

**Appendix 11J Through-Delta Survival and  
Delta Rearing Habitat of  
Juvenile Chinook Salmon**

# Appendix 11J Through-Delta Survival and Delta Rearing Habitat of Juvenile Chinook Salmon

## 11J.1 Introduction

This appendix presents the methods and results of the through-Sacramento–San Joaquin Delta (Delta) survival analysis and Delta rearing habitat of juvenile Chinook salmon (*Oncorhynchus tshawytscha*).

## 11J.2 Through-Delta Survival of Juvenile Chinook Salmon

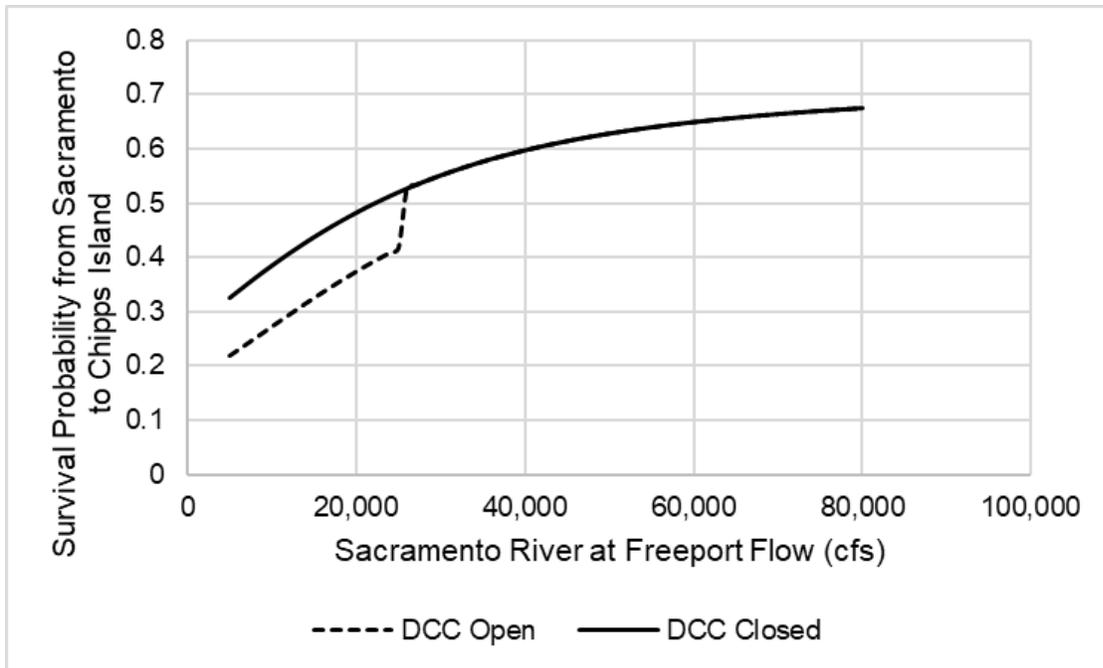
The through-Delta survival analysis of juvenile salmonids was based on the model of Perry et al. (2018). The analysis was conducted through a spreadsheet implementation of the model that was provided by Perry (pers. comm.) which reproduces the mean response of the STARS (Survival, Travel time, and Routing Simulation) model estimating through-Delta survival, travel time, and routing of juvenile Chinook salmon as a function of Sacramento River flow at Freeport (Perry et al. 2019).

### 11J.2.1. Methods

The original Excel file <North Delta Routing Management Tool v2.1.xlsx> (Perry pers. comm.) was adapted to make through-Delta survival calculations for the No Action Alternative (NAA)<sup>1</sup> and Alternatives 1, 2, and 3 CALSIM modeling outputs for the Sacramento River at Freeport. A lookup table of through-Delta survival in 1,000-cubic-feet-per-second increments was calculated (plotted in Figure 11J-1), with estimates of through-Delta survival for each month under each alternative being calculated based on the CALSIM modeling applied to the lookup table (with interpolation as necessary) for the months of September through June.

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<sup>1</sup> The term *NAA*, which is identical to the No Project Alternative, is used throughout Chapter 11, *Aquatic Biological Resources*, and associated aquatic resources appendices in the presentation of modeled results and represents no material difference from the No Project Alternative as discussed in Chapter 3, *Environmental Analysis*.



Notes: DCC = Delta Cross Channel; cfs = cubic feet per second.

**Figure 11J-1. Through-Delta Survival Function Based on Perry et al. (2018).**

The analysis was undertaken with the assumption that no Georgiana Slough Migratory Barrier was in place, and included a sensitivity analysis that assumed the presence of the barrier with a 50% reduction in entry into Georgiana Slough based on the approximate lower reduction<sup>2</sup> observed during 2 years of effectiveness studies completed by California Department of Water Resources (2012, 2015). The barrier was assumed to be present during the September–June period included in this analysis, and reduced entry into Georgiana Slough by 50% relative to what otherwise would have occurred (e.g., if there was 0.20 [20%] probability of a juvenile Chinook salmon entering Georgiana Slough without the barrier, this would be changed to 0.10 [10%] probability with the barrier).

In addition to overall through-Delta survival (Figure 11J-1), an analysis of survival from entry into the Delta Cross Channel (DCC) to San Joaquin River via Mokelumne River (see Perry et al. 2018:Reach 6 in Figure 6) was conducted to provide perspective on potential effects on juvenile fall-run Chinook salmon emigrating from the Mokelumne River (which receives water from the Sacramento River when the DCC is open). This analysis was limited to the month of June because the DCC is closed in the earlier spring months of the juvenile Chinook salmon emigration period from the Mokelumne River; there was no evidence of a flow-survival relationship in the interior Delta downstream of the Mokelumne River (Perry et al. 2018:Figure 4), so this reach was not considered in the analysis.

<sup>2</sup> The higher reduction (2011) was ~67%.

### 11J.2.2. Results

The results of the analyses are discussed in Chapter 11, *Aquatic Biological Resources*. Table 11J-1 provides the results of the sensitivity analysis including 50% reduction into Georgiana Slough assumed to occur as a result of the Georgiana Slough Migratory Barrier implementation. Table 11J-2 provides the results of the analysis of survival from DCC to San Joaquin River via Mokelumne River.

