics (Chapter 19)
  - Changes in employment, economic productivity, and municipal/industrial water costs
- Environmental Justice (Chapter 21)
  - Potential disproportionate effects to minority and low-income populations (focused on air quality and mercury)
- Geographic Focus of Analysis
    - Central Valley
    - San Francisco Bay Area
    - Central Coast (San Luis Obispo & Santa Barbara Counties)
    - Southern California

RECLAMATION

How to Provide Comments on the Draft EIS

- Comments due by 5:00 pm September 29, 2015
  - At the Public Meeting
    - Fill out Comment Cards
    - Record verbal comments with the Court Reporter
  - U.S. Mail – Send comments to:
    - Ben Nelson, Natural Resources Specialist,
      Bureau of Reclamation, Bay-Delta Office,
      801 I Street, Suite 140, Sacramento, CA 95814-2536
  - Email – Send comments to:
    - bcnelson@usbr.gov
  - Fax – Send comments to:
    - (916) 414-2439

RECLAMATION

23B.6 Display Boards – Spanish

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RECLAMATION

Managing Water in the West

Borrador de la Declaración de impacto ambiental

Operación coordinada a largo plazo del Proyecto del Valle Central (CVP) y el Proyecto Hídrico Estatal (SWP)

Reunión con el público

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

U.S. Department of the Interior
Bureau of Reclamation

Estructura para la reunión con el público

- Sesión abierta para responder preguntas acerca del borrador de la Declaración de impacto ambiental (Environmental Impact Statement, EIS)
- Revise las exposiciones durante la sesión abierta y platique con el personal
- Presentación corta (dará inicio 30 minutos después de que empiece la sesión abierta)
- Proporcione hoy comentarios para el registro, ya sea por escrito al presentar una tarjeta de comentarios o al reunirse con el relator del tribunal para grabar sus comentarios orales

RECLAMATION

Propósito del proyecto

- Continuar con la operación del Proyecto del Valle Central (Central Valley Project, CVP) en coordinación con la operación del Proyecto Hídrico Estatal (State Water Project, SWP), para los propósitos autorizados, de forma que:
  - sea comparable con los parámetros de operación históricos con ciertas modificaciones;
  - sea congruente con la Ley Federal de Recuperación; otras leyes y regulaciones federales; permisos y licencias federales; y derechos, permisos y licencias de agua del estado de California; y
  - permita a la Departamento de Recuperación (Recuperación) y al Departamento de Recursos Hídricos de California (California Department of Water Resources, DWR) cumplir sus obligaciones contractuales en la mayor medida posible.

RECLAMATION

La necesidad de la operación continua del CVP y del SWP

- La operación continua del CVP proporciona:
  - Regulación fluvial; mejoramiento de la navegación; control de inundaciones; suministro de agua para irrigación y uso doméstico; mitigación, protección y restauración de pesca y vida silvestre; fortalecimiento de pesca y vida silvestre; y generación de energía
- La operación continua del CVP y del SWP proporciona:
  - Operaciones del suministro de agua de conformidad con los derechos del agua y los requisitos de la calidad del agua adoptados por las agencias federales y estatales, incluida la Comisión Estatal para el Control de los Recursos Hídricos
  - Beneficios de recreación

RECLAMATION

Necesidad del proyecto

- El CVP y el SWP se llevan a cabo de acuerdo con las normas federales y estatales, incluida la Opinión biológica (Biological Opinion, BO) de 2008 del Servicio de Pesca y Vida Silvestre de EE. UU. (U.S. Fish and Wildlife Service, USFWS), y la BO de 2009 del Servicio Nacional de Pesca Marina (National Marine Fisheries Service, NMFS), las BO incluyen Alternativas Razonables y Prudentes (Reasonable and Prudent Alternatives, RPAs) para evitar poner en peligro la continuación de la existencia de las especies en la lista en peligro de extinción y modificar su hábitat primordial
  - El Tribunal de Distrito para el Distrito del Este de California dictaminó que la Departamento de Recuperación debe llevar a cabo análisis ambientales para determinar si la operación del CVP y del SWP con las BO (y las RPA) causarían impactos negativos importantes al medio ambiente

RECLAMATION

El CVP, el SWP y otras instalaciones principales de agua en California

RECLAMATION

Recursos de aguas superficiales

- Agua superficial o recursos de suministro de agua (capítulo 5)
  - Cambios en las reservas y las condiciones de los ríos
  - Cambios en el suministro de agua del CVP y del SWP
- Calidad del agua superficial (capítulo 6)
  - Cambios en la temperatura, la salinidad, el metilmercurio y el selenio
- Enfoque geográfico del análisis
  - Reservas y corrientes debajo de las reservas del CVP y del SWP
  - Delta
  - Áreas que utilizan agua del CVP y del SWP
    - Valle Central
    - Área de la Bahía de San Francisco
    - Costa Central (condados de San Luis Obispo y de Santa Bárbara)
    - Sur de California

