

Appendix I: Fixed-400,000 af Flood Storage Operation

1.0 FIXED-400,000 AF FLOOD STORAGE OPERATION

This operation set provides a comparison of operations before the SAFCA/Reclamation interim agreement in 1995 to the proposed operation for the Manual Update. As discussed in section 2.2, although USACE still prescribes operational decisions based on the 1986 WCD, the more conservative flood risk operation reflected in the SAFCA/Reclamation interim agreement is what Reclamation operates to today.

1.1 Comparison of Alternative 2 – Forecast-informed Operations to Cumulative Past Operation - Fixed-400,000 af Flood Storage

1.1.1 Hydrology and Hydraulics

This section compares period of record hydrology and evaluation of hydraulic effects between Alternative 2 – Forecast-informed Operations and the 1986 Fixed-400,000 af Flood Storage Operations scenario using an existing level of water demand in the CalSim II model. Significance criteria for hydrology and hydraulics effects would be the same as discussed in section 4.2.2.

When comparing the Alternative 2 modeled daily discharge frequencies to the Fixed-400,000 af operation, there was a slight increase in the discharge frequency of the 10,000 cfs to 30,000 cfs range and in the 70,000 cfs to 90,000 cfs range, as shown in Table 5-1. The modeling also indicates a slight decrease in discharge frequency in the 90,000 cfs to 115,000 cfs range. Overall, however, Alternative 2 – Forecast-informed operation discharges and effects on channel stability would be considered similar to those under the Fixed-400,000 af flood storage operation.

As Figure 5-1 shows, only 1 percent of the 82-year period of record are the flows greater than 20,000 cfs. In addition, flow exceedance probabilities appear to be much closer under these two operation scenarios than under the No Action/No Project, deviating less than 0.5 percent of the time. For the vast majority of the time, flows are within channel and less than 20,000 cfs. Flood risk management benefits of Alternative 2 are not realized until flows exceed 80,000 cfs when the new auxiliary spillway allows Folsom Dam to hold sustained flows for a longer duration.

Table 1-1. Modeled Average Daily Discharge Frequencies for Fixed-400,000 af Flood Storage Operation and Alternative 2 – Forecast-informed Operation

Discharge (cfs)	Fixed-400,000 af Flood Storage Operation Discharge Frequencies (# of days)	Alternative 2 – Forecast- informed Operation Discharge Frequencies (# of days)
< 10,000	28329	28312
10,000 to < 20,000	953	976
20,000 to < 30,000	139	147
30,000 to < 40,000	64	53
40,000 to < 50,000	27	28

50,000 to < 60,000	19	12
60,000 to < 70,000	8	8
70,000 to < 80,000	3	5
80,000 to < 90,000	1	4
90,000 to < 100,000	2	1
100,000 to 115,000	6	3

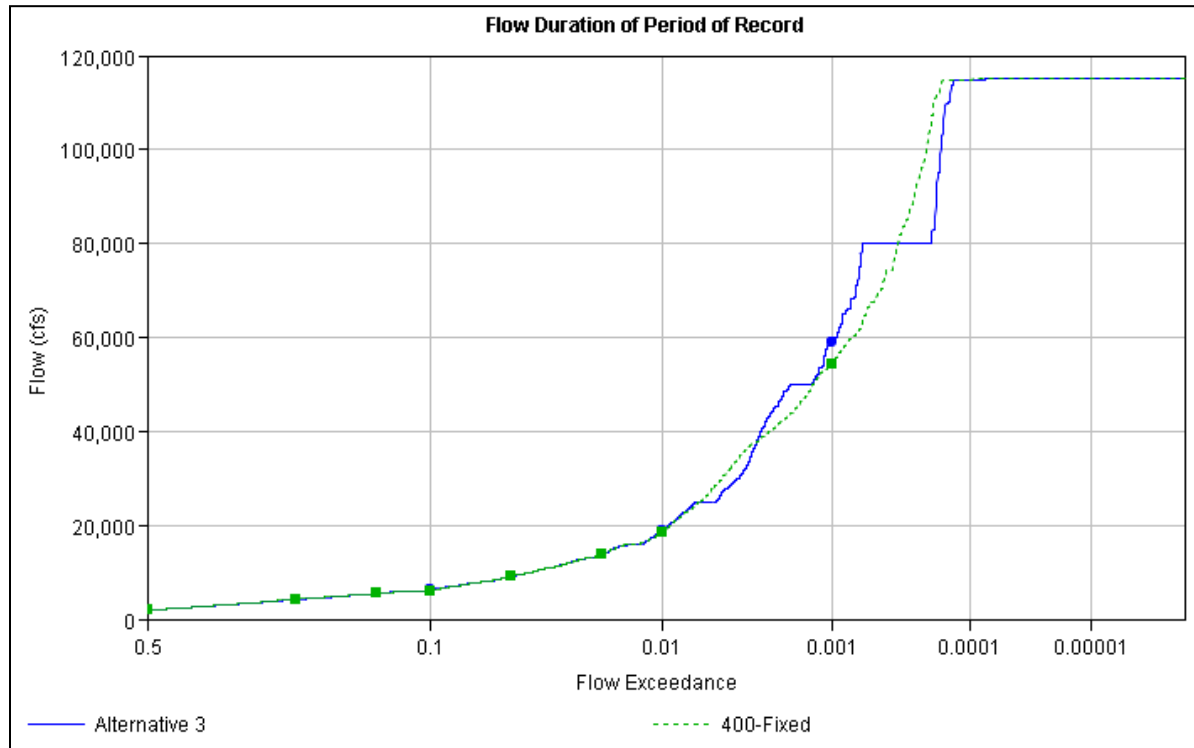


Figure 1-1: Probability of Flow Exceedance for Alternative 2 and Fixed-400,000 af Condition

As shown in Figure 4-6, Alternative 2 – Forecast-informed Operations (J602F3) is capable of passing more rare events at the normal and emergency objective releases of 115,000 cfs and 160,000 cfs than the Fixed-400,000 af Flood Storage operation (E503p). The modeling results that Figure 4-6 depicts demonstrates that flood risk reduction for the Sacramento area is improved the most from Alternative 2 than any of the other modeled Folsom Dam operation scenarios. In particular, the 1 in 200 AEP event would be contained within the existing channel of the lower American River. For the Fixed-400,000 af flood storage operation, the levees would be overtopped before the 1 in 150 AEP event.

Considering more frequent events, the regulated flow-frequency curves in Figure 4-6 indicate that Alternative 2 (J602F3) annual maximum peak flows track closely with the Fixed-400,000 af flood storage operation (E503P) up to the 1/7 AEP, with some minor increases in flows to the 1/15 AEP. However, after that frequency, flows would be consistently less than or equal to modeled flows for the Fixed-400,000 af operation. In general, flows for more frequent events in the lower American River under Alternative 2 would be consistent with those expected under the

Fixed-400,000 af flood storage operation, while flows for larger events would in general be reduced for Alternative 2.

Channel Stability and Sediment

Since modeled Folsom Dam releases are consistent between Alternative 2 and Fixed-400,000 af operations, the channel widening and degradation/aggradation trends discussed in Section 4.2 would similarly apply to the Fixed-400,000 af operation as well.

Folsom Lake Bank Erosion

The percentage of days with water surface elevations above 466 feet would be lower with Alternative 2 forecast-informed operations (0.27 percent) than with the Fixed-400,000 af flood storage operation (0.88 percent). The percentage of days with water surface elevations below 395 feet would also be slightly lower with Alternative 2 (8.34 percent) than with the Fixed-400,000 af operation (8.24 percent). This data is illustrated in Figure 5-2.

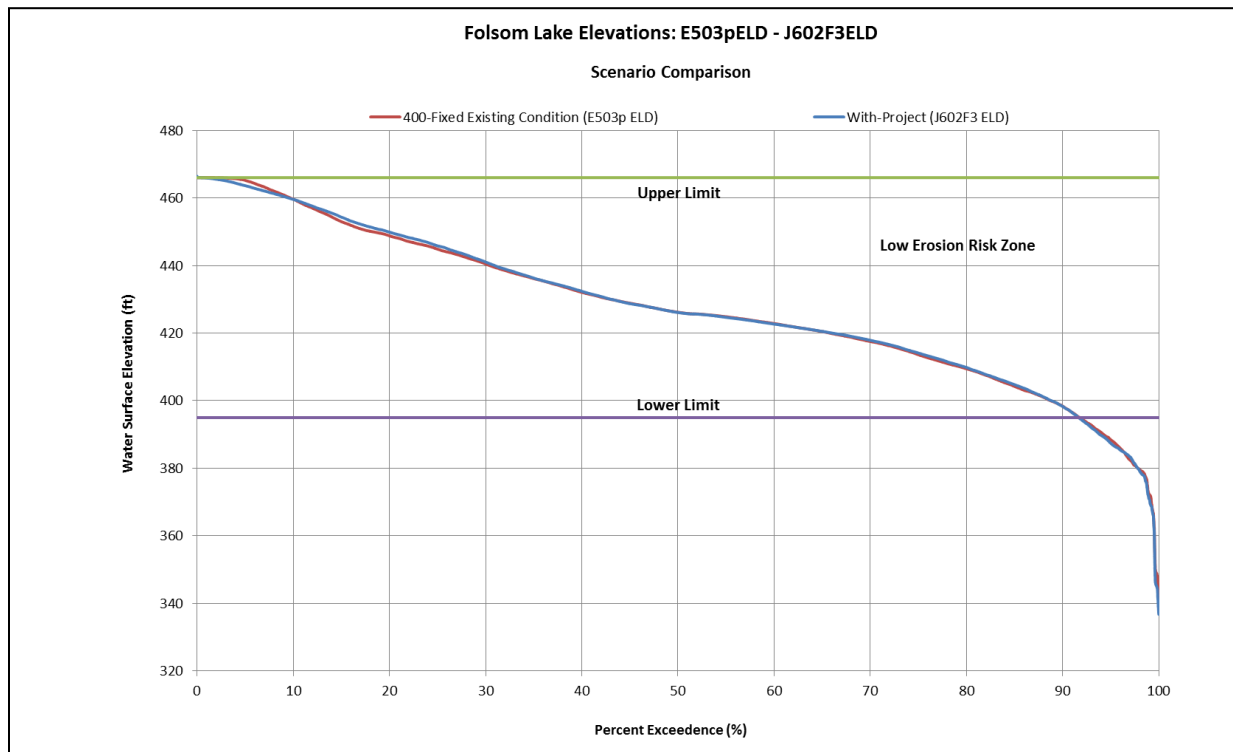


Figure 1-2. Folsom Lake Pool Levels Comparison of Fixed-400,000 af Flood Storage Operation and Alternative 2 - Forecast-informed Operations.

Based on the modeled period of record water surface elevations at Folsom Lake, bank erosion rates under Alternative 2 would be considered consistent with the Fixed-400,000 af operation.

1.1.2 Water Quality

This section discusses water quality comparisons between Alternative 2 – Forecast-informed Operations and the 1986 Fixed-400,000 af Flood Storage Operation using an existing level of water demand in the CalSim II model. Significance criteria for water quality effects would be the same as discussed in section 4.4.2.

General Observations

Delta water quality modeling indicates that, in general, the parameters show some differences between the Fixed-400,000 af flood storage operation and Alternative 2 Forecast-informed Operation, as summarized in Table 5-2.

Table 1-2. Differences in Delta Outflow, E/I Ratio, and X2 Location for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Delta Outflow Summary of Results	Evaluation Parameters	Differences by Water Year Type					
		Long-term	Wet	Above Normal	Below Normal	Dry	Critical
Long-term and water year type average Delta Outflow – Generally similar long-term average Delta outflows and generally similar average Delta outflow most of the time during all water year types (± 2.0 percent).	Monthly Maximum Reduction	✓	✓	✓	✓	-2.0 percent	✓
	Delta Outflow March–May	✓	✓	✓	✓	✓	✓
	Delta Outflow Objectives	NA	✓	✓	✓	✓	✓
E/I Ratio Summary of Results	Evaluation Parameters	Long-term	Wet	Above Normal	Below Normal	Dry	Critical
Long-term and water year type average E/I Ratio – Generally similar long-term average and generally similar most of the time during all water year types. The maximum change seen is (± 3.1 percent) in Critical year types.	E/I Ratio	✓	✓	-1.5 percent to +0.6 percent	✓	-0.9 percent to +1.1 percent	-3.1 percent to +1.0 percent
X2 Location Summary of Results	Evaluation Parameters	Long-term	Wet	Above Normal	Below Normal	Dry	Critical
Long-term and water year type average X2 Location – Generally similar long-term average and generally similar most of the time during all water year types.	X2 Location (km)	Up to +0.1	-0.1 to 0.0	± 0.1	± 0.1	-0.1 to +0.2	-0.1 to 0.0
	X2 Location Count 81 km	NA	✓	✓	✓	✓	✓
	X2 Location Count 74 km	NA	✓	✓	1	✓	-1
	X2 Location Count 64 km	NA	✓	✓	✓	1	✓

Note: “✓” refers to same or similar values, generally representing a less than 1-percent difference in parameters.