**Table 11J-1. Probability of Juvenile Chinook Salmon Through-Delta Survival, Averaged by Month and Water Year Type, Based on Perry et al. (2018), Including 50% Reduction in Georgiana Slough Entry Assumed for Georgiana Slough Migratory Barrier.**

Month	Water Year Type	NAA	Alt 1A	Alt 1B	Alt 2	Alt 3
Sep	Wet	0.42	0.42 (0%)	0.42 (0%)	0.42 (0%)	0.42 (0%)
Sep	Above Normal	0.42	0.42 (0%)	0.42 (0%)	0.42 (0%)	0.42 (0%)
Sep	Below Normal	0.32	0.32 (1%)	0.32 (1%)	0.32 (1%)	0.32 (1%)
Sep	Dry	0.29	0.30 (4%)	0.30 (4%)	0.30 (4%)	0.30 (3%)
Sep	Critically Dry	0.33	0.34 (3%)	0.34 (3%)	0.34 (3%)	0.33 (1%)
Oct	Wet	0.41	0.41 (0%)	0.41 (0%)	0.41 (0%)	0.41 (0%)
Oct	Above Normal	0.37	0.37 (0%)	0.37 (1%)	0.37 (0%)	0.37 (2%)
Oct	Below Normal	0.32	0.33 (1%)	0.33 (1%)	0.33 (1%)	0.35 (8%)
Oct	Dry	0.31	0.33 (7%)	0.33 (7%)	0.32 (5%)	0.32 (3%)
Oct	Critically Dry	0.27	0.27 (1%)	0.27 (1%)	0.27 (1%)	0.27 (1%)
Nov	Wet	0.44	0.44 (0%)	0.44 (0%)	0.44 (0%)	0.44 (0%)
Nov	Above Normal	0.41	0.41 (0%)	0.41 (0%)	0.41 (0%)	0.42 (2%)
Nov	Below Normal	0.42	0.42 (1%)	0.42 (1%)	0.42 (1%)	0.43 (3%)
Nov	Dry	0.38	0.39 (2%)	0.39 (2%)	0.39 (2%)	0.38 (1%)
Nov	Critically Dry	0.32	0.32 (1%)	0.32 (1%)	0.32 (1%)	0.32 (1%)
Dec	Wet	0.51	0.51 (0%)	0.51 (0%)	0.51 (0%)	0.51 (0%)
Dec	Above Normal	0.51	0.51 (-1%)	0.51 (0%)	0.51 (-1%)	0.51 (0%)
Dec	Below Normal	0.51	0.51 (-1%)	0.51 (0%)	0.51 (-1%)	0.51 (0%)
Dec	Dry	0.48	0.48 (-1%)	0.48 (0%)	0.48 (-1%)	0.48 (0%)
Dec	Critically Dry	0.42	0.42 (0%)	0.42 (0%)	0.42 (0%)	0.42 (1%)
Jan	Wet	0.63	0.63 (0%)	0.63 (0%)	0.63 (0%)	0.63 (0%)
Jan	Above Normal	0.59	0.58 (-1%)	0.58 (-1%)	0.58 (-1%)	0.59 (-1%)
Jan	Below Normal	0.53	0.53 (0%)	0.53 (-1%)	0.53 (-1%)	0.53 (-1%)
Jan	Dry	0.48	0.48 (0%)	0.48 (0%)	0.48 (0%)	0.48 (0%)
Jan	Critically Dry	0.46	0.46 (0%)	0.46 (0%)	0.46 (0%)	0.46 (0%)
Feb	Wet	0.66	0.66 (0%)	0.66 (0%)	0.66 (0%)	0.66 (0%)
Feb	Above Normal	0.63	0.62 (-1%)	0.62 (-1%)	0.62 (-1%)	0.62 (-1%)
Feb	Below Normal	0.58	0.58 (0%)	0.58 (0%)	0.58 (0%)	0.58 (0%)

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Month	Water Year Type	NAA	Alt 1A	Alt 1B	Alt 2	Alt 3
Feb	Dry	0.53	0.53 (0%)	0.53 (0%)	0.53 (0%)	0.53 (0%)
Feb	Critically Dry	0.49	0.49 (0%)	0.49 (0%)	0.49 (0%)	0.49 (0%)
Mar	Wet	0.64	0.63 (0%)	0.63 (0%)	0.63 (0%)	0.63 (0%)
Mar	Above Normal	0.62	0.62 (-1%)	0.62 (-1%)	0.62 (-1%)	0.62 (-1%)
Mar	Below Normal	0.53	0.53 (-1%)	0.53 (-1%)	0.53 (-1%)	0.53 (-1%)
Mar	Dry	0.51	0.51 (-1%)	0.51 (-1%)	0.51 (-1%)	0.51 (-1%)
Mar	Critically Dry	0.46	0.46 (0%)	0.46 (0%)	0.46 (0%)	0.46 (0%)
Apr	Wet	0.61	0.60 (0%)	0.60 (0%)	0.60 (0%)	0.60 (0%)
Apr	Above Normal	0.56	0.56 (0%)	0.56 (0%)	0.56 (0%)	0.56 (0%)
Apr	Below Normal	0.51	0.51 (0%)	0.51 (0%)	0.51 (0%)	0.51 (0%)
Apr	Dry	0.47	0.47 (0%)	0.47 (0%)	0.47 (0%)	0.47 (0%)
Apr	Critically Dry	0.45	0.45 (0%)	0.45 (0%)	0.45 (0%)	0.45 (0%)
May	Wet	0.58	0.58 (0%)	0.58 (0%)	0.58 (0%)	0.58 (0%)
May	Above Normal	0.53	0.53 (0%)	0.53 (0%)	0.53 (0%)	0.53 (0%)
May	Below Normal	0.49	0.49 (0%)	0.49 (0%)	0.49 (0%)	0.49 (0%)
May	Dry	0.45	0.45 (0%)	0.45 (0%)	0.45 (0%)	0.45 (0%)
May	Critically Dry	0.42	0.42 (0%)	0.42 (0%)	0.42 (0%)	0.42 (0%)
Jun	Wet	0.46	0.46 (0%)	0.46 (0%)	0.46 (0%)	0.46 (0%)
Jun	Above Normal	0.39	0.39 (0%)	0.39 (0%)	0.39 (0%)	0.39 (0%)
Jun	Below Normal	0.36	0.36 (0%)	0.36 (0%)	0.36 (0%)	0.36 (0%)
Jun	Dry	0.36	0.36 (0%)	0.36 (0%)	0.36 (0%)	0.36 (0%)
Jun	Critically Dry	0.32	0.32 (0%)	0.32 (0%)	0.32 (0%)	0.32 (0%)

Note: Percentage values in parentheses indicate differences of alternatives compared to NAA.

**Table 11J-2. June Probability of Juvenile Chinook Salmon Survival from Delta Cross Channel to San Joaquin River via Mokelumne River, Averaged by Water Year Type, Based on Perry et al. (2018).**

Water Year Type	NAA	Alt 1A	Alt 1B	Alt 2	Alt 3
Wet	0.27	0.27 (0%)	0.27 (0%)	0.27 (0%)	0.27 (0%)
Above Normal	0.31	0.31 (0%)	0.31 (0%)	0.31 (0%)	0.31 (0%)
Below Normal	0.38	0.38 (0%)	0.38 (0%)	0.38 (0%)	0.38 (0%)
Dry	0.37	0.37 (0%)	0.37 (0%)	0.37 (0%)	0.37 (0%)
Critically Dry	0.34	0.34 (0%)	0.34 (0%)	0.34 (0%)	0.34 (0%)

Note: Percentage values in parentheses indicate differences of alternatives compared to NAA.