RECLAMATION

Recursos de agua subterránea

- Recursos de agua subterránea y calidad (capítulo 7)
  – Cambio en el uso de aguas subterráneas y elevaciones
  – Potencial de reducción de la calidad del agua subterránea
- Enfoque geográfico del análisis
  – Áreas que utilizan agua del CVP y del SWP
    - Valle Central
    - Área de la Bahía de San Francisco
    - Costa Central (condados de San Luis Obispo y de Santa Bárbara)
    - Sur de California

RECLAMATION

Recursos acuáticos

- Recursos de pesca y acuáticos (capítulo 9)
  - Cambios en las condiciones del hábitat para los peces en las reservas del CVP y del SWP
  - Cambios en las condiciones del hábitat para los peces en las corrientes descendientes de las reservas del CVP y del SWP y en el delta
    - salmónidos (incluidos el salmón plateado; el salmón rosado de las temporadas de invierno, primavera, otoño y finales de otoño; y la trucha arcoíris)
    - esturión verde y blanco
    - lamprea del Pacífico
    - splittail de Sacramento (Pogonichthys macrolepidotus)
    - eperlano del delta
    - eperlano de aleta larga
    - lubina rayada
    - sábalo americano
    - bagre

RECLAMATION

Recursos de vida silvestre y botánicos

- Recursos biológicos terrestres (capítulo 10)
  - Cambios en las condiciones del hábitat a lo largo de los ríos descendientes de las reservas del CVP y del SWP
  - Cambios en las condiciones del hábitat a lo largo de las llanuras aluviales de ríos y del delta
  - Cambios en las condiciones del hábitat en el desvío de Yolo
  - Cambios en las condiciones del hábitat a consecuencia de las condiciones de salinidad

RECLAMATION

Aspectos socioeconómicos

- Recursos agrícolas (capítulo 12)
  - Cambios en la producción y el empleo agrícola
- Aspectos socioeconómicos (capítulo 19)
  - Cambios en el empleo, la productividad económica y los costos del agua municipal o industrial
- Justicia ambiental (capítulo 21)
  - Efectos potenciales desproporcionados para las poblaciones minoritarias y de bajos ingresos (enfocados en la calidad del aire y en el mercurio)
- Enfoque geográfico del análisis
  - Valle Central
  - Área de la Bahía de San Francisco
  - Costa Central (condados de San Luis Obispo y de Santa Bárbara)
  - Sur de California

RECLAMATION

Cómo proporcionar comentarios sobre el borrador de la EIS

- Los comentarios deberán entregarse antes de las 5:00 p. m., el 29 de septiembre de 2015
  - En la reunión con el público
    - Llene las tarjetas de comentarios
    - Grabe sus comentarios orales con el relator del tribunal
  - Por correo postal de EE.UU., envíe sus comentarios a:
    - Ben Nelson, Natural Resources Specialist, Bureau of Reclamation, Bay-Delta Office, 801 I Street, Suite 140, Sacramento, CA 95814-2536
  - Por correo electrónico, envíe sus comentarios a:
    - bcnelson@usbr.gov
  - Por fax, envíe sus comentarios al:
    - (916) 414-2439

RECLAMATION

23B.7 Presentation – English

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RECLAMATION

Managing Water in the West

Draft Environmental Impact Statement for the Coordinated Long-term Operation of Central Valley Project (CVP) and State Water Project (SWP)

Public Meetings - September 2015

U.S. Department of the Interior
Bureau of Reclamation

Meeting Approach

- Opportunities to learn and discuss at subject matter stations
- Brief slide presentation on Draft Environmental Impact Statement (DEIS)
  - Background
  - Alternatives analyzed in the DEIS
  - Schedule
- Opportunities to provide input on the DEIS:
  - Written comment cards
  - Spoken comments to a court reporter onsite

2 RECLAMATION

If You have Questions about the DEIS

- Staff available before and after brief slide presentation for questions and discussions on DEIS topics:
  - Purpose and Need for the Project
  - Surface Water, Water Supplies, Water Quality, and Groundwater
  - Biological Resources
  - Socioeconomics

3

RECLAMATION

Guidelines for this Public Input Meeting

- Complete this brief slide presentation on time
- Direct questions or comments on the DEIS to the subject matter team
- Let speakers finish without interruption
- Respect the meeting approach

4

RECLAMATION

Overview of DEIS

- Background and Recent Court Decisions
- Study Area and Evaluation Period
- Range of Alternatives
- Opportunities to Provide Comments on DEIS

5

RECLAMATION

Background for the DEIS

2008

- Reclamation issued a Biological Assessment (BA) for the Long-Term Operations of the CVP and SWP
- U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (BO) with a Reasonable and Prudent Alternative (RPA) for the Delta Smelt and their critical habitat
- Reclamation initiated operations under the BO and the RPA

6

RECLAMATION

Background for the DEIS - continued

2009

- National Marine Fisheries Service (NMFS) issued a BO with a RPA for salmonids, green sturgeon, and killer whale and their critical habitats
- Reclamation initiated operations under the BO and the RPA
- The District Court for the Eastern District (District Court):
  - Remanded portions of the BOs back to USFWS and NMFS
  - Required Reclamation to complete a National Environmental Policy Act (NEPA) analysis to review impacts related to implementing the BOs