Even though Alternative 2 - Forecast-informed Operations results show a maximum of 2 percent decrease in average monthly values for March of dry water years, the magnitude of differences in Delta outflow is within a range of ± 0.4 percent for the full simulation period average monthly outflow. Long-term average March through May outflow shows a 0.1 percent reduction over the full simulation period with a maximum 0.8 percent reduction observed in dry water years.

Long-term average monthly E/I ratios show very little absolute difference for the two operations compared, in the range of ± 0.1 percent. The relative difference ranges from -0.4 percent in

average monthly values for January to 0.5 percent in average monthly values for March and June.

The X2 location in general shows minimal difference for the two operations. Long-term average X2 locations show no change for all months, except a 0.1 km increase in April. The water year type differences are typically ± 0.1 km or less, with an exception of 0.2 km in average monthly values for April of dry water years. The maximum year-to-year change for each month in the 82-year period of record monthly change ranges from 0.1 km in February, July and August to 1.2 km in April and May. Minimum monthly change observed ranges from -1.2 km in June to -0.1 km in April and August. Both operations have X2 locations greater than those required by September standards while meeting October X2 standards. Both operations meet the Delta outflow objectives for July through January. Results indicate that the scenarios are similar with respect to the fall X2 standards.

As shown in Table 5-3, with Alternative 2 the X2 moves east of the control point four more times than the Fixed-400,000 af flood storage operation: at the 74 km control point in two years in June of below-normal water year types, in one year in April of critical water year types, and in one year at the 64 km control point in April of dry water year types. A 1 km or greater shift was noted for Alternative 2 - Forecast-informed Operations three times: once in April and twice in May. Although Alternative 2 - Forecast-informed Operations would not be considered similar with Fixed-400,000 af flood storage operation, these differences would be considered less than significant because of the small increase in occurrences of these shifts. In addition, typical CVP/SWP operations would be managed to prevent those minor shifts in X2 location. Finally, the instances of those shifts occur during the modified spring refill at Folsom Dam under Alternative 2, presenting more potential conservation storage that could be applied to address these shifts in X2 as necessary by CVP/SWP operators.

Table 1-3. Difference in X2 Location Evaluation Parameters for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation

X2 Location	Evaluation Parameters	Change
Long-term and water year type average X2 Location – Generally similar long-term average and generally similar most of the time during all water year types. The maximum change is seen in April - June (± 1.2 km).	Change in X2 Location Monthly Maximum Value km	0.1 east
	Change in X2 Location Monthly Minimum Value km	0
	X2 Location Relative Change km (Maximum)	1.2
	X2 Location Relative Change km (Minimum)	-1.2
	X2 Exceeding Fall Standards (Count)	✓
	X2 Location Shift	Count
	> or = 1 km	3
	0.5–1.0 km	5
	0.25–0.5 km	7

Note: “✓” refers to same or similar values, generally representing a less than 1-percent difference in parameters.

For occurrences of salinity levels of greater than 150 mg/L at the CCWD Rock Slough intake, Alternative 2 model outputs show a decrease in one year in October of dry water years and in one year in September of critical water years compared to Fixed-400,000 af operations, as shown in Table 5-4. The salinity levels also show an increase in October of water year 1992 year, a critical water year. The maximum difference in salinity was an increase of 7.49 mg/L (from

218.92 mg/L to 226.41 mg/L). Although a difference of >3 mg/L means that Alternative 2 - Forecast-informed Operations is considered “not consistent” with Fixed-400,000 af flood storage operation outputs; however, typical CVP/SWP operations would be managed to prevent those minor shifts in salinity at the Rock Slough intake. Overall, effects to Rock Slough intake water quality under Alternative 2 operations would be less than significant when compared to the Fixed-400,000 af operation.

Table 1-4. Difference in Rock Slough Intake Salinity Parameters for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation

Salinity Rock Slough	Evaluation Parameters	Differences by Water Year Type					
		Long-term	Wet	Above Normal	Below Normal	Dry	Critical
Water year type Salinity at Rock Slough Intake – Generally similar long-term average and generally similar most of the time during all water year types.	Salinity Rock Slough (Change in Count >150 mg/L)	NA	√	√	√	o	1, o
	Salinity Rock Slough Max Change (>150 mg/L: 7.49 mg/L)						

Note: “√” refers to same or similar values, generally representing a less than 1-percent difference in parameters.

Note: “o” refers to a decrease in the count of occurrences of greater than 150 mg/L salinity at Rock Slough.

1.1.3 Vegetation and Wildlife

This section discusses comparisons between vegetation and wildlife conditions, including special status plants and animals, for Alternative 2 – Forecast-informed Operations and the 1986 Fixed-400,000 af Flood Storage Operations scenario using an existing level of water demand in the CalSim II model. Significance criteria for vegetation and wildlife effects, including special status plants and animals, would be the same as discussed in section 4.5.2. A detailed analysis of potential differences in cottonwood growth and backwater recharge along the lower American River is provided in Appendix C.

Lower American River

The lower American River terrestrial assessment focuses on cottonwood growth and backwater recharge. This section includes a summary of the results.

Cottonwood Growth

Alternative 2 - Forecast-informed Operations results indicate that average daily lower American River flows under the 1,765-cfs threshold could decrease between 1.4 to 4.7 average days per month over a 4-consecutive-month period during the cottonwood growing season relative to Fixed-400,000 af flood storage operation. Relative to Fixed-400,000 af flood storage operation, this change would provide additional flows for cottonwood radial growth, resulting in a potential benefit during the cottonwood growing season. However, when looking at change under the 3,000-cfs threshold comparison, cottonwood maintenance and optimal growth would stay relatively consistent during the cottonwood growing season between Fixed-400,000 af flood storage operation and Alternative 2 - Forecast-informed Operations. In addition, there would be no substantial difference in the pattern of peak flows needed to inundate terraces for cottonwood dispersal and regeneration between Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

Backwater Recharge

Relative to Fixed-400,000 af flood storage operation, Alternative 2 - Forecast-informed Operations would result in a minimal change in the average number of days when average daily flows are below the thresholds during winter and spring. Given the minimal difference between Fixed-400,000 af flood storage operation and Alternative 2 - Forecast-informed Operations, average daily flows are projected to remain essentially the same. As a result, there would be essentially no change to the magnitude and frequency of flows to substantially alter the existing backwater habitats dependent on the lower American River.

Folsom Reservoir

With Alternative 2 - Forecast-informed Operations, the water surface elevation fluctuations at Folsom Reservoir would remain within normal operating parameters (i.e., it is not anticipated that water elevations would exceed the 466 foot-msl threshold or barren band for durations that could affect existing vegetation). Folsom Reservoir has water levels that routinely fluctuate. Alternative 2 - Forecast-informed Operations would result in water surface elevation patterns that are the same as or slightly lower than those with Fixed-400,000 af flood storage operation.

Special Status Plant and Animal Species

USFWS has designated the Parkway as critical habitat for VELB, and this species has been recorded in elderberry shrubs near backwater ponds along the lower American River. Sanford's arrowhead, western pond turtle, and tri-colored blackbirds are special-status species known to occur in several backwater pond areas along the lower American River. However, these flows would not be reduced by sufficient magnitude and frequency to substantially alter existing water fluctuations (pond levels) and vegetation dependent on these ponds. Because effects on backwater habitats with Alternative 2 - Forecast-informed Operations would be less than significant, effects on elderberry shrubs and special-status species that depend on these habitats would also be less than significant.

Alternative 2 - Forecast-informed Operations would not change the distribution of vegetation or alter riparian vegetation scattered around Folsom Reservoir. The fluctuation zone at Folsom Reservoir is essentially devoid of vegetation with typical elevations levels ranging from 384 to 463 feet msl. Under these conditions, any elderberry shrubs that would be established at Folsom Reservoir would exist above the fluctuation zone and would not be adversely affected by the flood-control project operations.

1.1.4 Fisheries

This section discusses comparisons between conditions for fisheries under Alternative 2 – Forecast-informed Operations and the 1986 Fixed-400,000 af Flood Storage Operations scenario using an existing level of water demand in the CalSim II model. Significance criteria for fisheries effects would be the same as discussed in section 4.6.2.

Lower American River

For salmonid and other fish species, daily flow and water temperature model results on a monthly basis were examined for the lower American River below Nimbus Dam, at Watt Avenue, and near the mouth of the lower American River (i.e., RM 1). In addition to flow and water temperature modeling, model results for spawning habitat availability (WUA) and potential redd dewatering were examined for steelhead and fall-run Chinook salmon. For fall-run Chinook salmon, an updated lower American River early lifestage mortality model also was used to compare thermally-influenced early lifestage mortality.

Flows

Generally, flows are similar most of the time during October through February, lower more often during March, April, July, and August, and higher more often during May, June, and September, as described in more detail below, and shown in Table 5-5.

Long-term average monthly flows below Nimbus Dam under Alternative 2 – Forecast-informed operations relative to Fixed-400,000 af flood storage operation are generally similar during most months of the year, but are slightly higher during November, May, June, and September, and slightly lower during March, April, July, and August. Average monthly flows during wet water years are similar during most months, with slight reductions during February, April, July, and August, and slight increases during December, June, and September. Average monthly flows during above-normal water years are generally slightly higher during October, November, January, May, and September, are substantially higher during June, and are lower during December, March, April, July, and August. During below-normal water years, average monthly flows are higher during January, February, June, and August, and lower during October, March, April, and July. During dry water years, average monthly flows are higher during January, February, and May through August, and are substantially lower during March and April. During critical water years, average monthly flows are higher during November, January through March, and July, and are lower during October, December, April, and August. Long-term average monthly flows and average monthly flow by water year type at Watt Avenue and at the mouth of the lower American River exhibit trends similar to those described for below Nimbus Dam.

Monthly flow exceedance distributions for Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation demonstrate that flows are generally similar most of the time during October through February, but are lower more often during March, April, July and August, and are higher more often during May, June and September (Figures 5-3 through 5-14). In addition, flows generally increase during a portion of the lowest-flow conditions (i.e., lowest 25 percent of the monthly distribution) during October through March, and July. By contrast, flows decrease during the lowest-flow conditions during April.

Long-term and Water Year Type Average Lower American River Flowbelow Nimbus Dam Under J602F3 ELD relative to E503p ELD												
Analysis Period	Flow (cfs)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Long-term												
Full Simulation Period ²												
400-fixed Existing Condition (E503p ELD)	2,172	3,074	3,477	4,596	4,945	4,348	3,686	3,622	3,507	3,518	2,468	2,577
With-Project (J602F3 ELD)	2,154	3,106	3,497	4,610	4,976	4,242	3,524	3,680	3,698	3,471	2,380	2,611
Difference	-18	32	20	14	31	-106	-162	58	191	-47	-88	34
Percent Difference ³	-0.8	1.0	0.6	0.3	0.6	-2.4	-4.4	1.6	5.4	-1.3	-3.6	1.3
Water Year Types ¹												
Wet												
400-fixed Existing Condition (E503p ELD)	2,352	3,838	5,812	8,564	8,428	7,150	5,826	6,156	5,924	3,607	3,485	3,836
With-Project (J602F3 ELD)	2,335	3,864	5,892	8,509	8,328	7,200	5,737	6,153	6,211	3,529	3,233	3,875
Difference	-17	26	80	-55	-100	50	-89	-3	287	-78	-252	39
Percent Difference ³	-0.7	0.7	1.4	-0.6	-1.2	0.7	-1.5	0.0	4.8	-2.2	-7.2	1.0
Above Normal												
400-fixed Existing Condition (E503p ELD)	2,070	3,567	3,313	5,692	6,898	6,125	3,891	3,418	2,685	4,290	2,270	3,727
With-Project (J602F3 ELD)	2,094	3,734	3,252	5,752	6,955	5,991	3,730	3,556	2,987	3,978	2,162	3,890
Difference	24	167	-61	60	57	-134	-161	138	302	-312	-108	163
Percent Difference ³	1.2	4.7	-1.8	1.1	0.8	-2.2	-4.1	4.0	11.2	-7.3	-4.8	4.4
Below Normal												
400-fixed Existing Condition (E503p ELD)	2,049	2,584	2,403	2,349	3,788	2,829	3,464	3,128	2,566	4,499	1,940	1,847
With-Project (J602F3 ELD)	2,028	2,573	2,423	2,388	3,933	2,687	3,203	3,152	2,811	4,393	1,965	1,834
Difference	-21	-11	20	39	145	-142	-261	24	245	-106	25	-13
Percent Difference ³	-1.0	-0.4	0.8	1.7	3.8	-5.0	-7.5	0.8	9.5	-2.4	1.3	-0.7
Dry												
400-fixed Existing Condition (E503p ELD)	2,262	2,650	1,953	1,704	1,735	2,192	2,012	1,653	2,182	3,257	2,016	1,532
With-Project (J602F3 ELD)	2,256	2,633	1,958	1,764	1,815	1,805	1,763	1,818	2,241	3,331	2,059	1,544
Difference	-6	-17	5	60	80	-387	-249	165	59	74	43	12
Percent Difference ³	-0.3	-0.6	0.3	3.5	4.6	-17.7	-12.4	10.0	2.7	2.3	2.1	0.8
Critical												
400-fixed Existing Condition (E503p ELD)	1,830	2,040	1,619	1,234	1,119	1,166	1,116	1,263	1,551	1,741	1,513	1,017
With-Project (J602F3 ELD)	1,758	2,100	1,587	1,281	1,226	1,194	1,039	1,271	1,538	1,895	1,497	1,018
Difference	-72	60	-32	47	107	28	-77	8	-13	154	-16	1
Percent Difference ³	-3.9	2.9	-2.0	3.8	9.6	2.4	-6.9	0.6	-0.8	8.8	-1.1	0.1
1 As defined by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB 1995)												
2 Based on the entire simulation period												
3 Relative difference of the monthly average												