### 11J.3 Delta Rearing Habitat of Juvenile Chinook Salmon

Channel margin habitat in the Delta, and in much of the Sacramento and San Joaquin Rivers in general, has been considerably reduced in relation to historical extent because of the construction of levees and the armoring of their banks with riprap (Williams 2006). These practices have reduced the extent of high-value rearing or holding habitat for Chinook salmon juveniles. Whereas previous riverbank protection of levees focused on solely riprap installation, more recent protection incorporates riparian and wetland benches, as well as other habitat features, to restore habitat function (H. T. Harvey & Associates and PRBO Conservation Science 2010; Hellmair et al. 2018). The riparian and wetland benches are shallow, restored areas along the channel margins that have relatively gentle slopes (e.g., 10:1 instead of the customary 3:1; Casas et al. 2012) and are designed to be wetted or flooded during certain parts of the year to provide habitat for listed species of fish, including juvenile Chinook salmon, and non-special-status species. Wetland benches are at lower elevations where more frequent wetting and inundation may be expected, and riparian benches occupy higher portions of the slope where inundation is restricted to high-flow events. These benches are planted and often secured with riprap or other materials.

Several levee improvement projects in the north Delta have been implemented and included the restoration of riparian and wetland benches. The restored benches were intended to be inundated under specific flows during certain months to provide suitable habitat for listed species of fish; the total length is approximately 47,000 linear feet (ft) (~8.9 miles)<sup>3</sup>. Restored benches in the north Delta could potentially be affected by the water operations of the Project because of changes in water level; for example, less water entering the Delta because of Project diversions upstream of the Delta could result in riparian benches being inundated less frequently. This possibility was examined by calculating bench inundation indices for juvenile Chinook salmon (see Section 11J.3.1, *Methods*). These indices range from 0 (no availability of bench habitat) to 1 (water depth on the bench is optimal for juvenile Chinook salmon year-round). The analysis was undertaken for riparian and wetland benches in five grouped geographic locations within the north Delta by linking bench elevation data to DSM2-HYDRO-simulated water surface elevation for three seasonal periods (fall: October–November; winter: December–February; spring: March–June).

#### 11J.3.1. Methods

Data for 37 riparian benches (total length = 31,428 ft; 6.0 miles) and 17 wetland benches (total length = 15,973 ft; 3.0 miles) in the north Delta were obtained (Table 11J-3). Some riparian and wetland benches were located at the same site (Figure 11J-2), indicated in Table 11J-3 by having the same number in their codes. Each bench belonged to one of five grouped geographic locations and was matched with the nearest DSM2-HYDRO output location for which stage data were available.

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<sup>3</sup> For comparison, the total length of riverbank (including both banks) along the main migratory pathways in the north Delta upstream of Rio Vista is ~90 miles (mainstem Sacramento River), ~12 miles (Sutter Slough), ~18 miles (Steamboat Slough), and ~14 miles (Miner Slough).

In order to represent inundation of differing levels of the benches over their entire elevations, four equally spaced increments were calculated between the minimum and maximum elevations. For example, riparian bench R1 in Cache Slough (minimum elevation = 4.3 ft, maximum elevation = 6.3 ft) was divided into the increments 4.3 ft, 4.8 ft, 5.3 ft, and 5.8 ft. In essence, this process divided each bench into four sub-benches, each of slightly different elevation. This approach was adopted because division into regular increments (e.g., every 0.5 ft or every 1 ft) would have been computationally intensive because the difference between maximum and minimum elevations varied from 5 ft or more (e.g., riparian bench R5) to less than 2 ft.

Water depth on each sub-bench was determined for every 15-minute timestep available from the DSM2-HYDRO simulation. The depth was calculated as the difference between the water surface elevation at the nearest DSM2-HYDRO output location and the sub-bench elevation; if this calculation was negative, it indicated that the water was below the level of the sub-bench, and water depth was zero. Water depth was converted to a habitat suitability score by applying the suitability curve from the U.S. Fish and Wildlife Service (2005) for juvenile winter-run Chinook salmon (Figure 11J-3). The U.S. Fish and Wildlife Service (2005:218–221) provides several different curves, but the curve for juvenile winter-run Chinook salmon was selected because it represents juveniles greater than 2.36 inches (60 mm) in length, which is representative of most winter-run-sized juvenile Chinook salmon entering the Delta (del Rosario et al. 2013:8).

The habitat suitability score for each sub-bench in each 15-minute period was then multiplied by the length of the site at which each sub-bench occurred. An overall bench inundation index was calculated for each bench type in each of the five geographic group locations in three seasons (fall: October–November; winter: December–February; spring: March–June) in each water year type, by summing all of the applicable 15-minute length-weighted habitat suitability scores, then dividing by the sum of the corresponding site lengths for all observations. This final bench inundation index represents the overall suitability of bench habitat for juvenile Chinook salmon based on water depth. The index ranges from zero (no water of suitable depth available at any time) to 1 (optimal water depth available at all times on all sub-benches).<sup>4</sup>

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<sup>4</sup> For example, a bench inundation index of 0.20 equates to optimal depth (suitability = 1) 20% of the time within a season (with no other inundation occurring); or equates to relatively poor depth (suitability = 0.20) 100% of the time within a season. Note that depending on water depth under the NAA, bench inundation indices could be greater, the same, or less under the Project, as a result of differences in suitability with differences in water depth (see Figure 11J-3).

**Table 11J-3. Characteristics of the Benches Analyzed for Inundation Effects of the Project**

<b>Bench Type</b>	<b>Code</b>	<b>Geographic Group</b>	<b>Waterbody</b>	<b>Length (feet)</b>	<b>Min. Elevation (feet NAVD)</b>	<b>Max. Elevation (feet NAVD)</b>	<b>DSM2-HYDRO Node</b>
Riparian	R1	Cache Slough	Cache Slough	495	4.3	6.3	CACHE_RYER
Riparian	R2	Sacramento River above Hood	Sacramento River	268	5.0	10.0	NDD_US
Riparian	R3	Sacramento River above Hood	Sacramento River	894	5.0	10.0	NDD_US
Riparian	R4	Sacramento River above Hood	Sacramento River	166	5.0	10.0	NDD_US
Riparian	R5	Sacramento River above Hood	Sacramento River	322	5.1	10.4	NDD_US
Riparian	R6	Sacramento River above Hood	Sacramento River	285	5.8	10.4	NDD_US
Riparian	R7	Sacramento River above Hood	Sacramento River	1,254	6.0	8.6	NDD_US
Riparian	R8	Sacramento River above Hood	Sacramento River	1,320	6.0	10.6	NDD_US
Riparian	R9	Sacramento River above Hood	Sacramento River	730	6.5	7.5	NDD_US
Riparian	R10	Sacramento River above Hood	Sacramento River	1,061	7.1	8.3	NDD_US
Riparian	R11	Sacramento River above Hood	Sacramento River	1,473	8.0	10.0	NDD_US
Riparian	R12	Sacramento River above Hood	Sacramento River	329	8.0	10.0	NDD_US
Riparian	R13	Sacramento River above Hood	Sacramento River	888	8.0	10.0	NDD_US
Riparian	R14	Sacramento River above Hood	Sacramento River	720	8.0	10.0	NDD_US
Riparian	R15	Sacramento River above Hood	Sacramento River	1,566	8.0	10.0	NDD_US
Riparian	R16	Sacramento River above Hood	Sacramento River	298	8.0	10.0	NDD_US
Riparian	R17	Sacramento River above Hood	Sacramento River	970	8.0	12.0	NDD_US
Riparian	R18	Sacramento River above Hood	Sacramento River	770	3.9	3.9	NDD_US
Riparian	R19	Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Sacramento River	210	5.0	5.8	RSAC123
Riparian	R21	Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Sacramento River	660	4.6	6.6	RSAC123
Riparian	R22	Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Sacramento River	815	5.0	7.0	RSAC123
Riparian	R24	Sacramento River above Hood	Sacramento River	1,322	4.6	13.9	RSAC155