7

RECLAMATION

Results of the Delta Smelt Consolidated Cases

- United States Court of Appeals for the Ninth Circuit (Ninth Circuit)
  - Issued an opinion on March 13, 2014, to reverse the remanded USFWS BO District Court Opinion
  - Issued Mandate September 16, 2014
- District Court
  - Revised Final Order issued October 1, 2014
- U.S. Supreme Court
  - Two Petitions for Writ of Certiorari submitted on October 2 and 7, 2014
  - Denied the Writ on January 12, 2015

8

RECLAMATION

Results of the Salmonid Consolidated Cases

- Ninth Circuit
  - Issued an opinion on December 22, 2014, to reverse the remanded NMFS BO District Court Opinion
  - Judgment entered in favor of Federal Defendants and Defendant-Intervenors on all remaining claims
  - Mandate issued on February 17, 2015
- District Court
  - Revised Final Order issued May 5, 2015

9

RECLAMATION

Results of the Need for a NEPA Document

- Ninth Circuit
  - Did not change the District Court's mandate to complete a NEPA document to analyze potential effects related to implementation of the BOs
- District Court
  - Revised Final Order issued October 1, 2014
  - The District Court mandated that the Record of Decision (ROD) be completed by:
    - December 1, 2015 (per the Consolidated Delta Smelt Cases)
    - December 1, 2016 (per the Consolidated Salmonid Cases)

10

RECLAMATION

Purpose of the Action

- Continue the operation of the CVP, in coordination with the SWP, for the authorized purposes, in a manner that:
  - Is similar to historic operational parameters with certain modifications;
  - Is consistent with Federal Reclamation law; other Federal laws; Federal permits and licenses and; State of California water rights, permits, and licenses; and
  - Enables Reclamation and DWR to satisfy their contractual obligations to the fullest extent possible.

11

RECLAMATION

Evaluation Period and Study Area

- Evaluation Period
  - Year 2030
  - Climate change and sea level rise at Year 2030 for all alternatives
- Extent of Study Area
  - CVP and SWP service areas
  - Reservoirs in CVP and SWP service areas that store CVP and/or SWP water
  - Rivers downstream of CVP and SWP reservoirs

12

RECLAMATION

Range of Alternatives

- No Action Alternative (NAA)

  Continuation of existing policy and management direction for Year 2030

  CVP and SWP operations with full implementation of the RPA actions in the 2008 FWS BO and 2009 NMFS BO

- Second Basis of Comparison (SBC)

  CVP and SWP operations that would have occurred without implementation of the 2008 FWS and 2009 NMFS BOs

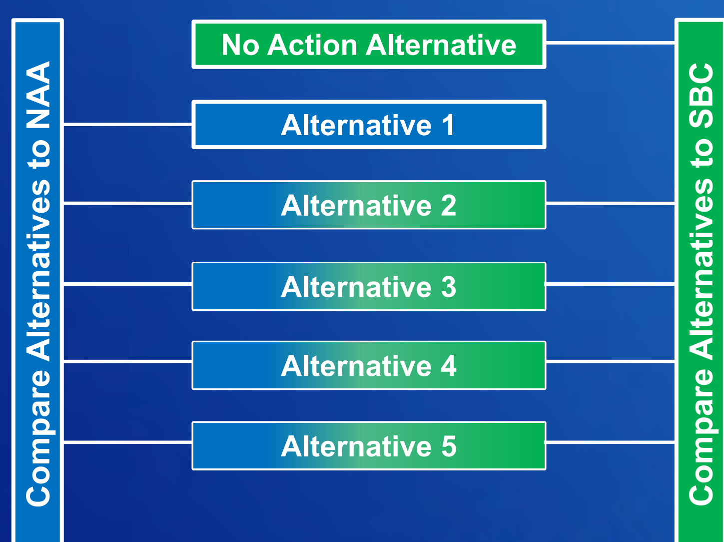
- Alternatives 1 – 5

  Range of alternatives described on subsequent slides

13

RECLAMATION

Environmental Consequences



14

RECLAMATION

Assumptions Included in NAA, SBC, and Alternatives 1 - 5

- Continued implementation of Central Valley Project Improvement Act Programs
- Red Bluff Pumping Plant
- Whiskeytown Lake temperature control devices
- Lower American River Flow Management Standard
- San Joaquin River Restoration Program
- Habitat restoration of up to:
  - 10,000 acres wetland habitat (Cache Slough/Suisun Marsh)
  - 17,000 to 20,000 acres floodplain habitat in Yolo Bypass

15

RECLAMATION

Alternative 1

- CVP and SWP Operations
  - Identical to SBC
- Non-Operational Actions
  - Identical to SBC

16

RECLAMATION

Alternative 2

- CVP and SWP Operations
  - Identical to NAA
- Non-Operational Actions
  - Does not include actions identified in the BOs that have not been fully defined at this time and could result in construction
    - Fish passage at Shasta, Folsom, and New Melones dams
    - Temperature management devices at Folsom Lake
    - Ecosystem restoration projects along the Stanislaus River
    - Improvements at Tracy and Skinner fish collection facilities