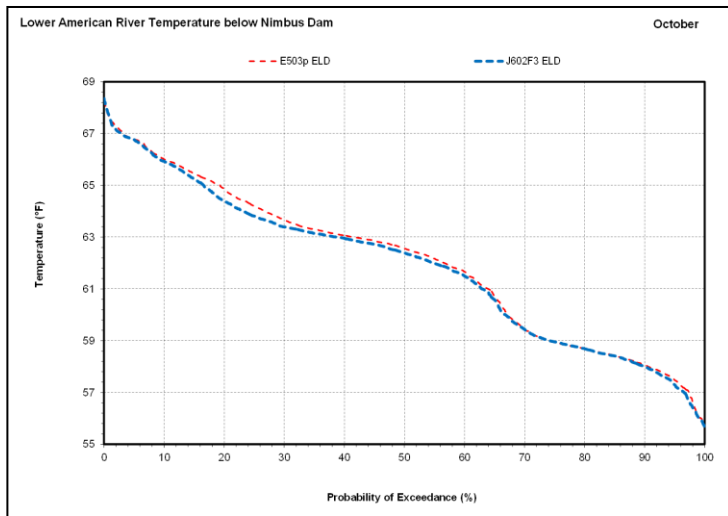


Figure 1-3. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for October under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

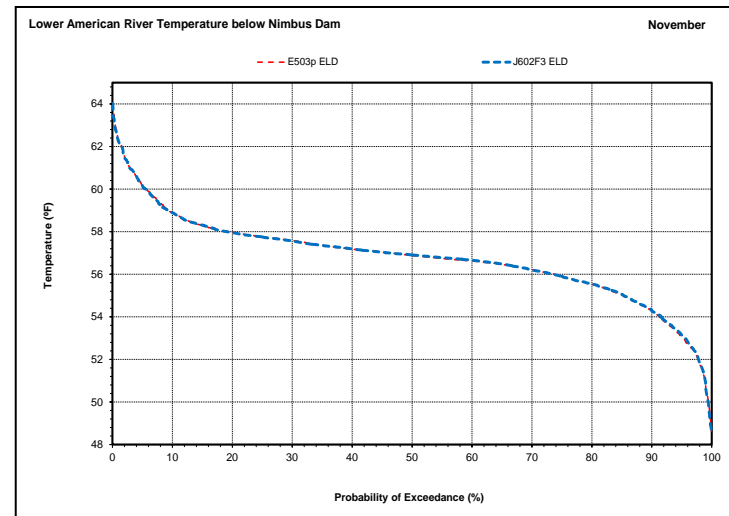


Figure 1-4. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for November under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

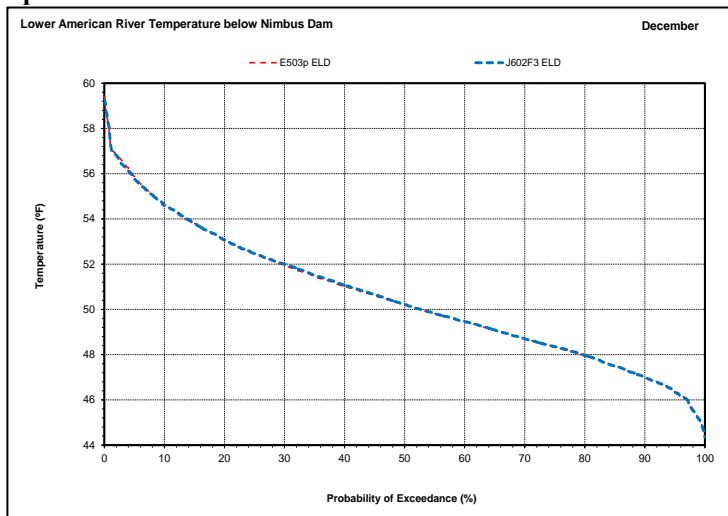


Figure 1-5. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for December under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation

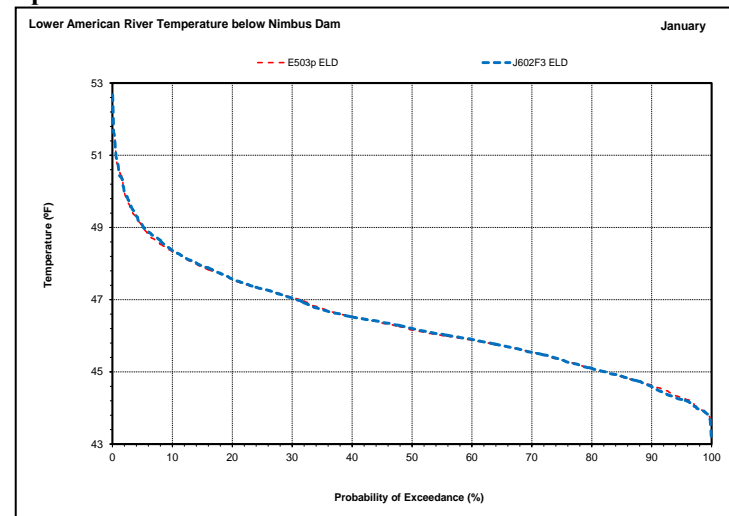


Figure 1-6. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for January under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation

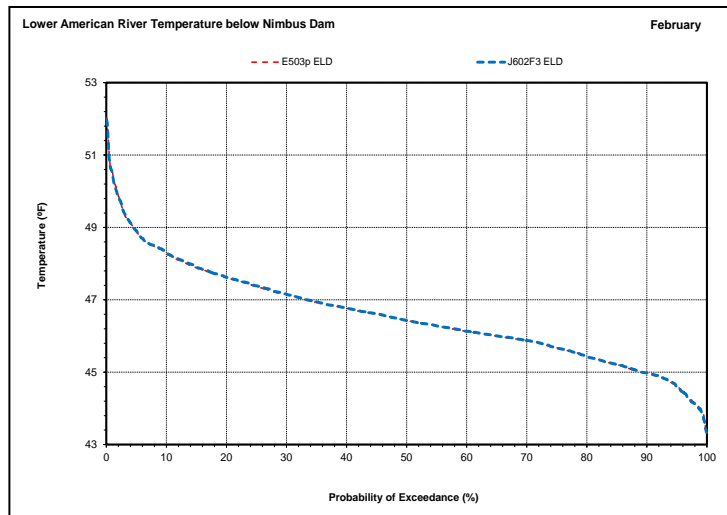


Figure 1-7. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for February under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

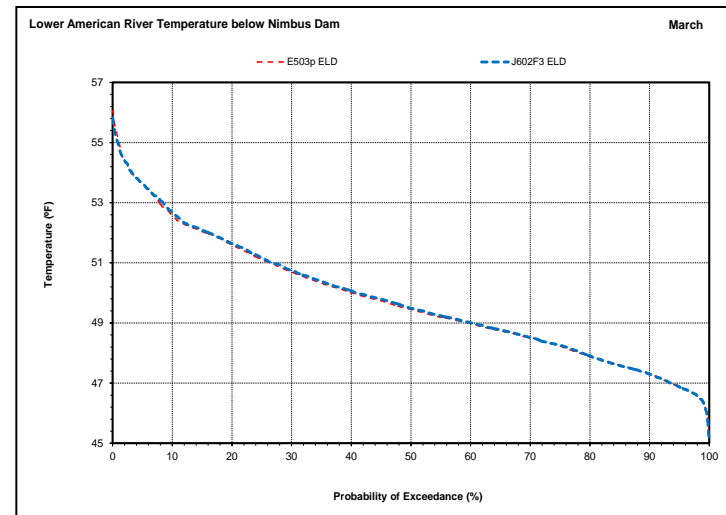


Figure 1-8. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for March under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

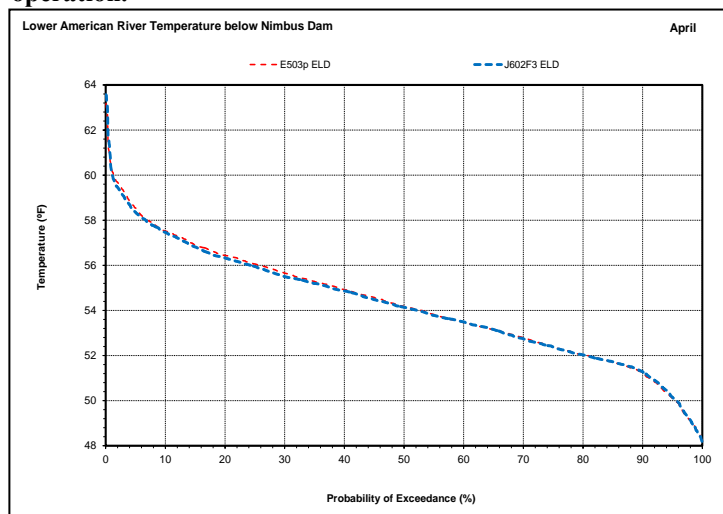


Figure 1-9. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for April under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation ELD.

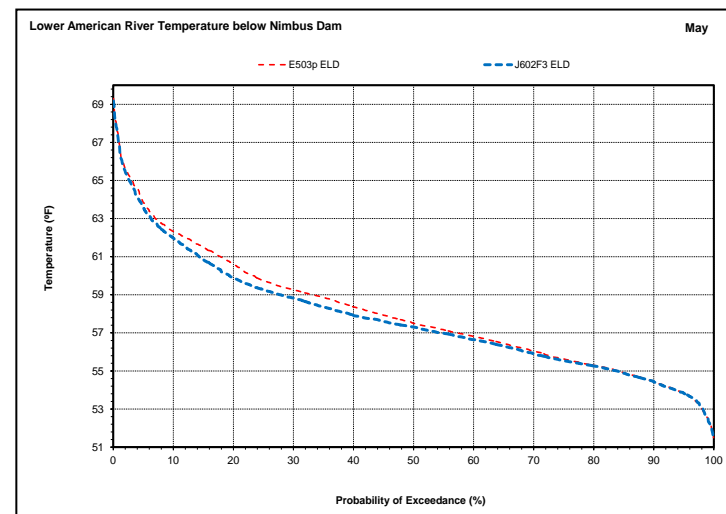


Figure 1-10. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for May under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

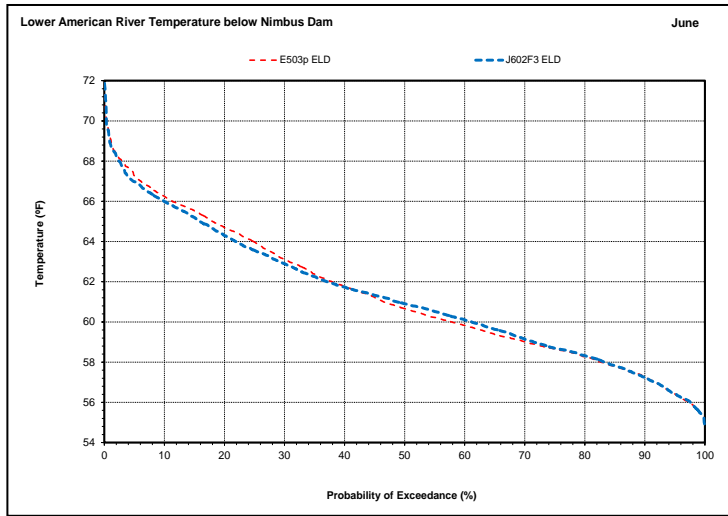


Figure 1-11. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for June under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