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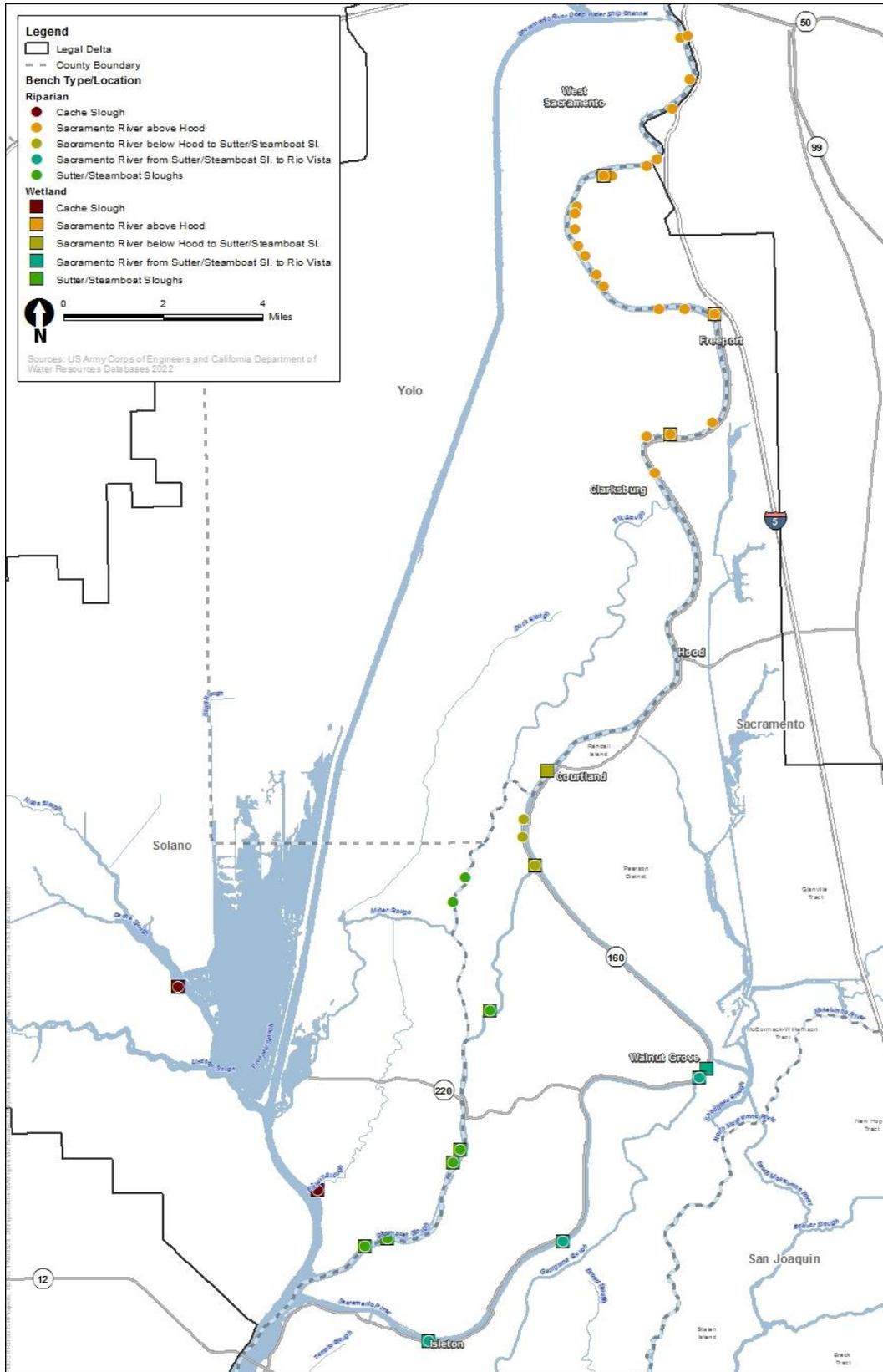
<b>Bench Type</b>	<b>Code</b>	<b>Geographic Group</b>	<b>Waterbody</b>	<b>Length (feet)</b>	<b>Min. Elevation (feet NAVD)</b>	<b>Max. Elevation (feet NAVD)</b>	<b>DSM2-HYDRO Node</b>
Riparian	R25	Sacramento River above Hood	Sacramento River	198	5.5	8.2	RSAC155
Riparian	R26	Sacramento River above Hood	Sacramento River	1,124	6.1	9.1	RSAC155
Riparian	R27	Sacramento River above Hood	Sacramento River	1,668	6.3	8.5	RSAC155
Riparian	R28	Sacramento River above Hood	Sacramento River	895	8.0	12.0	RSAC155
Riparian	R29	Sacramento River below Hood to Sutter/Steamboat Sloughs	Sacramento River	292	4.9	5.5	SAC_DS_SUTSL
Riparian	R30	Sacramento River below Hood to Sutter/Steamboat Sloughs	Sacramento River	420	5.5	6.1	SAC_DS_SUTSL
Riparian	R31	Sacramento River below Hood to Sutter/Steamboat Sloughs	Sacramento River	2,325	6.2	8.2	SAC_DS_SUTSL
Riparian	R33	Cache Slough	Cache Slough	2,455	4.6	6.6	SLCCH016
Riparian	R34	Sutter/Steamboat Sloughs	Steamboat Slough	708	2.1	5.0	SLSBT011
Riparian	R35	Sutter/Steamboat Sloughs	Steamboat Slough	740	2.1	8.0	SLSBT011
Riparian	R36	Sutter/Steamboat Sloughs	Steamboat Slough	439	5.1	7.0	SLSBT011
Riparian	R37	Sutter/Steamboat Sloughs	Steamboat Slough	430	4.3	6.3	SLSBT011
Riparian	R38	Sutter/Steamboat Sloughs	Steamboat Slough	353	5.1	5.8	STMBT_SL
Riparian	R39	Sutter/Steamboat Sloughs	Sutter Slough	1,415	4.2	7.2	SUT_US_MIN
Riparian	R40	Sutter/Steamboat Sloughs	Sutter Slough	1,150	4.2	7.2	SUT_US_MIN
Wetland	W1	Cache Slough	Cache Slough	495	2.3	4.3	CACHE_RYER
Wetland	W8	Sacramento River above Hood	Sacramento River	1,320	2.9	4.1	NDD_US
Wetland	W19	Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Sacramento River	210	0.9	2.1	RSAC123
Wetland	W20	Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Sacramento River	745	-0.5	3.4	RSAC123
Wetland	W21	Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Sacramento River	660	2.6	4.6	RSAC123