17

RECLAMATION

Alternative 3

- CVP and SWP Operations
  - Similar to SBC
  - Plus Old and Middle River Criteria (OMR) to reduce “reverse flows” in the central and southern Delta less stringent than under NAA
- Non-Operational Actions
  - Predation Control
    - Increase Black Bass and Striped Bass bag limits
    - Pikeminnow sport reward program
  - Trap and Haul Fish Passage
  - Trap at Head of Old River and barge to Chipps Island
  - Ocean Harvest Limits Revisions
    - Consistent with Viable Salmonid Population standards for natural origin Central Valley Chinook Salmon

18

RECLAMATION

Alternative 4

- CVP and SWP Operations
  - Identical to SBC
- Non-Operational Actions
  - Predation Control   same as Alternative 3
  - Trap and Haul Fish Passage – same as Alternative 3
  - Ocean Harvest Limits Revisions
    - Salmon harvest restrictions to reduce by-catch of winter-run and spring-run Chinook Salmon to less than 10 percent of age-3 cohort in all years

19

RECLAMATION

Alternative 5

- CVP and SWP Operations
  - Similar to NAA
  - Plus requirements for positive OMR Criteria in April and May (no reverse flow conditions)
  - Delta Cross Channel operations per pilot study
- Non-Operational Actions
  - Same as NAA

20

RECLAMATION

EIS Schedule

- Public Draft EIS Published — July 31, 2015
- Public Meetings
  - Sacramento — September 9, 2015
  - Red Bluff — September 10, 2015
  - Los Banos — September 15, 2015
  - Irvine — September 17, 2015
- End of DEIS Comment Period — September 29, 2015
- Final EIS Published — Late October 2015
- Record of Decision — December 1, 2015

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RECLAMATION

How to Comment on the DEIS

- At the Public Meeting
  - Submit a Comment Card at the Public Meeting
  - Meet with the Court Reporter to record your verbal comment
- U.S. Post Office Mail – Send comments to:
  - Ben Nelson, Natural Resources Specialist,
Bureau of Reclamation, Bay Delta Office,
801 I Street, Suite 140, Sacramento, CA 95814-2536
- Email – Send comments to:
  - bcnelson@usbr.gov
- Fax – Send comments to:
  - (916) 414-2439

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RECLAMATION

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23B.8 Presentation – Spanish

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RECLAMATION
Managing Water in the West

Borrador de la Declaración de Impacto Ambiental para la Operación coordinada a largo plazo del Proyecto del Valle Central de California (CVP) y el Proyecto Hídrico Estatal (SWP)

Juntas públicas - Septiembre de 2015

U.S. Department of the Interior
Bureau of Reclamation

Enfoque de la junta

- Oportunidades para aprender y dialogar en las estaciones de las materias
- Breve presentación de diapositivas del Borrador de la Declaración de Impacto Ambiental (Draft Environmental Impact Statement, DEIS)
  - Antecedentes
  - Alternativas analizadas en el DEIS
  - Calendario de eventos
- Oportunidades para dar su opinión con respecto al DEIS:
  - Tarjetas de comentarios por escrito
  - Comentarios orales a un relator del tribunal en el lugar

2 RECLAMATION

Si tiene preguntas sobre el DEIS

- El personal estará disponible antes y después de la presentación de diapositivas para preguntas y diálogos acerca de temas del DEIS:
  - El propósito y la necesidad del proyecto
  - Aguas superficiales, suministros de agua, calidad del agua y aguas subterráneas
  - Recursos biológicos
  - Aspectos socioeconómicos

3

RECLAMATION

Directrices para esta junta de opinión pública

- Complete esta breve presentación de diapositivas a tiempo.
- Dirija sus preguntas o comentarios acerca del DEIS al equipo de la materia.
- Permita que los presentadores hablen sin interrupciones.
- Respete el enfoque de la junta.

4

RECLAMATION

Resumen del DEIS

- Antecedentes y decisiones recientes del Tribunal
- Área de estudio y periodo de evaluación
- Rango de alternativas
- Oportunidades para proporcionar comentarios acerca del DEIS

5

RECLAMATION

Antecedentes para el DEIS

2008

- El Departamento de Recuperación emitió una Evaluación biológica (Biological Assessment, BA) para las operaciones a largo plazo del Proyecto del Valle Central de California (Central Valley Project, CVP) y el Proyecto Hídrico Estatal (State Water Project, SWP).
- El Servicio de Pesca y Vida Silvestre de EE. UU. (U.S. Fish and Wildlife Service, USFWS) emitió una Opinión biológica (Biological Opinion, BO) con una Alternativa razonable y prudente (Reasonable and Prudent Alternative, RPA) para el eperlano del delta y su hábitat crítico.
- El Departamento de Recuperación inició operaciones en el marco de la BO y la RPA.

6

RECLAMATION

Antecedentes para el DEIS, continuación
2009

- El Servicio Nacional de Pesca Marina (National Marine Fisheries Service, NMFS) publicó una BO con una RPA para salmónidos, esturión verde y la orca y sus hábitats críticos.
- El Departamento de Recuperación inició operaciones en el marco de la BO y la RPA.
- El Tribunal de Distrito para el Distrito del Este (Tribunal de Distrito):
  - Devolvió partes de las BO consignados al USFWS y al NMFS.
  - Exigió al Departamento de Recuperación que complete un análisis de la Ley Nacional de Política Ambiental (National Environmental Policy Act, NEPA) para revisar los impactos relacionados con la implementación de las BO.