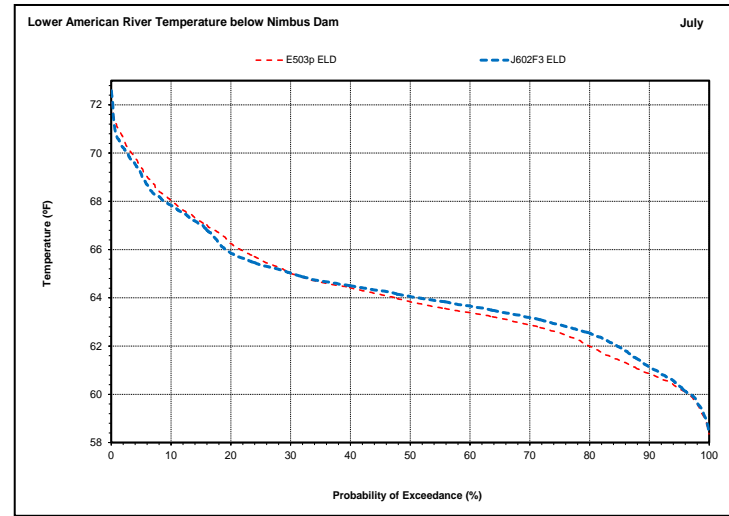


Figure 1-12. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for July under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

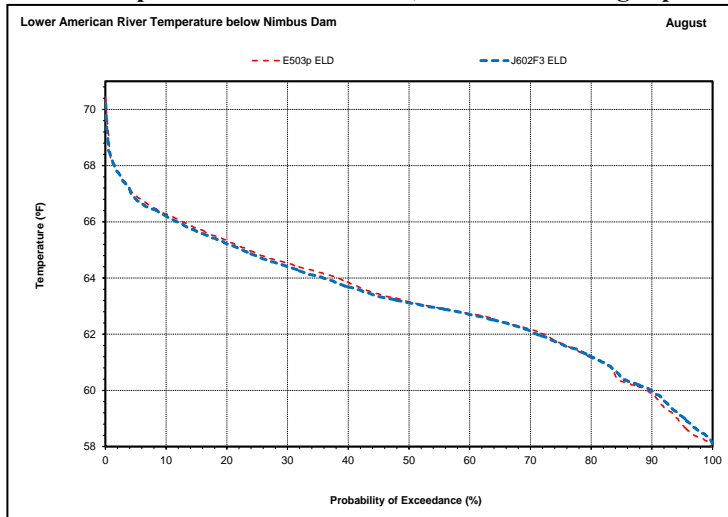


Figure 1-13. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for August under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

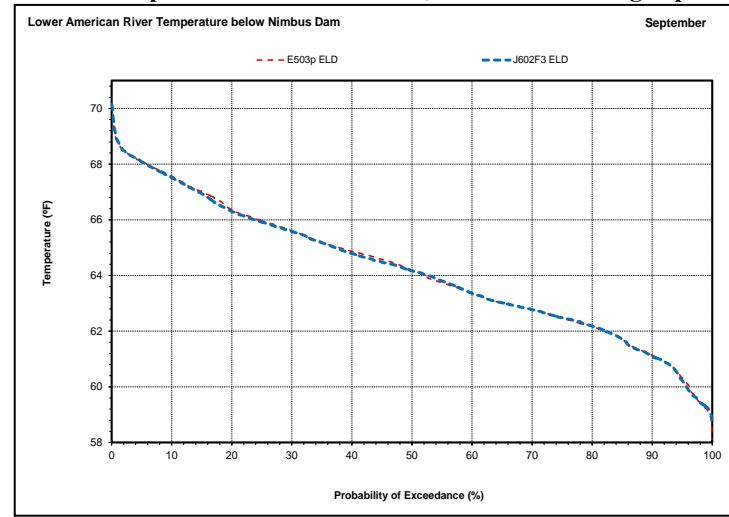


Figure 1-14. Lower American River Flow Probability of Exceedance Distributions below Nimbus Dam for September under Alternative 2 - Forecast-informed Operations and Fixed-400,000 af flood storage operation.

Monthly flow exceedance distributions at Watt Avenue and at the mouth of the lower American River exhibit similar trends as described for below Nimbus Dam.

In addition to evaluating general changes in the monthly flow exceedance distributions, net changes in flow of 10 percent or more are calculated based on the monthly exceedance distributions to determine whether flow increases by 10 percent or more with higher frequency, or whether flow decreases by 10 percent or more with higher frequency (i.e., the percentage of the time that flow increases by 10 percent or more minus the percentage of time that flow decreases by 10 percent or more). The net change in flow of 10 percent or more is evaluated on a monthly basis for below Nimbus Dam, at Watt Avenue and at the mouth of the lower American River for the entire distribution of flows, and/or for the lowest 40 percent of the distribution of flows, depending on the species and lifestage being evaluated.

Under Alternative 2 - Forecast-informed Operations relative to Fixed-400,000 af flood storage operation, net changes in flow at all three locations of 10 percent or more over the entire monthly distributions are generally similar (i.e., less than 5 percent) during August through January (Table 5-6). Flows increase by 10 percent or more with higher frequency during July, and with generally substantially higher frequency (i.e., 10 percent or more) during February, May and June. By contrast, flows decrease by 10 percent or more with substantially higher frequency during March and April.

Net changes in flow of 10 percent or more during low-flow conditions are generally similar (i.e., less than 5 percent) during May, June and September (Table 5-7). Net increases in flow of 10 percent or more occur with higher or substantially higher frequency during October through March, July and August, while a net decrease in flow of 10 percent or more occurs substantially more often during April under Alternative 2 - Forecast-informed Operations relative to Fixed-400,000 af flood storage operation.

Table 1-6. Monthly Net Changes in Flow of 10 Percent or More below Nimbus Dam, at Watt Avenue, and at the Mouth of the Lower American River

Indicator of Potential Impact	Location	Metric	Range	Net Change in Probability of Exceedance under J602F3 ELD relative to E503p ELD											
	Description	%		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean Daily Flow (cfs)	American River below Nimbus Dam	10	All Years	3	4	4	4	12	-11	-20	10	12	6	0	-1
	American River at Watt Avenue	10	All Years	3	4	4	3	10	-10	-18	11	12	7	0	-1
	Mouth of the American River (RM1)	10	All Years	3	4	3	-1	9	-10	-17	9	12	7	1	-1

Table 1-7. Monthly Net Changes in Flow of 10 Percent or More during Low-Flow Conditions below Nimbus Dam, at Watt Avenue, and at the Mouth of the Lower American River

Indicator of Potential Impact	Location	Metric	Range	Net Change in Probability of Exceedance under J602F3 ELD relative to E503p ELD											
	Description	%		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean Daily Flow (cfs)	American River below Nimbus Dam	10	Lower 40%	8	10	10	9	11	8	-19	0	0	10	6	-2
	American River at Watt Avenue	10	Lower 40%	8	10	10	10	11	8	-18	0	0	12	7	-2
	Mouth of the American River (RM1)	10	Lower 40%	8	10	7	0	6	7	-13	0	-1	12	7	-1

Based on the general changes in flows (described above) and water temperatures (see Riverine Temperature section below), as well as fish species and lifestage-specific flow and water temperature-related impact indicators presented below, potential changes in species and

lifestage-specific suitabilities under Alternative 2 - Forecast-informed Operations relative to Fixed-400,000 af flood storage operation are described in the following sections.

Riverine Temperatures

Simulated monthly water temperatures at representative nodes in the rivers in the local project area indicate that water temperatures under Alternative 2 - Forecast-informed Operations relative to Fixed-400,000 af flood storage operation are generally: (1) equivalent or similar most of the time in the Sacramento River, but are measurably cooler more often during August below Keswick Dam and during May at Freeport and are measurably warmer more often during July at Bend Bridge; (2) equivalent or similar most of the time in the Feather River below the Thermalito Afterbay Outlet and at the mouth; and (3) similar during most months in the lower American River, but with some measurably cooler water temperatures during late spring and early summer.

Changes in simulated water temperatures within each evaluated water body under Alternative 2 - Forecast-informed Operations relative to Fixed-400,000 af flood storage operation are summarized in Table 5-8 through Table 5-10 below.

Table 1-8. Riverine Water Temperatures for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation - Long-term Average and Average by Water Year Type

River and Location	Evaluation metrics and Summary of Effects	Results					
		Long-term and Water Year Type Average Water Temperature					
		Long-term	Wet	Above Normal	Below Normal	Dry	Critical
American River below Nimbus Dam	Generally similar long-term average water temperatures and average water temperatures by water year type during most months at all locations.	✓	✓	✓	✓	Cooler in May	✓
American River at Watt Avenue		✓	Warmer in Jul	Cooler in May	✓	Cooler in May	Cooler in Jul
American River at the mouth		✓	Warmer in Jul	Cooler in May	✓	Cooler in May	Cooler in Jul

Table 1-9. Riverine Water Temperatures for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation - Net Measurable Differences over Entire Monthly Exceedance Distributions

River and Location	Evaluation metrics and Summary of Effects	Results
		Entire Monthly Exceedance Distributions
American River below Nimbus Dam	Generally similar water temperatures over most of the monthly exceedance distributions at all locations.	Net measurable reductions in May & Jun
American River at Watt Avenue		Net measurable reduction in May
American River at the mouth		Net measurable increase in May & Jun; net increase in Aug

Table 1-10. Riverine Water Temperatures for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation - Net Measurable Differences over Warmest 25 percent of Monthly Exceedance Distributions

River and Location	Summary of Effects	Warmest 25 percent of the Monthly Exceedance Distributions
American River below Nimbus Dam	Generally similar water temperatures over most of the monthly exceedance distributions at all locations.	Net measurable reductions in May–Jul & Oct
American River at Watt Avenue		Net measurable reductions in May–Jul
American River at the mouth		Net measurable reductions in May– Jul

Note: “✓” refers to similar values of the evaluation metric for both scenarios.

Additional discussion of water temperature changes in the lower American River is provided below.

American River below Nimbus Dam

Long-term average monthly water temperatures in the American River below Nimbus Dam would be essentially equivalent during all months of the year. Monthly water temperatures by water year type would be generally similar during all months except for measurably cooler water temperatures during May of dry water years. Monthly water temperature exceedance probability distributions would be generally similar most of the time during all months, but are cooler during May through July and October.

Over the entire monthly distributions, net measurable decreases in water temperature would occur over 10 percent of the time during May and June. Over the warmest 25 percent of the monthly distributions, net measurable decreases in water temperature would occur over 10 percent or more in the distributions during May through July and October.

American River at Watt Avenue

Long-term average monthly water temperatures in the American River at Watt Avenue would be essentially equivalent during all months of the year. Monthly water temperatures by water year type would be generally similar during all months, except for measurably cooler water

temperatures during May of above-normal and dry water years and July of critical water years, and measurably warmer water temperatures during July of wet water years. Monthly water temperature exceedance probability distributions would be similar most of the time during all months, but are cooler for May through July.

Over the entire monthly distributions, net measurable decreases in water temperature would occur over 10 percent of the time during May. Over the warmest 25 percent of the monthly distributions, net measurable decreases in water temperature would occur over 10 percent or more in the distributions during May through July.

American River at the Mouth

Long-term average monthly water temperatures in the American River at the mouth (i.e., RM 1) would be essentially equivalent during all months of the year. Monthly water temperatures by water year type would be generally similar during all months, but would be measurably warmer during July of wet water years and measurably cooler during May of above-normal and dry water years and July of critical water years. Monthly water temperature exceedance probability distributions would be generally similar, but are slightly cooler for May through July and are slightly warmer for August.

Over the entire monthly distributions, net measurable decreases in water temperature would occur over 10 percent or more in the distributions during May and June, and a net measurable increase in water temperature would occur over 10 percent of the time during August. Over the warmest 25 percent of the monthly distributions, net measurable decreases in water temperature would occur over 10 percent or more in the distributions during May, June, and July.

Based on the general changes in flows (described above) and water temperatures (see Water Temperature section), as well as fish species and lifestage-specific flow and water temperature-related impact indicators presented below, potential changes in species and lifestage-specific suitabilities under Alternative 2 - Forecast-informed Operations relative to Fixed-400,000 af flood storage operation are described in the following sections.