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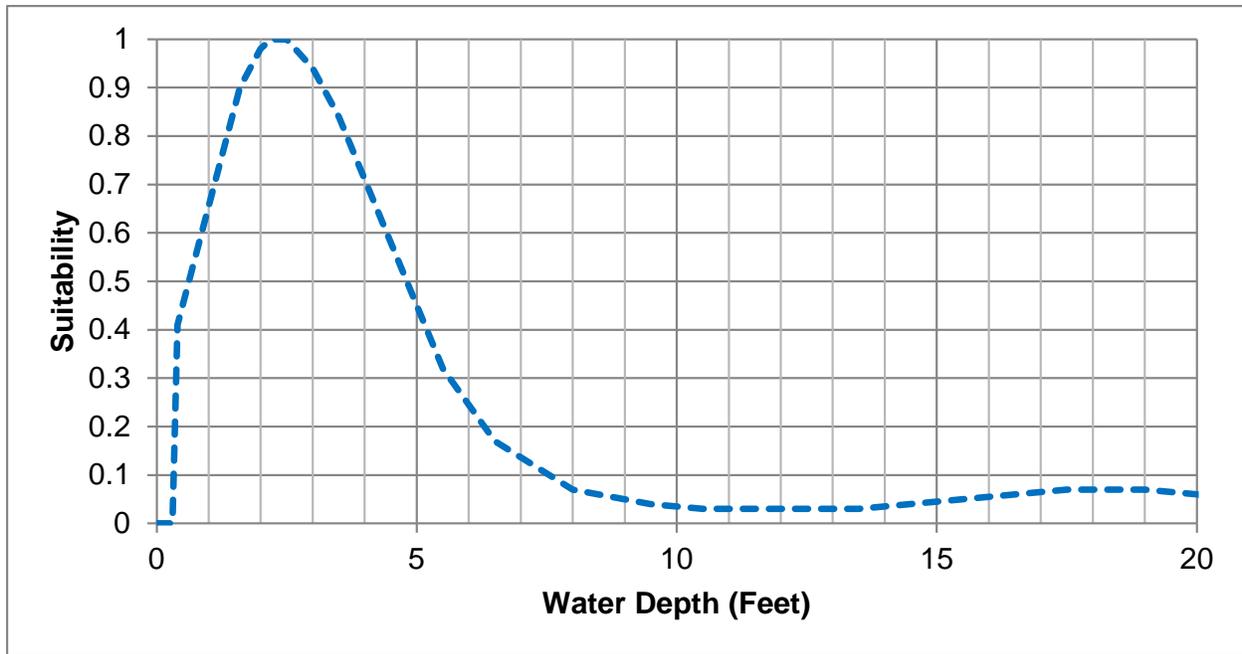
<b>Bench Type</b>	<b>Code</b>	<b>Geographic Group</b>	<b>Waterbody</b>	<b>Length (feet)</b>	<b>Min. Elevation (feet NAVD)</b>	<b>Max. Elevation (feet NAVD)</b>	<b>DSM2-HYDRO Node</b>
Wetland	W22	Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Sacramento River	815	2.9	4.9	RSAC123
Wetland	W23	Sacramento River below Hood to Sutter/Steamboat Sloughs	Sacramento River	790	-0.5	3.4	RSAC142
Wetland	W24	Sacramento River above Hood	Sacramento River	1,322	-0.8	4.2	RSAC155
Wetland	W26	Sacramento River above Hood	Sacramento River	1,124	1.8	2.8	RSAC155
Wetland	W31	Sacramento River below Hood to Sutter/Steamboat Sloughs	Sacramento River	2,325	3.2	5.2	SAC_DS_SUTSL
Wetland	W32	Cache Slough	Cache Slough	1,042	0.9	2.1	SLCCH016
Wetland	W33	Cache Slough	Cache Slough	2,455	2.6	4.6	SLCCH016
Wetland	W34	Sutter/Steamboat Sloughs	Steamboat Slough	708	0.9	2.1	SLSBT011
Wetland	W35	Sutter/Steamboat Sloughs	Steamboat Slough	740	0.9	2.1	SLSBT011
Wetland	W36	Sutter/Steamboat Sloughs	Steamboat Slough	439	0.9	2.1	SLSBT011
Wetland	W37	Sutter/Steamboat Sloughs	Steamboat Slough	430	2.3	4.3	SLSBT011
Wetland	W38	Sutter/Steamboat Sloughs	Steamboat Slough	353	0.9	2.1	STMBT_SL

Source: California Department of Water Resources 2016:5.D-272.

NAVD = North American Vertical Datum of 1988.



**Figure 11J-2. Benches Analyzed for Inundation Effects of the Project**



Source: U.S. Fish and Wildlife Service 2005:221.

**Figure 11J-3. Habitat Suitability Curve for Juvenile Winter-Run Chinook Salmon**

### 11J.3.2. Results

The results of the analysis are shown in Tables 11J-4 and 11J-5 and are discussed in Chapter 11.