7 RECLAMATION

Resultados de los casos consolidados sobre el eperlano del delta

- Tribunal de Apelaciones del Noveno Circuito de Estados Unidos (Noveno Circuito)
  - Emitió una opinión el 13 de marzo de 2014, para revertir la opinión consignada del Tribunal de Distrito sobre la BO del USFWS.
  - Emitió un mandato el 16 de septiembre de 2014.
- Tribunal de Distrito
  - Revisó su auto final emitido el 1.° de octubre de 2014.
- Tribunal Supremo de EE. UU.
  - Se le enviaron dos peticiones para un recurso de certiorari el 2 y el 7 de octubre de 2014.
  - El recurso se denegó el 12 de enero de 2015.

8 RECLAMATION

Resultados de los casos consolidados sobre los salmónidos

- Noveno Circuito

  Emitió una opinión el 22 de diciembre de 2014, para revertir la opinión consignada del Tribunal de Distrito sobre la BO del NMFS.

  El fallo se declaró a favor de los acusados federales y los demandados-interventores en todas las reclamaciones restantes.

  El mandato se emitió el 17 de febrero de 2015.

- Tribunal de Distrito

  Revisó su auto final emitido el 5 de mayo de 2015.

9

RECLAMATION

Resultados de la necesidad de un documento para cumplir la NEPA

- Noveno Circuito

  No cambió el mandato del Tribunal de Distrito para completar un documento para cumplir la NEPA con el fin de analizar los posibles efectos relacionados con la implementación de las BO.

- Tribunal de Distrito

  Revisó su auto final emitido el 1.° de octubre de 2014.

  El Tribunal de Distrito ordenó que el registro de decisión (Record of Decision, ROD) se complete para el:

  - 1.º de diciembre de 2015 (según los casos consolidados del eperlano del delta)
  - 1.º de diciembre de 2016 (según los casos consolidados de salmónidos)

10

RECLAMATION

Propósito de la acción

- Continuar con la operación del CVP, en coordinación con el SWP, para los propósitos autorizados, de forma que:
  - sea comparable con los parámetros históricos de operación con ciertas modificaciones;
  - sea consistente con la Ley Federal de Recuperación; con otras leyes federales; permisos y licencias federales; permisos y licencias de aguas del estado de California; y
  - permita al Departamento de Recuperación y al DWR satisfacer sus obligaciones contractuales al mayor grado posible.

11

RECLAMATION

Área de estudio y periodo de evaluación

- Periodo de evaluación
  - Año 2030
  - Cambio climático y aumento del nivel del mar en el año 2030 para todas las alternativas
- Alcance del área de estudio
  - Áreas de servicio del CVP y el SWP
  - Reservas en áreas de servicio del CVP y SWP que almacenan agua del CVP o SWP
  - Los ríos aguas abajo de las reservas del CVP y SWP

12

RECLAMATION

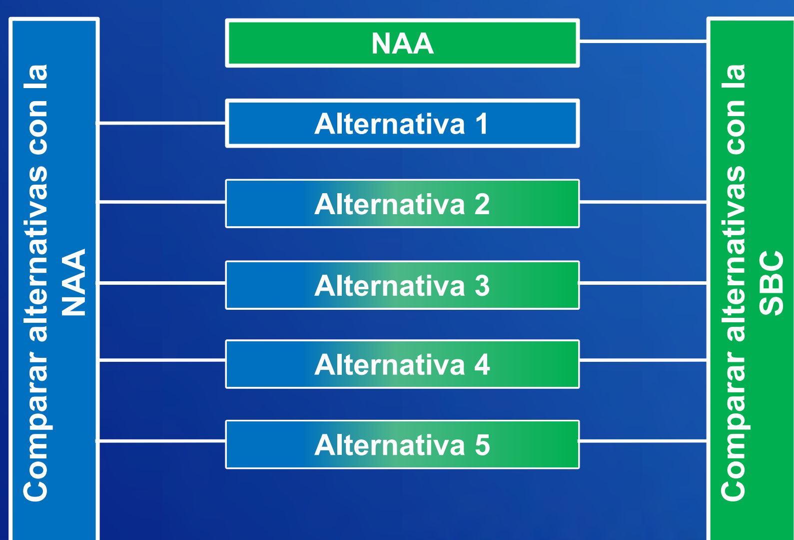
Rango de alternativas

- Alternativa de ausencia de acción (No Action Alternative, NAA)
  - Continuación de la política y la dirección de la gestión actual para el año 2030
  - Operaciones del CVP y el SWP con implementación completa de las acciones RPA en la BO de 2008 del Servicio de Pesca y Vida Silvestre (Fish and Wildlife Service, FWS) y la BO de 2009 del NMFS
- Segunda base de comparación (Second Basis of Comparison, SBC)
  - Operaciones del CVP y el SWP que hubieran ocurrido sin implementación de las BO de 2008 del FWS y de 2009 del NMFS
- Alternativas 1 a 5
  - Rango de alternativas descritas en diapositivas posteriores