Fish Species-specific Effects

Steelhead

Relative to the Fixed-400,000 af flood storage operation scenario, the With-Project Alternative 2 scenario would be expected to provide similar conditions for:

- a) Similar adult immigration (November through March) conditions, due similar flows during most months over the evaluation period, but with lower flows more often during March, and higher flows more often during February.
- b) Similar adult holding (November through March) conditions, due to the monthly flow exceedance distributions, similar flows during most months over the evaluation period, but with lower flows more often during March, and similar or higher flows more often

during February. Over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially greater frequency at both locations during March, and are higher by 10 percent or more with substantially higher frequency during February, with minor net changes in flow of 10 percent or more during November through January.

- c) Similar spawning conditions (January through mid-April [peaking during February]) due to similar long-term average spawning WUA and similar average spawning WUA during all water year types. Additionally, over the annual spawning WUA exceedance distribution, there was similar probability of spawning WUA equal to or greater than 80 percent of maximum spawning WUA, and generally similar spawning WUA over the distribution when spawning WUA is less than 80 percent of maximum under both scenarios. Embryo incubation (January through May [peaking during March]) conditions were similar due to similar long-term average annual redd dewatering index and similar average redd dewatering index during all water year types, and similar annual redd dewatering index over most of the exceedance distribution.
- d) Similar juvenile rearing and downstream movement (year-round) conditions due to: monthly flow exceedance distributions which show similar flows during October through January, but with higher flows more often during February, May, June, and September at most locations, and lower flows more often during March, April, July, and August at all locations. Flows are lower by 10 percent or more with substantially higher frequency during March and April at all locations, and are higher by 10 percent or more with higher or substantially higher frequency during February, and May through July at most locations and generally similar probabilities of exceeding UO and UT WTI values at all locations during most months, but with some slight decreases in exceedance probabilities during October, May, June, and August, and slight increases in exceedance during July and August at Watt Avenue and the mouth.
- e) Similar smolt emigration (December through April [peaking during January]) conditions over the monthly flow exceedance distributions include similar flows most of the time during December and January, higher flows more often during February, and lower flows more often during March and April at both locations. Flows are lower by 10 percent or more with substantially higher frequency during March and April, and are higher by 10 percent or more with higher or substantially higher frequency during February (no net difference in flow changes of 10 percent or more occur during December and January). During low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, and are higher by 10 percent or more with generally substantially higher frequency during December through March with generally similar water temperatures during all months of the evaluation period; and similar probabilities of exceeding UO and UT WTI values during all months at both locations, with the exception of a slight increase in the probability of exceeding the UO WTI value during March at the mouth.

Overall, in consideration of all flow and water temperature–related impact indicators, as well as peak lifestage-specific temporal considerations, and limiting factors and key stressors for

steelhead in the lower American River, habitat conditions are expected to be similar for steelhead under the Alternative 2 - Forecast-informed Operation.

Fall-run Chinook Salmon

Flow and water temperature model results were examined for the lower American River below Nimbus Dam, at Watt Avenue, and near the mouth of the lower American River (i.e., RM 1). Additional flow and water temperature nodes were used to simulate potential redd dewatering (i.e., daily water temperatures by river mile).

Relative to the Fixed-400,000 af flood storage operation scenario, the With-Project would be expected to provide:

- a) Similar adult immigration and staging (August through December [peaking during November]) conditions due to similar flows during October through December, lower flows during August, and similar or higher flows during September with minor net differences in flow changes of 10 percent or more during all months at all locations. During low-flow conditions, higher flows by 10 percent or more with substantially higher frequency during all months of the evaluation period, except during September when minor net differences in flow changes of 10 percent or more occur, and generally similar temperatures over the evaluation period, except during August at Watt Avenue and the mouth when temperatures are warmer. Similar monthly probabilities of exceeding both UO and UT WTI values at all locations, but with some slight reductions in exceedance during October and August, and a slight increase during August at the mouth.
- b) Similar spawning (mid-October through December [peaking during November]) conditions are generally equivalent to long-term average spawning WUA and average spawning WUA by water year type, and over the annual spawning WUA exceedance distribution, similar probability of spawning WUA equal to or greater than 80 percent of maximum spawning WUA, and generally similar spawning WUA when spawning WUA is less than 80 percent of maximum. Similar water temperatures occurred over the evaluation period, except for lower temperatures more often during October below Nimbus Dam. Similar probabilities of exceeding both UO and UT WTI values are expected during all months evaluated at both locations.
- c) Similar embryo incubation conditions (mid-October through March) were generally similar but slightly higher long-term average annual redd dewatering index and similar average redd dewatering index during most water year types, except for a slight increase during critical water years, along with similar or slightly higher annual redd dewatering index over most of the exceedance distribution. Similar water temperature over most of the monthly distributions, but with slightly lower temperatures more often during October below Nimbus Dam; and similar probabilities of exceeding both UO and UT WTI values are expected during all months evaluated at both locations.

- d) Similar annual long-term average early lifestage mortality and average annual early lifestage mortality by water year type and similar or slightly lower early lifestage annual mortality over most of the exceedance distribution.
- e) Similar juvenile rearing and downstream movement (January through May [peaking during February]) conditions due to similar flows during January, higher flows more often at most locations during February and May, and lower flows more often during March and April at all locations. Over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially higher frequency during March and April, and are higher by 10 percent or more with higher or substantially higher frequency during February and May, with minor net differences in flow changes of 10 percent or more during January. During low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, and are higher by 10 percent or more with higher or substantially higher frequency during January through March at most locations, with minor net differences in flow changes of 10 percent or more during May. Similar water temperatures more often over the evaluation period, except for lower temperatures during May at all locations, and similar probabilities of exceeding WTI values most of the time at all locations, but with slightly lower probabilities of exceedance during May at all locations.

Overall, in consideration of all flow and water temperature–related impact indicators, as well as peak lifestage-specific temporal considerations, and limiting factors and key stressors for salmonids in the lower American River, habitat conditions are expected to be generally similar for fall-run Chinook salmon under the Alternative 2 - Forecast-informed Operation.

Spring-run Chinook Salmon (non-natal juvenile rearing)

Flow and water temperature model results were examined for the lower American River near the mouth of the lower American River (i.e., RM 1) for non-natal juvenile rearing.

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation would be expected to provide less suitable non-natal juvenile rearing (November through April) conditions due to generally higher flows more often and lower flows more often with similar monthly frequency over the monthly flow exceedance distributions. During low flow conditions, generally slightly lower net changes in flow of 10 percent or more during January, March, and April, and higher flows by 10 percent or more with higher frequency during February would be expected. Overall, in consideration of all flow and water temperature-related impact indicators, habitat conditions are expected to be similar for spring-run Chinook salmon.

River Lamprey

Flow and water temperature model results were examined for the lower American River at Watt Avenue and near the mouth of the lower American River (i.e., RM 1).

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation would be expected to provide:

- a.) Similar adult immigration (September through June) conditions due to: (1) over the monthly flow exceedance distributions, similar flows during October through January, but with higher flows more often during February, May, and June, and lower flows more often during March and April; (2) over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially higher frequency during March and April, and are higher by 10 percent or more with higher or substantially higher frequency during February, May, and June; (3) during low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, and are higher by 10 percent or more with higher or substantially higher frequency during October through December, February, and March; (4) over the monthly water temperature exceedance distributions, similar water temperatures most of the time during October through April, and September at most locations, lower water temperatures more often during May and June, and higher water temperatures more often during August at most locations; and (5) similar probabilities of water temperatures occurring within the specified range during all months evaluated at both locations, but with a slighter higher probability of occurring within the range during May at Watt Avenue.
- b.) Similar spawning and embryo incubation (February through July) conditions, due to generally lower flows more often over the monthly flow exceedance distributions. During low flow conditions, lower flows by 10 percent or more with higher frequency during March and April, and higher flows by 10 percent or more with higher frequency during February, June and July; and generally similar monthly probabilities of water temperatures occurring within the specified range at both locations most of the time, but occurring within the specified range less often during February and May, and more often during July.
- c.) Similar ammocoete rearing and downstream movement (year-round) conditions due to: (1) over the monthly flow exceedance distributions, similar flows during October through January, but with higher flows more often during February, May, June, and September, and lower flows more often during March, April, July, and August; (2) over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially higher frequency during March and April, and are higher by 10 percent or more with higher or substantially higher frequency during February, and May through July; (3) during low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, and are generally higher by 10 percent or more with higher or substantially higher frequency during October through March, July, and August; (4) over the monthly water temperature exceedance distributions, similar water temperatures most of the time during October through April and during September, lower water temperatures more often during May and June, and higher water temperatures more often during August; and (5) similar monthly probabilities of exceeding the WTI value during all months evaluated at both locations.

Overall, in consideration of all flow and water temperature–related impact indicators, as well as peak lifestage-specific temporal considerations, habitat conditions are expected to be similar for river lamprey under Alternative 2 relative to the fixed 400,000 af flood storage operation condition.

Pacific Lamprey

Flow and water temperature model results were examined for the lower American River at Watt Avenue and near the mouth of the lower American River (i.e., RM 1).

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation would be expected to provide:

- a) Similar adult immigration (January through June) conditions due to: (1) over the monthly flow exceedance distributions, similar flows during January, but with higher flows more often during February, May, and June, and lower flows more often during March and April; (2) over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially higher frequency during March and April, and are higher by 10 percent or more with higher or substantially higher frequency during February, May, and June; (3) during low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, and are higher by 10 percent or more with higher or substantially higher frequency during January through March; (4) over the monthly water temperature exceedance distributions, similar water temperatures most of the time during January through April, and lower water temperatures more often during May and June; and (5) similar probabilities of water temperatures occurring within the specified range at both locations during all months evaluated, but with a slight increase in the probability of occurring within the range during May at Watt Avenue.
- b) Similar spawning and embryo incubation (March through August) conditions, as generally lower flows more often over the monthly flow exceedance distributions. During low flow conditions, lower flows by 10 percent or more with higher frequencies during March and April, and higher flows by 10 percent or more with higher frequencies during June and July; and generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range.
- c) Similar ammocoete rearing and downstream movement (year-round) conditions due to: (1) over the monthly flow exceedance distributions, similar flows during October through January, but with higher flows more often during February, May, June, and September, and lower flows more often during March, April, July, and August; (2) over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially higher frequency during March and April, and are higher by 10 percent or more with higher or substantially higher frequency during February, and May through July; (3) during low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, and are generally higher by 10 percent or more with higher or substantially higher frequency during October through March, July, and

August; (4) over the monthly water temperature exceedance distributions, similar water temperatures most of the time during October through April and during September, lower water temperatures more often during May and June, and higher water temperatures more often during August; and (5) similar monthly probabilities of exceeding the WTI value at both locations during all months.

Overall, in consideration of all flow and water temperature–related impact indicators, as well as peak lifestage-specific temporal considerations, habitat conditions are expected to be similar for Pacific lamprey under Alternative 2 relative to the fixed 400,000 af flood storage operation condition.

Hardhead

Flow and water temperature model results were examined for the lower American River at Watt Avenue.

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation would be expected to provide:

- a.) Similar adult and other lifestage (year-round) conditions due to: (1) over the monthly flow exceedance distributions, similar flows during October through January, but with higher flows more often during February, May, June, and September, and lower flows more often during March, April, July, and August; (2) over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially higher frequency during March and April, and are higher by 10 percent or more with higher or substantially higher frequency during February and during May through July; (3) during low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, and are generally higher by 10 percent or more with higher or substantially higher frequency during October through March, July, and August; (4) over the monthly water temperature exceedance distributions, similar water temperatures most of the time during October through April and during September, lower water temperatures more often during May and June, and higher water temperatures more often during August; and (5) similar monthly probabilities of water temperatures occurring within the specified range during all months, but with a slight reduction in the probability of occurring within the range during May (due to a reduction in water temperatures under Alternative 2).
- b.) Similar spawning (April through June) conditions due to: (1) over the monthly flow exceedance distributions, higher flows more often during May and June, and lower flows more often during April; (2) over the entire flow exceedance distributions, flows are lower by 10 percent or more with substantially higher frequency during April, and are higher by 10 percent or more with higher or substantially higher frequency during May and June; (3) during low-flow conditions, flows are lower by 10 percent or more with substantially higher frequency during April, with minor net differences in flow changes of 10 percent or more during May and June; (4) over the monthly water temperature exceedance distributions, similar water temperatures most of the time during April, and

lower water temperatures more often during May and June; and (5) similar monthly probabilities of water temperatures occurring within the specified range during all months evaluated, but with a slight increase in the probability of occurring within the range during April.

Overall, in consideration of all flow and water temperature–related impact indicators, as well as peak lifestage-specific temporal considerations, habitat conditions are expected to be similar for hardhead under Alternative 2 relative to the fixed 400,000 af flood storage operation condition.