**Table 11J-4. Mean Riparian and Wetland Bench Inundation Index by Geographic Group, Season, and Water Year Type**

Geographic Group	Bench Type	WYT	Season	NAA	Alt 1A	Alt 1B	Alt 2	Alt 3
Cache Slough	Riparian	W	Winter	0.00	0.00 (-1%)	0.00 (-1%)	0.00 (-1%)	0.00 (-1%)
Cache Slough	Riparian	AN	Winter	0.00	0.00 (-3%)	0.00 (-3%)	0.00 (-3%)	0.00 (-3%)
Cache Slough	Riparian	BN	Winter	0.00	0.00 (-3%)	0.00 (-4%)	0.00 (-3%)	0.00 (-4%)
Cache Slough	Riparian	D	Winter	0.00	0.00 (-13%)	0.00 (-13%)	0.00 (-14%)	0.00 (-12%)
Cache Slough	Riparian	C	Winter	0.00	0.00 (-6%)	0.00 (-5%)	0.00 (-6%)	0.00 (-4%)
Cache Slough	Wetland	W	Winter	0.14	0.14 (0%)	0.14 (0%)	0.14 (0%)	0.14 (0%)
Cache Slough	Wetland	AN	Winter	0.13	0.13 (-1%)	0.13 (-1%)	0.13 (-1%)	0.13 (-1%)
Cache Slough	Wetland	BN	Winter	0.14	0.14 (-1%)	0.14 (-1%)	0.14 (-1%)	0.14 (-1%)
Cache Slough	Wetland	D	Winter	0.13	0.13 (-1%)	0.13 (-1%)	0.13 (-1%)	0.13 (-1%)
Cache Slough	Wetland	C	Winter	0.11	0.11 (-1%)	0.11 (-1%)	0.11 (-1%)	0.11 (0%)
Sacramento River above Hood	Riparian	W	Winter	0.19	0.19 (-2%)	0.19 (-2%)	0.19 (-2%)	0.19 (-2%)
Sacramento River above Hood	Riparian	AN	Winter	0.13	0.13 (-2%)	0.13 (-2%)	0.13 (-2%)	0.13 (-3%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River above Hood	Riparian	BN	Winter	0.24	0.24 (-1%)	0.24 (-1%)	0.24 (-1%)	0.24 (-2%)
Sacramento River above Hood	Riparian	D	Winter	0.17	0.16 (-6%)	0.16 (-5%)	0.16 (-6%)	0.16 (-3%)
Sacramento River above Hood	Riparian	C	Winter	0.11	0.10 (-5%)	0.11 (-5%)	0.10 (-6%)	0.11 (-4%)
Sacramento River above Hood	Wetland	W	Winter	0.38	0.39 (1%)	0.39 (1%)	0.39 (1%)	0.39 (1%)
Sacramento River above Hood	Wetland	AN	Winter	0.45	0.45 (1%)	0.45 (2%)	0.45 (1%)	0.45 (1%)
Sacramento River above Hood	Wetland	BN	Winter	0.33	0.34 (2%)	0.34 (3%)	0.34 (2%)	0.34 (3%)
Sacramento River above Hood	Wetland	D	Winter	0.38	0.39 (3%)	0.39 (2%)	0.39 (3%)	0.38 (2%)
Sacramento River above Hood	Wetland	C	Winter	0.38	0.39 (2%)	0.39 (2%)	0.39 (2%)	0.39 (2%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	W	Winter	0.16	0.16 (-2%)	0.16 (-2%)	0.16 (-2%)	0.16 (-2%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	AN	Winter	0.14	0.13 (-5%)	0.13 (-5%)	0.13 (-4%)	0.13 (-5%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	BN	Winter	0.21	0.19 (-8%)	0.19 (-8%)	0.19 (-8%)	0.19 (-8%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	D	Winter	0.13	0.12 (-7%)	0.12 (-7%)	0.12 (-7%)	0.12 (-5%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	C	Winter	0.06	0.05 (-14%)	0.05 (-13%)	0.05 (-14%)	0.05 (-11%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	W	Winter	0.34	0.33 (-1%)	0.33 (-1%)	0.33 (-1%)	0.33 (-1%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	AN	Winter	0.29	0.29 (-1%)	0.29 (-1%)	0.29 (-1%)	0.29 (-1%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	BN	Winter	0.36	0.36 (0%)	0.36 (0%)	0.36 (0%)	0.36 (0%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	D	Winter	0.32	0.31 (-2%)	0.31 (-2%)	0.31 (-2%)	0.32 (-1%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	C	Winter	0.27	0.27 (0%)	0.27 (0%)	0.27 (0%)	0.27 (0%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	W	Winter	0.14	0.14 (-2%)	0.14 (-2%)	0.14 (-1%)	0.14 (-2%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	AN	Winter	0.13	0.12 (-5%)	0.12 (-6%)	0.12 (-4%)	0.12 (-5%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	BN	Winter	0.17	0.16 (-8%)	0.16 (-8%)	0.16 (-9%)	0.15 (-9%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	D	Winter	0.11	0.11 (-6%)	0.11 (-6%)	0.11 (-6%)	0.11 (-5%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	C	Winter	0.05	0.04 (-14%)	0.04 (-13%)	0.04 (-14%)	0.04 (-11%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	W	Winter	0.40	0.40 (-1%)	0.39 (-1%)	0.40 (-1%)	0.40 (-1%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	AN	Winter	0.36	0.36 (-1%)	0.35 (-1%)	0.35 (-1%)	0.35 (-1%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	BN	Winter	0.43	0.43 (-1%)	0.43 (0%)	0.43 (0%)	0.43 (0%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	D	Winter	0.38	0.37 (-2%)	0.37 (-2%)	0.37 (-2%)	0.37 (-1%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	C	Winter	0.31	0.31 (-1%)	0.31 (-1%)	0.31 (-1%)	0.31 (-1%)
Sutter/Steamboat Sloughs	Riparian	W	Winter	0.17	0.17 (-2%)	0.17 (-2%)	0.17 (-2%)	0.17 (-2%)
Sutter/Steamboat Sloughs	Riparian	AN	Winter	0.14	0.13 (-3%)	0.13 (-4%)	0.14 (-3%)	0.13 (-4%)
Sutter/Steamboat Sloughs	Riparian	BN	Winter	0.20	0.19 (-6%)	0.19 (-6%)	0.19 (-6%)	0.19 (-6%)
Sutter/Steamboat Sloughs	Riparian	D	Winter	0.14	0.13 (-5%)	0.13 (-5%)	0.13 (-5%)	0.14 (-4%)
Sutter/Steamboat Sloughs	Riparian	C	Winter	0.08	0.07 (-8%)	0.07 (-7%)	0.07 (-8%)	0.07 (-6%)
Sutter/Steamboat Sloughs	Wetland	W	Winter	0.48	0.48 (-1%)	0.48 (-1%)	0.48 (-1%)	0.48 (-1%)
Sutter/Steamboat Sloughs	Wetland	AN	Winter	0.45	0.44 (-1%)	0.44 (-1%)	0.44 (-1%)	0.44 (-1%)
Sutter/Steamboat Sloughs	Wetland	BN	Winter	0.52	0.51 (0%)	0.52 (0%)	0.52 (0%)	0.52 (0%)
Sutter/Steamboat Sloughs	Wetland	D	Winter	0.46	0.45 (-2%)	0.46 (-1%)	0.45 (-2%)	0.46 (-1%)
Sutter/Steamboat Sloughs	Wetland	C	Winter	0.39	0.39 (0%)	0.39 (0%)	0.39 (0%)	0.39 (0%)
Cache Slough	Riparian	W	Spring	0.00	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Cache Slough	Riparian	AN	Spring	0.00	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (-1%)
Cache Slough	Riparian	BN	Spring	0.00	0.00 (-2%)	0.00 (-2%)	0.00 (-2%)	0.00 (-1%)
Cache Slough	Riparian	D	Spring	0.00	0.00 (6%)	0.00 (6%)	0.00 (6%)	0.00 (6%)
Cache Slough	Riparian	C	Spring	0.00	0.00 (-7%)	0.00 (-7%)	0.00 (-7%)	0.00 (-7%)
Cache Slough	Wetland	W	Spring	0.10	0.10 (0%)	0.10 (0%)	0.10 (0%)	0.10 (0%)
Cache Slough	Wetland	AN	Spring	0.11	0.11 (0%)	0.11 (0%)	0.11 (0%)	0.11 (0%)
Cache Slough	Wetland	BN	Spring	0.10	0.10 (0%)	0.10 (0%)	0.10 (0%)	0.10 (0%)
Cache Slough	Wetland	D	Spring	0.10	0.10 (0%)	0.10 (0%)	0.10 (0%)	0.10 (0%)
Cache Slough	Wetland	C	Spring	0.11	0.11 (-1%)	0.11 (-1%)	0.11 (-1%)	0.11 (-1%)
Sacramento River above Hood	Riparian	W	Spring	0.12	0.11 (0%)	0.11 (-1%)	0.11 (0%)	0.11 (-1%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River above Hood	Riparian	AN	Spring	0.15	0.15 (-1%)	0.15 (-1%)	0.15 (0%)	0.15 (-1%)
Sacramento River above Hood	Riparian	BN	Spring	0.13	0.12 (-3%)	0.12 (-3%)	0.12 (-3%)	0.12 (-3%)
Sacramento River above Hood	Riparian	D	Spring	0.07	0.06 (-6%)	0.06 (-6%)	0.06 (-6%)	0.06 (-6%)
Sacramento River above Hood	Riparian	C	Spring	0.10	0.09 (-6%)	0.09 (-6%)	0.09 (-7%)	0.09 (-6%)
Sacramento River above Hood	Wetland	W	Spring	0.41	0.41 (0%)	0.42 (0%)	0.41 (0%)	0.42 (0%)
Sacramento River above Hood	Wetland	AN	Spring	0.37	0.37 (0%)	0.37 (0%)	0.37 (0%)	0.37 (0%)
Sacramento River above Hood	Wetland	BN	Spring	0.42	0.42 (1%)	0.42 (1%)	0.42 (1%)	0.42 (1%)