13

RECLAMATION

Consecuencias ambientales



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RECLAMATION

Supuestos incluidos en la NAA, la SBC y Alternativas 1 a 5

- Implementación continua de programas de la Ley de Mejora de el Proyecto del Valle Central
- Planta de bombeo Red Bluff
- Dispositivos de control de la temperatura del Lago Whiskeytown
- Norma de Administración del Caudal del Río American
- Programa de Restauración del Río San Joaquin
- Restauración del hábitat de hasta:
  - 10,000 acres de hábitat de humedales (Cache Slough/Suisun Marsh)
  - 17,000 a 20,000 acres de hábitat de terreno inundable en Yolo Bypass

Alternativa 1

- Operaciones del CVP y SWP
  - Idénticas a la SBC
- Acciones no operativas
  - Idénticas a la SBC

Alternativa 2

- Operaciones del CVP y SWP

  Idénticas a la NAA

- Acciones no operativas

  Sin incluir acciones identificadas en los BO que no hayan sido totalmente definidas en este momento y que podrían dar lugar a la construcción

  - Paso de peces en las presas de Shasta, Folsom y New Melones
  - Dispositivos de manejo de temperatura en el lago Folsom
  - Proyectos de restauración de ecosistemas en el río Stanislaus
  - Mejoras en las instalaciones de recolección de peces en Tracy y en Skinner

17

RECLAMATION

Alternativa 3

- Operaciones del CVP y SWP

  Similar a la SBC

  Además de criterios de los ríos Old y Middle (Old and Middle River, OMR) para reducir los "flujos inversos" en el delta central y del sur: menos estrictos que bajo la NAA

- Acciones no operativas

  Control de depredación

  - Aumentar los límites de pesca de lobina negra y lubina rayada
  - Programa de recompensa para pesca deportiva de carpa del Colorado

  Pasaje de peces por medio de captura y traslado

  Captura donde inicia el río Old y barcaza a la isla Chipps

  Revisión de los límites de captura en el océano

  - Conformidad con los estándares de poblaciones viables de salmónidos para salmón rosado de origen natural del Valle Central

18

RECLAMATION

Alternativa 4

- Operaciones del CVP y SWP
  - Idénticas a la SBC
- Acciones no operativas
  - Control de depredación: igual a la Alternativa 3
  - Pasaje de peces por medio de captura y traslado: igual a la Alternativa 3
  - Revisión de los límites de captura en el océano
    - Restricciones de captura de salmón para reducir la pesca durante la migración de invierno y de verano del salmón rosado a menos del 10 por ciento del grupo de edad de 3 años, cada año

19

RECLAMATION

Alternativa 5

- Operaciones del CVP y SWP
  - Similar a la NAA
  - Además de los requisitos para los Criterios OMR positivos en abril y mayo (no hay condiciones de flujo inverso)
  - Operaciones entre los canales del delta por estudio piloto
- Acciones no operativas
  - Igual a la NAA

20

RECLAMATION

Calendario de eventos de la EIS

- Borrador público de la EIS publicado el 31 de julio de 2015
- Juntas públicas
  - Sacramento 9 de septiembre de 2015
  - Red Bluff 10 de septiembre de 2015
  - Los Banos 15 de septiembre de 2015
  - Irvine 17 de septiembre de 2015
- Fin de la fecha de comentarios del DEIS 29 de septiembre de 2015
- La EIS final se publicará a finales de octubre de 2015
- Registro de decisión 1.º de diciembre de 2015

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RECLAMATION

Cómo hacer comentarios acerca del DEIS

- En la junta pública

  Entregue una tarjeta de comentarios en la junta pública

  Reúnase con el relator del tribunal para grabar sus comentarios orales
- Correo postal de EE. UU. - Envíe sus comentarios a:

  Ben Nelson, Natural Resources Specialist,
  Bureau of Reclamation, Bay Delta Office,
  801 I Street, Suite 140, Sacramento, CA 95814-2536
- Correo electrónico - Envíe sus comentarios a:

  bcnelson@usbr.gov
- Fax - Envíe sus comentarios a:

  (916) 414-2439

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RECLAMATION

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23B.9 Sign-In Sheets from Public Meetings

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RECLAMATION
Managing Water in the West

Public Meeting Sign In Sheet

Draft EIS for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Signing in is not required but allows Reclamation to provide you with important updates in the future.

Name	Organization	Address	E-mail
Michelle Morrow	DWR	1416 9th St	mmmorrow@water.ca.gov
MIKE FINNEGAN	w/ PCWA	11543 Big Falls Way Gold River	michael.r.fingn@gmail.com
Lee Bergfeld	MBK Engineers	455 University Ave Suite 100 Sacramento	bergfeld@mbkengineers.com
ANTHONY NAVASERO	DELTA STEWARDSHIP COUNCIL	980 9TH ST SAC, CA	ANTHONY.NAVASERO@DELTACOUNCIL.CA.GOV

RECLAMATION
Managing Water in the West

Public Meeting Sign In Sheet

Draft EIS for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Signing in is not required but allows Reclamation to provide you with important updates in the future.