Recreational Fisheries (Striped Bass and American Shad)

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation Striped bass and American shad would be expected to have similar adult attraction, adult immigration and spawning, and juvenile rearing and downstream movement conditions. White sturgeon would be expected to have similar adult immigration and holding, spawning and embryo incubation, and juvenile rearing and downstream movement conditions.

Overall, in consideration of all flow and water temperature–related impact indicators, as well as peak lifestage-specific temporal considerations, and limiting factors and key stressors for striped bass and American shad in the lower American River, habitat conditions are expected to be similar for these species under the Alternative 2 - Forecast-informed Operation.

Spawning Gravel Mobilization

As shown in Table 5-11, the number of days when flows would equal or exceed 30,000 cfs and 50,000 cfs would decrease with Alternative 2 compared to Fixed-400,000 af operations.

The minor decrease in flows that exceed 30,000 cfs (0.05 percent decrease) 50,000 cfs (0.02 percent decrease) would indicate that spawning gravel mobilization could experience a slight decrease when compared to the Fixed-400,000 af flood storage operation. However, the HEC-6T model indicates that regardless of how Folsom Dam is operated, the channel is likely to experience significant loss of gravel size sediment. Therefore, regardless of how Folsom Dam is operated, periodic gravel injection will be needed to replenish the gravel in the channel. It is inconclusive from the available information if the frequency of gravel injection would increase or decrease. Overall, effects of Alternative 2 on mobilization of lower American River spawning gravel would be considered less than significant compared to Fixed-400,000 af flood storage operations.

Table 1-11. Spawning Gravel Mobilization Flows Comparison of Fixed-400,000 af Flood Storage Operation and Alternative 2 - Forecast-informed operations.

	Fixed-400,000 af Flood Storage Operation		Alternative 2 - Forecast-informed operations	
	Number of Days	percent of Period of Record	Number of Days	percent of Period of Record

Number of days with American River flows below Nimbus Dam in excess of 30,000 cfs	130	0.44 percent	114	0.39 percent
Number of days with American River flows below Nimbus Dam in excess of 50,000 cfs	39	0.13 percent	33	0.11 percent

Sacramento River

For salmonid species, flow and water temperature model results were examined for the Sacramento River below Keswick Dam, at Ball's Ferry, at Jelly's Ferry, at Bend Bridge, at Red Bluff, at Verona, below the Feather River confluence, and at Freeport. In addition to flow and water temperature modeling, model results were examined for spawning habitat availability (weighted usable area, or WUA) for salmonid species. Modeling results for other fish species are described separately.

The species and lifestage-specific interpretive comparisons below are based on numerous outputs including: (1) long-term average and average by water year type riverine flows on a monthly basis; (2) monthly riverine flow exceedance distributions; (3) monthly water temperature exceedance distributions in relation to specific water temperature index values; (4) long-term average and average by water year type annual spawning habitat availability for anadromous salmonids; (5) annual spawning habitat availability exceedance distributions for anadromous salmonids; (6) long-term average and average by water year type monthly Delta outflow, Old and Middle River flow, and Delta exports; (7) monthly exceedance distributions for Delta outflow, Old and Middle River flow, and Delta exports; (8) long-term average and average by water year type monthly X2 location; and (9) monthly X2 location exceedance distributions.

Winter-run Chinook Salmon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration (November through July) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at all locations except Freeport; and (4) generally equivalent monthly probabilities of exceeding both UO and UT WTI values at all locations evaluated.

- b) Similar adult holding (November through July) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.3 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more during all months at both locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at both locations; and (4) generally equivalent monthly probabilities of exceeding both UT and UO WTI values at both locations evaluated.
- c) Similar spawning (April through August) and embryo (April through September) incubation conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.3 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent or similar net changes in flow of 10 percent or more during all months at both locations evaluated, except during July when flows are lower by 10 percent or more with slightly higher frequency (1.2 percent); (4) generally equivalent or similar long-term average spawning WUA and similar spawning WUA by water year type; (5) over the annual spawning WUA exceedance distribution, generally equivalent or similar spawning WUA over most of the distribution, with slightly more spawning WUA over about 20 percent of the middle portion of the distribution; and (6) equivalent or similar probabilities of exceeding both UO and UT WTI values most of the time at all locations, with slightly reduced exceedance probabilities below Keswick Dam (1.8 percent) during September and at Bend Bridge during August (2.4 percent), and slightly increased (1.3 percent) exceedance probabilities at Ball's Ferry during September .
- d) Similar juvenile rearing and downstream movement (July through March) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time at all locations, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at all locations except Freeport; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values during all months at all locations, but with a slightly higher probability of exceedance during October at Freeport.

In consideration of the general similarity of impact indicators to all lifestages of winter-run Chinook salmon in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation, no further evaluations are necessary.

Spring-run Chinook Salmon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration (March through September) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent or similar net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at all locations except Freeport; and (4) generally equivalent or similar monthly probabilities of exceeding both UO and UT WTI values at all locations evaluated.
- b) Similar adult holding (March through September) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.3 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more during all months at both locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at both locations; and (4) generally equivalent or similar monthly probabilities of exceeding both UT and UO WTI values at both locations evaluated.
- c) Similar spawning (September and October) and embryo incubation (September through January) conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types but with some slight increases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent net changes in flow of 10 percent or more during all months at both locations; and (4) equivalent or similar probabilities of exceeding both UO and UT WTI values most of the time at all locations, but with slightly increased (1.3 percent) exceedance probabilities at Ball's Ferry during September and slightly decreased (1.8 percent) exceedance probabilities below Keswick Dam during September.
- d) Similar juvenile rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and slightly lower average monthly flow during March and April at Freeport, and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.4 percent) in average monthly

flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time at all locations, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at all locations evaluated; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values during all months at all locations.

- e) Generally equivalent smolt emigration (October through May) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values at all locations evaluated during all months of the evaluation period.

In consideration of the general similarity of impact indicators to all lifestages of spring-run Chinook salmon in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Fall-run Chinook Salmon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration and staging (July through December) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and some slight decreases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent or similar net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (about 3 percent) below Keswick Dam and at Verona; and (4) generally equivalent or similar monthly probabilities of exceeding both UO and UT WTI values at all locations evaluated, except for a slightly increased probability of exceedance during July at Red Bluff (1.4 percent).
- b) Similar spawning (October through December) and embryo incubation (October through March) conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent net changes in flow of 10 percent or more during all months at both locations; (4) generally similar long-term average spawning

WUA and similar spawning WUA by water year type; (5) over the annual spawning WUA exceedance distribution, generally equivalent or similar spawning WUA over the entire distribution; and (6) equivalent or similar probabilities of exceeding both UO and UT WTI values most of the time at all locations.

- c) Similar juvenile rearing and downstream movement (December through July) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time at all locations, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at Bend Bridge and Verona; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values during all months at all locations.

In consideration of the general similarity of impact indicators to all lifestages of fall-run Chinook salmon in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Late Fall-run Chinook Salmon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration and staging (October through April) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent or similar monthly probabilities of exceeding both UO and UT WTI values at all locations evaluated.
- b) Similar spawning (January through April) and embryo incubation (January through June) conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with a slight increase of 1.4 percent in average monthly flow below Keswick Dam during May of above-normal water years; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent net changes in flow of 10 percent or more during all months at both locations; (4) generally similar long-term average spawning WUA and similar spawning WUA by water year type; (5) over the annual spawning WUA exceedance distribution, generally equivalent or similar spawning WUA over the entire distribution; and (6) equivalent or

similar probabilities of exceeding both UO and UT WTI values most of the time at all locations.

- c) Similar juvenile rearing and downstream movement (April through December) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period, except for slightly lower average monthly flow during April at Freeport, and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time at all locations, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam and at Verona; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values during all months at all locations.

In consideration of the general similarity of impact indicators to all lifestages of late fall-run Chinook salmon in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Steelhead

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration (August through March) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent or similar monthly probabilities of exceeding both UO and UT WTI values at all locations evaluated.
- b) Similar adult holding (August through March) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and slight decreases (up to 1.2 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent or similar net changes in flow of 10 percent or more during all months at both locations evaluated; and (4) generally equivalent or similar monthly probabilities of exceeding both UT and UO WTI values at both locations evaluated.

- c) Similar spawning (December through April) and embryo incubation (December through May) conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent net changes in flow of 10 percent or more during all months at both locations; (4) generally equivalent long-term average spawning WUA and spawning WUA by water year type; (5) over the annual spawning WUA exceedance distribution, generally equivalent spawning WUA over the entire distribution; and (6) equivalent or similar probabilities of exceeding both UO and UT WTI values most of the time at all locations, except for a slightly (2.4 percent) reduced probability of exceedance at Bend Bridge during May.
- d) Similar juvenile rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time at all locations, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) at all locations; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values during all months at all locations.
- e) Similar smolt emigration (January through June) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values at all locations evaluated during all months of the evaluation period, except for a slightly higher probability of exceedance during March at Freeport (2.4 percent).

In consideration of the general similarity of impact indicators to all lifestages of steelhead in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Green Sturgeon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration and holding (February through July) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value at all locations evaluated.
- b) Similar spawning and embryo incubation (March through August) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 1.8 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value at all locations evaluated.
- c) Similar adult post-spawning holding and emigration (July through November) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and some slight decreases (up to 1.3 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value at all locations evaluated.
- d) Similar juvenile rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 2.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value at all locations evaluated.

In consideration of the general similarity of impact indicators to all lifestages of green sturgeon in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

River Lamprey

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration (September through June) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range at all locations evaluated, but with a slightly lower probability of occurring within the specified range at Wilkins Slough during October.
- b) Similar spawning and embryo incubation (February through July) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 2.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified ranges at all locations evaluated, except for a slightly higher probability of occurring within the specified range during March below Keswick Dam (1.3 percent) and a slightly lower probability of occurring within the specified range during July at Red Bluff (1.4 percent).
- c) Similar ammocoete rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 2.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam; and (4) generally

equivalent or similar monthly probabilities of exceeding both UO and UT WTI values at all locations evaluated.

In consideration of the general similarity of impact indicators to all lifestages of river lamprey in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Pacific Lamprey

Relative to the Fixed-400,000 af flood storage operation scenario, Alternative 2 – Forecast-informed operations is expected to provide:

- a) Similar adult immigration (January through June) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent monthly probabilities of water temperatures occurring within the specified range at all locations evaluated.
- b) Similar spawning and embryo incubation (March through August) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.4 percent) and decreases (up to 2.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range at all locations evaluated, except for a slightly higher probability of occurring within the specified range during March below Keswick Dam and a slightly lower probability of occurring within the specified range during July at Red Bluff.
- c) Similar ammocoete rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 2.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam; and (4) generally

equivalent or similar monthly probabilities of exceeding both UO and UT WTI values at all locations evaluated.

In consideration of the general similarity of impact indicators to all lifestages of Pacific lamprey in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Hardhead

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult and other lifestage (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during July when flows are lower by 10 percent or more with somewhat higher frequency (3 percent) below Keswick Dam and at Verona; and (4) generally equivalent monthly probabilities of water temperatures occurring within the specified range at all locations evaluated.
- b) Similar spawning (April through June) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated, except for slightly lower average monthly flow during April at Freeport, and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight increases (up to 1.6 percent) and decreases (up to 1.1 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months at all locations evaluated; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range at all locations evaluated.

In consideration of the general similarity of impact indicators to all lifestages of hardhead in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Recreational Fisheries (White Sturgeon, Striped Bass and American Shad)

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation Striped bass and American shad would be expected to have similar adult immigration, juvenile rearing and downstream movement conditions. White sturgeon would be expected to have similar adult immigration and holding, spawning and embryo incubation, and juvenile rearing and downstream movement conditions.

In consideration of the general similarity of impact indicators to all lifestages of white sturgeon, striped bass and American shad in the Sacramento River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Feather River

Flow and water temperature model results were examined for the Feather River below the Fish Barrier Dam, below the Thermalito Afterbay Outlet, and at the mouth of the Feather River. In addition to flow and water temperature modeling, Model results were examined for spawning habitat availability (WUA) for salmonid species.

Flows in the Low Flow Channel below the Fish Barrier Dam were modeled consistent with the terms of the California Department of Water Resources' agreement with the California Department of Fish and Wildlife. Modeled results for long-term average flows, average flows by water year type, and flow exceedance probabilities during all years and during low-flow conditions were equivalent for the Folsom WCM alternatives relative to the baseline scenarios. Although these results are not repeated for the discussions below, the model results were considered for the Low Flow Channel below the Fish Barrier Dam along with the information presented below and incorporated them into the impact determinations for spring-run Chinook salmon, fall-run Chinook salmon, steelhead, river lamprey, Pacific lamprey, and hardhead.