Sacramento River above Hood	Wetland	D	Spring	0.43	0.43 (1%)	0.43 (1%)	0.43 (1%)	0.43 (1%)
Sacramento River above Hood	Wetland	C	Spring	0.40	0.41 (2%)	0.40 (2%)	0.41 (2%)	0.41 (2%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	W	Spring	0.07	0.07 (-2%)	0.07 (-2%)	0.07 (0%)	0.07 (-2%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	AN	Spring	0.12	0.12 (-1%)	0.12 (-2%)	0.12 (0%)	0.12 (-4%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	BN	Spring	0.06	0.05 (-9%)	0.05 (-9%)	0.05 (-9%)	0.05 (-9%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	D	Spring	0.06	0.05 (-5%)	0.05 (-5%)	0.05 (-5%)	0.05 (-4%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	C	Spring	0.05	0.04 (-14%)	0.04 (-14%)	0.04 (-14%)	0.04 (-13%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	W	Spring	0.27	0.27 (0%)	0.27 (0%)	0.27 (0%)	0.27 (-1%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	AN	Spring	0.29	0.29 (0%)	0.29 (0%)	0.29 (0%)	0.29 (0%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	BN	Spring	0.30	0.30 (-1%)	0.30 (-1%)	0.30 (-1%)	0.30 (-1%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	D	Spring	0.23	0.22 (-1%)	0.22 (-1%)	0.22 (-1%)	0.22 (-1%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	C	Spring	0.27	0.26 (-1%)	0.27 (-1%)	0.26 (-1%)	0.26 (-1%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	W	Spring	0.05	0.05 (-2%)	0.05 (-2%)	0.05 (-1%)	0.05 (-3%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	AN	Spring	0.10	0.10 (-1%)	0.10 (-1%)	0.10 (0%)	0.09 (-4%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	BN	Spring	0.04	0.04 (-9%)	0.04 (-9%)	0.04 (-9%)	0.04 (-9%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	D	Spring	0.05	0.05 (-3%)	0.05 (-3%)	0.05 (-3%)	0.05 (-3%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	C	Spring	0.04	0.04 (-11%)	0.04 (-11%)	0.04 (-11%)	0.04 (-11%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	W	Spring	0.32	0.31 (0%)	0.31 (0%)	0.31 (0%)	0.31 (0%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	AN	Spring	0.34	0.34 (0%)	0.34 (0%)	0.34 (0%)	0.34 (0%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	BN	Spring	0.34	0.34 (-1%)	0.34 (-1%)	0.34 (-1%)	0.34 (-1%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	D	Spring	0.27	0.27 (-1%)	0.27 (-1%)	0.27 (-1%)	0.27 (-1%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	C	Spring	0.31	0.31 (-1%)	0.31 (-1%)	0.31 (-1%)	0.31 (-1%)
Sutter/Steamboat Sloughs	Riparian	W	Spring	0.08	0.08 (-1%)	0.08 (-1%)	0.08 (-1%)	0.08 (-2%)
Sutter/Steamboat Sloughs	Riparian	AN	Spring	0.12	0.12 (-1%)	0.12 (-1%)	0.12 (0%)	0.12 (-3%)
Sutter/Steamboat Sloughs	Riparian	BN	Spring	0.07	0.07 (-5%)	0.07 (-5%)	0.07 (-5%)	0.07 (-6%)
Sutter/Steamboat Sloughs	Riparian	D	Spring	0.07	0.06 (-4%)	0.06 (-4%)	0.06 (-4%)	0.06 (-4%)
Sutter/Steamboat Sloughs	Riparian	C	Spring	0.07	0.06 (-8%)	0.06 (-8%)	0.06 (-8%)	0.06 (-8%)
Sutter/Steamboat Sloughs	Wetland	W	Spring	0.40	0.40 (0%)	0.40 (0%)	0.40 (0%)	0.40 (0%)
Sutter/Steamboat Sloughs	Wetland	AN	Spring	0.42	0.42 (0%)	0.42 (0%)	0.42 (0%)	0.42 (0%)
Sutter/Steamboat Sloughs	Wetland	BN	Spring	0.43	0.43 (0%)	0.43 (0%)	0.43 (0%)	0.43 (0%)
Sutter/Steamboat Sloughs	Wetland	D	Spring	0.36	0.35 (-1%)	0.35 (-1%)	0.35 (-1%)	0.35 (-1%)
Sutter/Steamboat Sloughs	Wetland	C	Spring	0.40	0.40 (-1%)	0.40 (-1%)	0.40 (-1%)	0.40 (-1%)
Cache Slough	Riparian	W	Fall	0.00	0.00 (-3%)	0.00 (-3%)	0.00 (-3%)	0.00 (-3%)
Cache Slough	Riparian	AN	Fall	0.00	0.00 (-5%)	0.00 (-5%)	0.00 (-5%)	0.00 (0%)
Cache Slough	Riparian	BN	Fall	0.00	0.00 (-5%)	0.00 (-5%)	0.00 (-5%)	0.00 (16%)
Cache Slough	Riparian	D	Fall	0.00	0.00 (-7%)	0.00 (-7%)	0.00 (-7%)	0.00 (-7%)
Cache Slough	Riparian	C	Fall	0.00	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Cache Slough	Wetland	W	Fall	0.10	0.10 (0%)	0.10 (0%)	0.10 (0%)	0.10 (0%)
Cache Slough	Wetland	AN	Fall	0.09	0.09 (0%)	0.09 (0%)	0.09 (0%)	0.09 (1%)
Cache Slough	Wetland	BN	Fall	0.10	0.10 (0%)	0.10 (0%)	0.10 (0%)	0.10 (1%)
Cache Slough	Wetland	D	Fall	0.09	0.09 (0%)	0.09 (0%)	0.09 (0%)	0.09 (0%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Cache Slough	Wetland	C	Fall	0.08	0.08 (0%)	0.08 (0%)	0.08 (0%)	0.08 (0%)
Sacramento River above Hood	Riparian	W	Fall	0.02	0.02 (-5%)	0.02 (-7%)	0.02 (-5%)	0.02 (-6%)
Sacramento River above Hood	Riparian	AN	Fall	0.02	0.02 (-3%)	0.02 (0%)	0.02 (-3%)	0.02 (7%)
Sacramento River above Hood	Riparian	BN	Fall	0.02	0.02 (-17%)	0.02 (-16%)	0.02 (-17%)	0.02 (-12%)
Sacramento River above Hood	Riparian	D	Fall	0.01	0.01 (-23%)	0.01 (-22%)	0.01 (-24%)	0.01 (-14%)
Sacramento River above Hood	Riparian	C	Fall	0.00	0.00 (36%)	0.00 (32%)	0.00 (41%)	0.00 (36%)
Sacramento River above Hood	Wetland	W	Fall	0.47	0.47 (0%)	0.47 (0%)	0.47 (0%)	0.47 (0%)
Sacramento River above Hood	Wetland	AN	Fall	0.39	0.40 (1%)	0.40 (2%)	0.40 (1%)	0.41 (5%)
Sacramento River above Hood	Wetland	BN	Fall	0.37	0.38 (5%)	0.38 (5%)	0.38 (4%)	0.40 (11%)
Sacramento River above Hood	Wetland	D	Fall	0.29	0.31 (8%)	0.31 (8%)	0.31 (8%)	0.31 (7%)
Sacramento River above Hood	Wetland	C	Fall	0.25	0.25 (3%)	0.25 (3%)	0.25 (3%)	0.25 (3%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	W	Fall	0.01	0.01 (-5%)	0.01 (-9%)	0.01 (-5%)	0.01 (-9%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	AN	Fall	0.00	0.00 (-16%)	0.00 (-3%)	0.00 (-16%)	0.00 (27%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	BN	Fall	0.00	0.00 (-38%)	0.00 (-37%)	0.00 (-38%)	0.00 (-32%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	D	Fall	0.00	0.00 (-59%)	0.00 (-57%)	0.00 (-59%)	0.00 (-43%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Riparian	C	Fall	0.00	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	W	Fall	0.19	0.19 (-1%)	0.18 (-1%)	0.19 (-1%)	0.18 (-1%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	AN	Fall	0.17	0.17 (0%)	0.17 (1%)	0.17 (0%)	0.18 (2%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	BN	Fall	0.18	0.18 (-1%)	0.18 (-1%)	0.18 (-1%)	0.18 (2%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	D	Fall	0.14	0.14 (1%)	0.14 (1%)	0.14 (1%)	0.14 (2%)
Sacramento River below Hood to Sutter/Steamboat Sloughs	Wetland	C	Fall	0.12	0.12 (1%)	0.12 (1%)	0.12 (1%)	0.12 (1%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	W	Fall	0.01	0.00 (-7%)	0.00 (-11%)	0.00 (-7%)	0.00 (-11%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	AN	Fall	0.00	0.00 (-17%)	0.00 (-3%)	0.00 (-17%)	0.00 (33%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	BN	Fall	0.00	0.00 (-32%)	0.00 (-31%)	0.00 (-32%)	0.00 (-27%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	D	Fall	0.00	0.00 (-49%)	0.00 (-46%)	0.00 (-49%)	0.00 (-31%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Riparian	C	Fall	0.00	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	W	Fall	0.23	0.23 (-1%)	0.23 (-1%)	0.23 (-1%)	0.23 (-1%)