Name	Organization	Address	E-mail
MAURY KRUTA	NCPA	651 CIRBY ROSEVILLE	MAURYKRU@GMAIL.COM
Kevan Samsam	Delta Stewardship Council	980 Ninth St #1500 95814	Ksamsam@Deltacouncil.ca.gov
Robin McGinnis	CA Dept of Water Resources	1416 9th St Rm1104 Sac CA 95814	robin.mcginnis@water.ca.gov
Krystal Acierto	CDFW	830 S St.	Krystal.Acierto@wildlife.ca.gov
Duane Linander	CDFW	830 S St.	Duane.Linander@wildlife.ca.gov

RECLAMATION
Managing Water in the West

Public Meeting Sign In Sheet

Draft EIS for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

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Name	Organization	Address	E-mail
Justin P Day	City of Redding	777 Cypress Ave Redding, CA 96002	jday@reupower.com
Keith Marine	NSR	5000 Bechelli Ln. Redding, CA	marine@nsrnet.com
HAROLD JONES	SHASTA LAKE BUSINESS OWNER	PO BOX 1768 LAKEHEAD, CA 96051	harold6shastacabins.com
BOB & BARBARA HENNIGAN		16400 JULIE LANE RED BLUFF, CA	BARBHNIGN @ AOL
* 2 others	attended who didn't sign in.		

RECLAMATION
Managing Water in the West

Public Meeting Sign In Sheet

Draft EIS for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Signing in is not required but allows Reclamation to provide you with important updates in the future.

Name	Organization	Address	E-mail
James Brobeck	AquAlliance	Chico CA	jimb@aqualliance.net
Nora Todenhagen	AquAlliance	Chico	NTODENHAGEN@gmail.com

RECLAMATION
Managing Water in the West

Public Meeting Sign In Sheet

Draft EIS for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Signing in is not required but allows Reclamation to provide you with important updates in the future.

Name	Organization	Address	E-mail
Chris Austin	Maven's Notebook		chrisellyn@earthlink.net

Congressman Jim Costa
16th District, California
www.costa.house.gov

MATT WAINWRIGHT
District Representative

2222 M Street, Suite 305
Merced, CA 95340
matt.wainwright@mail.house.gov

Phone: (209) 384-1620
Fax: (209) 384-1629

RECLAMATION
Managing Water in the West

Public Meeting Sign In Sheet

Draft EIS for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Signing in is not required but allows Reclamation to provide you with important updates in the future.

Name	Organization	Address	E-mail
Nicolas Cardella	Peltzer & Richardson Law Corp.		NCARDELLA@PRLAWCORP.com
Cathy Weber	League of Women Voters	PO Box 130 Snelling, CA 95369	cweber130@gmail.com
Vicki Jones	Merced County Environ. Health	260 E. 15th St., Merced, CA 95341	vjones@co.merced.ca.us
Ara Azhderian	San Luis & Delta-Mendota Water Authority	PO Box 2142 Los Banos, CA 93635	ara.azhderian@sldmwa.org
John Bean	Grassland Water Dist Consult.	200 W. Willmott Los Banos, CA	
Matt Wainwright	Rep. Jim Costa (CA-16)	2222 M St, Suite 305 Merced, CA 95340	matt.wainwright@mail.house.gov
Joe Del Bosque	Calif Water Commission		joe@delbosquefarms.com

RECLAMATION

Managing Water in the West

Public Meeting Sign In Sheet

Draft EIS for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Signing in is not required but allows Reclamation to provide you with important updates in the future.

Name	Organization	Address	E-mail
Paul A. Marshall	DWR	1416 9th Street, Sacto	Paul.Marshall@water.ca.gov

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23B.10 Transcript of Verbal Comments from Public Meetings

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Public Meetings

Draft Environmental Impact Statement

for the Coordinated Long-Term Operation

of the Central Valley Project

and State Water Project

Thursday, September 10, 2015

Red Bluff Community Center

1500 S. Jackson St

Red Bluff, CA 96080

6:00 P.M.

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Reported By: Priscilla Steele, CSR No. 14052

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PUBLIC COMMENT SESSION

JAMES BROBECK: I'm a water policy analyst for Aqualliance; one word with one A in the middle. It's an organization.

My first comment is that the comment period needs to be extended. This is a voluminous document, and it was not distributed in a timely manner. I've been able to review some of it online, but online is very un-user-friendly as far as searching because it comes in so many segments. And it took over a week to receive one of these CDs in the mail for the entire project. I'm just getting one right now for the first time, leaving me two weeks to review this and compose legitimate comments. So I am asking the Bureau to extend the comment period another 30 days and to ask the Court for flexibility in issuing the FEIS and the record of decision, that the artificial deadline for the ROD makes it impossible for the public to fully analyze the alternatives and to compose valid comments. Would like to see a 30-day, if not a 60-day extension.

I was very concerned that the presentation tonight gave the purpose of the action as what appeared to be maintaining the status quo on water deliveries, in contradiction to the hydrologic reality of the system.