Spring-run Chinook Salmon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Generally similar adult immigration (March through September) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows by water year type most of the time during all water year types, but with some increases (up to 3.0 percent) and decreases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more most of the time, but with lower flows by 10 percent or more with somewhat higher frequency during June below the Thermalito Afterbay Outlet and at the mouth and during September below the Thermalito Afterbay Outlet (3 percent) and with higher flows by 10 percent or more with somewhat higher frequency (about 3 percent–6.1 percent) during August at both the above locations; and (4) generally equivalent monthly probabilities of exceeding both UO and UT WTI values.
- b) Similar adult holding (March through September) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows by water year type most of the time during all water year types, but with an increase of 3.0 percent and decrease of 1.4 percent in

average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more most of the time, but with lower flows by 10 percent or more with slightly higher frequency (about 3 percent) during June and September below the Thermalito Afterbay Outlet, and with higher flows by 10 percent or more with somewhat higher frequency (about 6.1 percent) during September below the Thermalito Afterbay Outlet; and (4) generally equivalent or similar monthly probabilities of exceeding both UO and UT WTI values.

- c) Similar spawning (September through October) and embryo incubation (September through February) conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with an increase of 3 percent and decrease of 2.9 percent in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent or similar net changes in flow of 10 percent or more, except for an decrease in flow of 10 percent or more with slightly higher frequency (1.2 percent) during September below the Thermalito Afterbay Outlet; (4) generally equivalent long-term average spawning WUA and equivalent or similar average spawning WUA by water year type; (5) over the annual spawning WUA exceedance distribution, generally equivalent or similar spawning WUA over the entire distribution, with spawning WUA always above 80 percent of maximum under both scenarios; and (6) equivalent or similar probabilities of exceeding both UO and UT WTI values.
- d) Similar juvenile rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows by water year type most of the time, but with some increases (up to 3 percent) and decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time but with lower flows by 10 percent or more with somewhat higher frequency (3 percent) during June at the mouth and during June and September below the Thermalito Afterbay Outlet, and with higher flows by 10 percent or more with higher frequency during August at the mouth (3 percent) and below the Thermalito Afterbay Outlet (6.1 percent); and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values, except for slightly reduced probabilities of exceedance during September below the Thermalito Afterbay Outlet.
- e) Similar smolt emigration (October through June) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows by water year type most of the time, but some decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time, but with lower flows by 10 percent or more with slightly higher

frequency (3 percent) during June at both locations; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values during all months of the evaluation period.

In consideration of the general similarity of impact indicators to all lifestages of spring-run Chinook salmon in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Fall-run Chinook Salmon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar spawning (October through December) and embryo incubation (October through March) conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types, but with a slight decrease of about 2.9 percent in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent or similar net changes in flow of 10 percent or more most of the time, but with lower flows by 10 percent or more with slightly higher frequency (2.4 percent) during November below the Thermalito Afterbay Outlet; (4) generally equivalent long-term average spawning WUA and average spawning WUA by water year type; (5) over the annual spawning WUA exceedance distribution, generally equivalent or similar spawning WUA over the entire distribution, with spawning WUA always above 80 percent of maximum under both scenarios; and (6) equivalent or similar probabilities of exceeding both UO and UT WTI values.
- b) Similar juvenile rearing and downstream movement (November through June) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows by water year type most of the time, but with some slight increases (up to 3 percent) and decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more most of the time, but with lower flows by 10 percent or more with slightly higher frequency (3 percent) during June at both locations; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values.

In consideration of the general similarity of impact indicators to all lifestages of fall-run Chinook salmon in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Steelhead

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Generally similar adult immigration (August through March) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows by water year type most of the time, but with some slight increases (up to 3 percent) and decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more most of the time, but with higher flows by 10 percent or more with somewhat higher frequency (about 3 percent–6.1 percent) during August below the Thermalito Afterbay Outlet and at the mouth and lower flows by 10 percent or more with slightly higher frequency (3 percent) during September below the Thermalito Afterbay Outlet; and (4) generally equivalent or similar monthly probabilities of exceeding both UO and UT WTI values.
- b) Similar adult holding (August through March) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows by water year type most of the time, but with some slight increases (up to 3 percent) and decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, generally equivalent net changes in flow of 10 percent or more most of the time, but with higher flows by 10 percent or more with somewhat higher frequency (about 3 percent–6.1 percent) during August below the Thermalito Afterbay Outlet and at the mouth and lower flows by 10 percent or more with slightly higher frequency (3 percent) during September below the Thermalito Afterbay Outlet; and (4) generally equivalent or similar monthly probabilities of exceeding both UO and UT WTI values.
- c) Similar spawning (January through April) and embryo incubation (January through May) conditions due to: (1) generally equivalent long-term average monthly flows during the evaluation period and generally equivalent or similar average monthly flows during all water year types; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) equivalent net changes in flow of 10 percent or more; (4) generally equivalent long-term average spawning WUA and equivalent or similar average spawning WUA by water year type; (5) over the annual spawning WUA exceedance distribution, generally equivalent or similar amounts of spawning WUA over the entire distribution; and (6) equivalent or similar probabilities of exceeding both UO and UT WTI values.
- d) Similar juvenile rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows by water year type most of the time, but with some increases (up to 3 percent) and decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or

similar net changes in flow of 10 percent or more most of the time, but with lower flows by 10 percent or more with slightly higher frequency (3 percent) during June and September below the Thermalito Afterbay Outlet, and with higher flows by 10 percent or more with higher frequency (6.1 percent) during August below the Thermalito Afterbay Outlet; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values at both locations throughout the evaluation period.

- e) Similar smolt emigration (October through April) conditions due to: (1) generally equivalent long-term average monthly flows over the evaluation period and generally equivalent or similar average monthly flows by water year type most of the time, but with a some slight decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent or similar net changes in flow of 10 percent or more; and (4) generally equivalent or similar probabilities of exceeding UO and UT WTI values throughout the evaluation period.

In consideration of the general similarity of impact indicators to all lifestages of steelhead in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Green Sturgeon

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration and holding (February through November) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some increases (up to 3.0 percent) and decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, but with lower flows of 10 percent or more with somewhat higher frequency (3 percent) at both locations during June and below the Thermalito Afterbay Outlet in September, and higher flows of 10 percent or more with somewhat higher frequency at the mouth of the lower Feather River (3 percent) and below the Thermalito Afterbay Outlet (6.1 percent) during August; and (4) generally equivalent or similar monthly probabilities of exceeding both the specified WTI value at both locations throughout the evaluation period.
- b) Similar spawning and embryo incubation (March through August) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight decreases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more during all months evaluated, except during June when flows are

lower by 10 percent or more with higher frequency (3 percent) and flows are higher by 10 percent or more with higher frequency (6.1 percent) during August; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value.

- c) Similar juvenile rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some increases (up to 3 percent) and some decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, but with lower flows of 10 percent or more with somewhat higher frequency (3 percent) at both locations during June and below the Thermalito Afterbay Outlet in September, and higher flows of 10 percent or more with somewhat higher frequency at the mouth of the lower Feather River (3 percent) and below the Thermalito Afterbay Outlet (6.1 percent) during August; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value.

In consideration of the general similarity of impact indicators to all lifestages of green sturgeon in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

River Lamprey

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration (September through June) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some increases (up to 3 percent) and some decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, but with lower flows of 10 percent or more with higher frequency (3 percent) at both locations during June and below the Thermalito Afterbay Outlet during September; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range, except for a slight decrease (1.3 percent) in the probability of occurring within the range during May below the Thermalito Afterbay Outlet.
- b) Similar spawning and embryo incubation (February through July) conditions due to: (1) generally equivalent long-term average monthly flows and generally equivalent or similar average monthly flows most of the time during all water year types, but with a decreases of 1.4 percent in average monthly flow during June of dry years below the Thermalito Afterbay Outlet; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net

changes in flow of 10 percent or more during all months at all locations evaluated, except during June when flows are lower by 10 percent or more with slightly higher frequency (3 percent) below the Thermalito Afterbay Outlet; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range.

- c) Similar ammocoete rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some increases (up to 3 percent) and some decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, but with lower flows of 10 percent or more with somewhat higher frequency (3 percent) at both locations during June and below the Thermalito Afterbay Outlet in September, and higher flows of 10 percent or more with somewhat higher frequency at the mouth of the lower Feather River (3 percent) and below the Thermalito Afterbay Outlet (6.1 percent) during August; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value.

In consideration of the general similarity of impact indicators to all lifestages of river lamprey in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Pacific Lamprey

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult immigration (January through June) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some slight decreases (up to 1.4 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, but with lower flows of 10 percent or more with higher frequency (3 percent) at both locations during June; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range but with a slight decrease in probability of 1.3 percent during May below the Thermalito Afterbay Outlet.
- b) Similar spawning and embryo incubation (March through August) conditions due to: (1) generally equivalent long-term average monthly flows and generally equivalent or similar average monthly flows most of the time during all water year types, but with a decrease of 1.4 percent in average monthly flow during June of dry water years below the Thermalito Afterbay Outlet; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions,

equivalent net changes in flow of 10 percent or more during all months at all locations evaluated, except during June when flows are lower by 10 percent or more with higher frequency (3 percent) below the Thermalito Afterbay Outlet and during August when flows are higher by 10 percent or more with higher frequency (3 percent) below the Thermalito Afterbay Outlet; and (4) generally equivalent monthly probabilities of water temperatures occurring within the specified range.

- c) Similar ammocoete rearing and downstream movement (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some increases (up to 3 percent) and some decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, but with lower flows of 10 percent or more with somewhat higher frequency (3 percent) at both locations during June and below the Thermalito Afterbay Outlet in September, and higher flows of 10 percent or more with somewhat higher frequency at the mouth of the lower Feather River (3 percent) and below the Thermalito Afterbay Outlet (6.1 percent) during August; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value.

In consideration of the general similarity of impact indicators to all lifestages of Pacific lamprey in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Hardhead

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult and other lifestage (year-round) conditions due to: (1) generally equivalent long-term average monthly flows at all locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with some increases (up to 3 percent) and some decreases (up to 2.9 percent) in average monthly flow; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, but with lower flows of 10 percent or more with somewhat higher frequency (3 percent) at both locations during June and below the Thermalito Afterbay Outlet in September, and higher flows of 10 percent or more with somewhat higher frequency at the mouth of the lower Feather River (3 percent) and below the Thermalito Afterbay Outlet (6.1 percent) during August; and (4) generally equivalent or similar monthly probabilities of exceeding the specified WTI value.
- b) Similar spawning (April through June) conditions due to: (1) generally equivalent long-term average monthly flows at both locations evaluated and generally equivalent or similar average monthly flows most of the time during all water year types, but with a

decrease of 1.4 percent in average monthly flow during June of dry water years below the Thermalito Afterbay Outlet; (2) generally equivalent or similar flows most of the time over the monthly flow exceedance distributions; (3) during low-flow conditions, equivalent net changes in flow of 10 percent or more most of the time, except for a reduction in flow by 10 percent or more with higher frequency (3 percent) during June below the Thermalito Afterbay Outlet; and (4) generally equivalent or similar monthly probabilities of water temperatures occurring within the specified range.

In consideration of the general similarity of impact indicators to all lifestages of hardhead in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Recreational Fisheries (White Sturgeon, Striped Bass and American Shad)

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation Striped bass and American shad would be expected to have similar adult immigration, juvenile rearing and downstream movement conditions. White sturgeon would be expected to have similar adult immigration and holding, spawning and embryo incubation, and juvenile rearing and downstream movement conditions.

In consideration of the general similarity of impact indicators to all lifestages of white sturgeon, striped bass and American shad in the Feather River under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Sacramento-San Joaquin Delta and Yolo Bypass

Old and Middle River (OMR) flows and X2 location for Delta smelt and longfin smelt were modeled. Delta outflow and water temperatures in the Sacramento River at Freeport for Delta smelt were also examined.

Model results for Sacramento River flows at Rio Vista, Yolo Bypass outflow, Delta outflow, and OMR flows for all runs of Central Valley Chinook salmon and Central Valley steelhead were examined. OMR flows were also examined for adult San Joaquin River fall- and late fall-run Chinook salmon.