Through-Delta Survival and Delta Rearing Habitat  
of Juvenile Chinook Salmon

<b>Geographic Group</b>	<b>Bench Type</b>	<b>WYT</b>	<b>Season</b>	<b>NAA</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	AN	Fall	0.21	0.21 (0%)	0.21 (1%)	0.21 (0%)	0.21 (2%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	BN	Fall	0.22	0.21 (-1%)	0.22 (0%)	0.21 (-1%)	0.22 (3%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	D	Fall	0.18	0.18 (2%)	0.18 (2%)	0.18 (2%)	0.18 (2%)
Sacramento River from Sutter/Steamboat Sloughs to Rio Vista	Wetland	C	Fall	0.15	0.15 (1%)	0.15 (1%)	0.15 (1%)	0.15 (1%)
Sutter/Steamboat Sloughs	Riparian	W	Fall	0.02	0.02 (-2%)	0.02 (-3%)	0.02 (-2%)	0.02 (-3%)
Sutter/Steamboat Sloughs	Riparian	AN	Fall	0.02	0.02 (-3%)	0.02 (0%)	0.02 (-3%)	0.02 (7%)
Sutter/Steamboat Sloughs	Riparian	BN	Fall	0.02	0.01 (-6%)	0.01 (-6%)	0.01 (-6%)	0.02 (-1%)
Sutter/Steamboat Sloughs	Riparian	D	Fall	0.01	0.01 (0%)	0.01 (0%)	0.01 (-1%)	0.01 (1%)
Sutter/Steamboat Sloughs	Riparian	C	Fall	0.01	0.01 (2%)	0.01 (2%)	0.01 (2%)	0.01 (2%)
Sutter/Steamboat Sloughs	Wetland	W	Fall	0.33	0.33 (0%)	0.33 (-1%)	0.33 (0%)	0.33 (-1%)
Sutter/Steamboat Sloughs	Wetland	AN	Fall	0.29	0.29 (0%)	0.29 (1%)	0.29 (0%)	0.30 (2%)
Sutter/Steamboat Sloughs	Wetland	BN	Fall	0.31	0.31 (0%)	0.31 (0%)	0.31 (0%)	0.32 (2%)
Sutter/Steamboat Sloughs	Wetland	D	Fall	0.25	0.26 (2%)	0.26 (2%)	0.26 (2%)	0.26 (2%)
Sutter/Steamboat Sloughs	Wetland	C	Fall	0.22	0.22 (1%)	0.22 (1%)	0.22 (1%)	0.22 (1%)

Notes: Percentage values in parentheses indicate differences compared to the NAA. Absolute and percentage values are rounded; as a result, differences between absolutes and differences between percentages may not always appear consistent.

Results are not future predictions and are intended only to compare scenarios.

NAA = No Action Alternative; WYT = water year type (W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry).

**Table 11J-5. Riparian Bench Length and Total Deficit Compared to NAA (linear feet)**

<b>Geographic Group</b>	<b>Bench Type</b>	<b>Length (feet)</b>	<b>Alt 1A</b>	<b>Alt 1B</b>	<b>Alt 2</b>	<b>Alt 3</b>
Cache Slough	Riparian	2,950	0	0	0	0
Cache Slough	Wetland	3,992	-55	-50	-55	-41
Sacramento River above Hood	Riparian	18,251	-1,179	-1,154	-1,197	-1,140
Sacramento River above Hood	Wetland	3,766	-6	1	-9	6
Sacramento River below Hood to Sutter/ Steamboat Sloughs	Riparian	3,037	-417	-394	-433	-339
Sacramento River below Hood to Sutter/ Steamboat Sloughs	Wetland	3,115	-70	-56	-71	-35
Sacramento River from Sutter/ Steamboat Sloughs to Rio Vista	Riparian	1,685	-143	-142	-148	-152
Sacramento River from Sutter/ Steamboat Sloughs to Rio Vista	Wetland	2,430	-50	-41	-51	-30
Sutter/Steamboat Sloughs	Riparian	5,235	-427	-426	-430	-412
Sutter/Steamboat Sloughs	Wetland	2,670	-42	-34	-43	-26
Total	Both	47,131	-2,389 (-5.1%)	-2,298 (-4.9%)	-2,436 (-5.2%)	-2,169 (-4.6%)

Note: Results are not future predictions and are intended only to compare scenarios.

## 11J.4 References

### 11J.4.1. Printed References

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#### **11J.4.2. Personal Communications**

Perry, Russell. Research Fisheries Biologist, Quantitative Fisheries Ecology Section, USGS Western Fisheries Research Center, Columbia River Research Laboratory, Cook, WA. June 18, 2019—Email containing Excel file <North Delta Routing Management Tool v2.1.xlsx> sent to Marin Greenwood, Aquatic Ecologist, ICF, Sacramento, CA.