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The presentation disfavored reasonable reductions that would have perhaps protected the fishery, in favor of meeting so-called obligations to deliver water. I say "so-called" because these are not obligations. The Bureau is required to balance the public trust with the desires of the contract of those receiving the water. And the operations of the water projects have been in favor of the contractors, to the disadvantage of the public trust as clearly evidenced by the destruction of the delta smelt, the destruction of the salmon in the Sacramento River.

I'm outraged that last year's operations wiped out the winter and spring salmon before they spawned. And it appears that mismanagement is going to replicate the destruction of this year's salmon population, leading to a probable extinction of this species.

I'm amazed that Alternative 1 and 4 are being presented, the alternatives the contractors sent because they clearly violate the court orders to protect the public trust. I think that this process is invalidated by the failure of the Department of Water Resources to create a CEQA equivalent document. There is no CEQA equivalent document for this project. There needs to be because the State Water Project is integral. This is the coordinated SDWP, State Department of Water Resources. And the CVP is the federal part. So here we are having the feds come up

with a draft document, but there is no document to cover the state side of it. There needs to be a sequel equivalent analysis.

I'm upset that the Bureau's presentation tonight obfuscated the fact that the lawsuits they cited were lawsuits that were being presented by state water contractors. That obfuscation is unnecessary. It's important to know who is pushing this process. And it's not the public. It's a very small portion of the California population. The state water contractors and settlement contractors were the ones pushing to eliminate the BO and the RPA. The Central Valley Hydrologic model ends in 2003, omitting the most current 12 years. The model is therefore completely inadequate, and any conclusions from the model are as well.

NORA TODENHAGEN: My concern with the project and the alternatives is that they are based on what is, really, incomplete data. We don't have a true analysis of the water coming into the systems if we assume continuation of the streams and tributaries, which have been drained due to groundwater extraction.

Also, the model on which these decisions or alternatives are based dates only to 2003. So that all of the data information on groundwater and surface water interactions from 2003 to the present has not been used in

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creating these proposals.

JAMES BROBECK: Aqualliance is very concerned that the cumulative impacts to the aquifer system resulting from integrating the groundwater into the state water supply through groundwater substitution water transfers. And continued expansion of groundwater-dependent irrigated agriculture is not being revealed or analyzed. The inevitable de-watering of tributaries and extirpation of groundwater-dependent ecosystems, such as Valley Oak Groves, needs to be revealed and analyzed. For the Bureau to analyze only impacts associated with their demand on the groundwater to facilitate water deliveries throughout the state is unacceptable, if not illegal.

(Whereupon, the public comment session concluded at 7:45 p.m.)

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REPORTER'S CERTIFICATE

STATE OF CALIFORNIA)
) ss
COUNTY OF SACRAMENTO)

I, PRISCILLA STEELE, a Certified Shorthand Reporter, licensed by the State of California and empowered to administer oaths and affirmations pursuant to Section 2093 (b) of the Code of Civil Procedure, do hereby certify:

The said proceedings were recorded stenographically by me and were thereafter transcribed into typewriting;

That the foregoing transcript is a true record of the proceedings which then and there took place;

That I am a disinterested person to said action.

IN WITNESS WHEREOF, I have subscribed my name on September 16, 2015.

PRISCILLA STEELE
Certified Shorthand Reporter No. 14052

♀

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PRISCILLA STEELE
Certified Shorthand Reporter No. 14052

Northern California Court Reporters
Certified Deposition Reporters

Expedite	Hold	Appearance

Job date: 9/10/15 Job #:

Reporter: Priscilla Steele

Ordering counsel: Reclamation Bureau (Christine Kohn)

Opposing counsel:

Location: 1500 S. Jackson St, Red Bluff, Ca 96080 Venue: Red Bluff Community Center

Caption: Public Meetings Draft Environmental impact Statement Case #: Public Hearing

Witness	Pages	Witness	Pages
1.	6	4.	
2.		5.	
3.		6.	

Per diem billed to: Christine Kohn (hours) @ $

Copies Bill/Send to Page rate $6.50 ASCII

Exhibits

Special comments: $300 per diem (half DAY), 277 miles @ $0.55/mile, 6 pages @ $6.50/page

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Public Meetings
Draft Environmental Impact Statement
for the Coordinated Long-Term Operation
of the Central Valley Project
and State Water Project

Tuesday, September 15, 2015
Los Banos Community Center
645 7th Street
Los Banos, CA 93635
6:00 P.M.

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Reported By: Priscilla Steele, CSR No. 14052

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PUBLIC COMMENT SESSION

(No comments made.)

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) ss
COUNTY OF SACRAMENTO)

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IN WITNESS WHEREOF, I have subscribed my name on September 16, 2015.

P. Steele

PRISCILLA STEELE
Certified Shorthand Reporter No. 14052

Northern California Court Reporters

Job Date: 9/15/15 Job#: ____________

Reporter: Priscilla Steele

Ordering Counsel: Bureau of Reclamation (CHRISTINE KOHN)

Location: 645 7th St, Los Banos, Ca 93635 Venue: LOS BANOS Community Center

Caption: Public Meetings Draft Environmental impact Case# Public Meeting

Pages
3

Per diem billed to: Christine Kohn

Page rate
$6.50

Special comments: $300 perdiem (Half day), 226 miles @ $0.55/mile, 3 pages @ $6.50/page

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