In addition, the Yolo Bypass outflow for Delta smelt, splittail, green sturgeon, and white sturgeon, as well as the X2 location for American shad and striped bass were examined. Exports at the SWP and CVP export facilities year-round were modeled. The model results showed that: (1) long-term average monthly total SWP and CVP Delta exports would be generally equivalent year-round; (2) average total Delta exports by water year type would be generally equivalent, except for some slight increases (up to 1.5 percent) and decreases (up to 3.8 percent) during some months of dry and critical water years; and (3) monthly exceedance distributions would be generally similar year-round. For these reasons, no further evaluations were conducted to evaluate fish salvage at the SWP and CVP export facilities.

Delta Smelt in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult conditions due to: (1) equivalent or similar monthly probabilities of water temperatures at Freeport occurring within the specified water temperature range (December through May); (2) equivalent probabilities of X2 occurring between 74 and 81 river kilometers (Rkm) during wet and above-normal water years (September through November); and (3) generally equivalent monthly probabilities of OMR flows being more negative than -5,000 cfs (December through February).
- b) Similar adult spawning conditions in the Yolo Bypass (December through May) due to generally equivalent or similar net changes in Yolo Bypass outflow of 10 percent or more during the evaluation period, with the exception of January when flows would be reduced by 10 percent or more with a higher (8.5 percent) frequency. However, all of the 10 percent or greater reductions in flow over the exceedance distribution would occur when Yolo Bypass outflow is less than about 40 cfs; therefore, these reductions are not expected to affect inundation extent or frequency in the Yolo Bypass.
- c) Similar egg and embryo conditions (February through May), because of equivalent or similar monthly probabilities of water temperatures at Freeport occurring within the specified water temperature range.
- d) Similar larvae conditions (March through June) due to: (1) similar monthly probabilities of water temperatures at Freeport occurring within the specified water temperature range; (2) during March through June of dry and critical water years, generally equivalent probabilities of mean monthly OMR flows being more negative than -1,500 cfs; and (3) and generally equivalent net changes of 10 percent or more in mean monthly Delta outflow.
- e) Similar juvenile conditions (May through July) due to: (1) similar monthly probabilities of water temperatures at Freeport occurring within the specified water temperature range; and (2) between 65 and 80 Rkm, X2 location moves upstream by 0.5 Rkm or more with generally similar frequency, including a 1.2-percent reduction in frequency during May and a 2.4-percent increase in frequency during June.

In consideration of the general similarity of impact indicators to all lifestages of Delta smelt in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Longfin Smelt in the Delta Region

Relative to the 400-fixed Flood Storage Operation Existing Condition scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult conditions (December through March), because of generally equivalent monthly probabilities of OMR flows being more negative than -5,000 cfs.
- b) Generally similar larvae and juvenile conditions, because: (1) during April and May of dry and critical water years, the probabilities of mean monthly OMR flows being more negative than -1,500 cfs would be generally equivalent, and the probabilities of mean monthly OMR flows being less than 0 would be generally equivalent; (2) for all water years during January through June, mean monthly X2 location would occur downstream of 75 Rkm with generally similar frequency during all months evaluated; and (3) for dry and critical water years only during January through June, mean monthly X2 location would occur downstream of 75 Rkm with generally equivalent frequencies during all months evaluated.

In consideration of the general similarity of impact indicators to all lifestages of longfin smelt in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Winter-run Chinook Salmon in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar juvenile and emigration conditions (November through May) due to: (1) generally equivalent net changes in mean monthly Rio Vista flows of 10 percent or more; (2) generally equivalent or similar net changes in mean monthly Yolo Bypass outflow of 10 percent or more, except during January when flows would be lower by 10 percent or more with higher frequency (8.5 percent; see the previous discussion for Delta smelt); (3) generally equivalent or similar net changes in mean monthly Delta outflow of 10 percent or more; and (4) generally equivalent probabilities of OMR flows being more negative than -2,500 cfs.

In consideration of the general similarity of impact indicators to all lifestages of winter-run Chinook salmon in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Spring-run Chinook Salmon in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar juvenile and emigration conditions (November through June) due to: (1) generally equivalent net changes in mean monthly Rio Vista flows of 10 percent or more; (2) generally equivalent or similar net changes in mean monthly Yolo Bypass outflow of 10 percent or more, except during January when flows would be lower by 10 percent or more with higher frequency (8.5 percent; see the previous discussion for Delta smelt); (3) generally equivalent or similar net changes in mean monthly Delta outflow of 10 percent;

and (4) generally equivalent probabilities of OMR flows being more negative than –2,500 cfs.

In consideration of the general similarity of impact indicators to all lifestages of spring-run Chinook salmon in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Fall-run and Late Fall-run Chinook Salmon in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar juvenile and emigration conditions (November through June) due to: (1) generally equivalent net changes in mean monthly Rio Vista flows of 10 percent or more; (2) generally equivalent or similar net changes in mean monthly Yolo Bypass outflow of 10 percent or more, except during January when flows would be lower by 10 percent or more with higher frequency (8.5 percent; see the previous discussion for Delta smelt); (3) generally equivalent or similar net changes in mean monthly Delta outflow of 10 percent or more; and (4) generally equivalent probabilities of OMR flows being more negative than –2,500 cfs.
- b) Generally similar San Joaquin River adult fall-run Chinook salmon conditions (December through February), because of generally similar probabilities of OMR flows being more negative than -5,000 cfs, with a slightly decreased probability during December.

In consideration of the general similarity of impact indicators to all lifestages of fall-run and late fall-run Chinook salmon in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Steelhead in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar juvenile and emigration conditions (October through July) due to: (1) generally equivalent net changes in mean monthly Rio Vista flows of 10 percent or more; (2) generally equivalent or similar net changes in mean monthly Yolo Bypass outflow of 10 percent or more, except during January when flows would be lower by 10 percent or more with slightly higher frequency (8.5 percent; see the previous discussion for Delta smelt); (3) generally equivalent or similar net changes in mean monthly Delta outflow of 10 percent or more; and (4) generally equivalent probabilities of OMR flows being more negative than –2,500 cfs.

In consideration of the general similarity of impact indicators to all lifestages of steelhead in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Green Sturgeon in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Generally similar juvenile rearing and emigration conditions (year-round), because of generally equivalent or similar net changes in mean monthly Yolo Bypass outflow of 10 percent or more, except during September when flows would be higher by 10 percent or more with higher frequency (3.7 percent) and during January when flows would be lower by 10 percent or more with higher frequency (about 8.5 percent).

In consideration of the general similarity of impact indicators to all lifestages of green sturgeon in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

White Sturgeon in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Generally similar juvenile rearing and emigration conditions (April through June), because of generally equivalent net changes in mean monthly Yolo Bypass outflow of 10 percent or more.

In consideration of the general similarity of impact indicators to all lifestages of white sturgeon in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Splittail in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Similar adult spawning and embryo incubation conditions (February through May), because of generally equivalent net changes in mean monthly Yolo Bypass outflow of 10 percent or more.
- b) Similar juvenile rearing and emigration conditions (April through July), because of generally equivalent net changes in mean monthly Yolo Bypass outflow of 10 percent or more.

In consideration of the general similarity of impact indicators to all lifestages of splittail in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

American Shad in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Generally similar egg and larval conditions (April through June), because of generally equivalent or similar net changes of 1 RKm or more in X2 location.

In consideration of the general similarity of impact indicators to all lifestages of American shad in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation scenario, no further evaluations are necessary.

Striped Bass in the Delta Region

Relative to the Fixed-400,000 af flood storage operation scenario, the Alternative 2 - Forecast-informed Operation is expected to provide:

- a) Generally similar egg and larval conditions (April through June), because of generally equivalent or similar net changes of 1 RKm or more in X2 location.

In consideration of the general similarity of impact indicators to all lifestages of striped bass in the Delta under the Alternative 2 - Forecast-informed Operation relative to the Fixed-400,000 af flood storage operation, no further evaluations are necessary.

1.1.5 Water Supply

This section discusses water supply comparisons between Alternative 2 – Forecast-informed Operations and the 1986 Fixed-400,000 af Flood Storage Operations scenario using an existing level of water demand in the CalSim II model. Significance criteria for water quality effects would be the same as discussed in section 4.7.2.

General Observations

CalSim II model outputs for Fixed-400,000 af flood storage operation and Alternative 2 - Forecast-informed Operations indicate that, overall, Alternative 2 - Forecast-informed Operations would be generally similar to Fixed-400,000 af flood storage operation. There could be some occurrences of slight increases and decreases in evaluation metrics, as expected with any changes in the CalSim II models.

Folsom Reservoir storages for Alternative 2 - Forecast-informed Operations are higher than for Fixed-400,000 af flood storage operation for March through June and are lower for February. March and April releases are reduced accordingly. As indicated in Table 5-12, storage in

Folsom Reservoir is higher in May and similar in September, implying better availability of water to meet summer water delivery obligations and higher Folsom Reservoir releases through the summer. Similar storages were seen for the other reservoirs.

Fall mean monthly flows below Nimbus Dam show very slight changes (± 1 percent), relative to the basis of comparison, and meet the MRR. Sacramento River flows below Keswick Dam and at Rio Vista are similar for the two scenarios and meet the MRR.

Table 1-12. Storages, Flows, and MFR for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Evaluation Parameters	Evaluation Metrics and Summary of Effects	Generalized Results
End of Month Storages (May and September)		
Folsom	Monthly exceedance distributions – Folsom storages as noted; Similar storages for others.	May – higher storages. September – similar storages.
Shasta		✓
Oroville		✓
Mean Monthly Flows and MFR Compliance (October through December)		
Lower American River below Nimbus Dam	Monthly exceedance distributions – Similar flows; MFR met.	October - very small decreases in flows. November and December – very small increases in flows.
Sacramento River below Keswick Dam		✓
Sacramento River at Rio Vista		✓

Note: “✓” refers to similar value of the evaluation metric for both scenarios.

Because of changes in the Folsom Reservoir storages and allocations from Alternative, long-term average annual CVP deliveries show a slight increase (1 TAF), while long-term average annual SWP deliveries are same for the two scenarios, as summarized in Table 5-13. It is notable that the average annual CVP deliveries for the dry years show a slight increase of 7 TAF, while those for the critical years are the same. Deliveries to lower American River purveyors are generally similar with some increases and decreases (± 45 AF) for the long-term average (Table 5-14).

Table 1-13. CVP/SWP Deliveries for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Evaluation Parameters	Evaluation Metrics and Summary of Effects	Generalized Results					
CVP/SWP Deliveries							
Delivery Type	Long-term and water year type average annual deliveries – Generally similar long-term average annual deliveries and generally similar average annual deliveries most of the time during all water year types, but with some slight increases and/or decreases.	Long-term and Water Year Type Average Annual Deliveries					
		Long-term	Wet	Above Normal	Below Normal	Dry	Critical
CVP M&I NOD		✓	✓	1 TAF increase	✓	✓	✓
CVP agricultural NOD		1 TAF increase	✓	1 TAF increase	1 TAF decrease	2 TAF increase	✓
CVP settlement NOD		✓	✓	✓	✓	✓	✓
CVP refuges NOD		✓	✓	✓	✓	✓	✓
CVP M&I SOD		✓	✓	✓	✓	✓	✓
CVP agricultural SOD		1 TAF increase	✓	1 TAF increase	3 TAF decrease	5 TAF increase	✓
CVP exchange contractors		✓	✓	✓	✓	✓	✓
CVP refuges SOD		✓	✓	1 TAF decrease	✓	✓	✓
Total CVP deliveries		1 TAF increase	✓	3 TAF increase	4 TAF decrease	7 TAF increase	✓
SWP contractors		✓	✓	✓	4 TAF decrease	4 TAF increase	4 TAF decrease

Note: “✓” refers to the same value of the evaluation metric for both scenarios.

NOD = North of Delta

SOD = South of Delta

Table 1-14. American River Purveyors Deliveries for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Evaluation Parameters	Evaluation Metrics and Summary of Effects	Results		
American River Purveyors Deliveries				
Purveyor Delivery Type	Long-term monthly average, maximum and minimum deliveries – Generally similar deliveries with some increases and decreases as noted.	Monthly Average, Maximum, and Minimum Deliveries		
		Average	Maximum	Minimum
American River Pump Station deliveries to PCWA		✓	✓	✓
City of Folsom deliveries		✓	✓	1 AF increase for July and August. 1 AF decrease for April.
City of Roseville deliveries		1 AF decrease for March. 1–2 AF increase for all other months.	✓	6 AF decrease for April.
San Juan Water District deliveries		✓	✓	✓
SSWD deliveries from Folsom		✓	✓	✓
Folsom Pumping Plant deliveries		2 AF decrease for March. 1–2 AF increase for all other months.	✓	6 and 5 AF increase for July and August. 8 AF decrease for April
FWTP deliveries		3 AF increase for July.	✓	✓
Freeport Regional Water Project deliveries		1 AF increase in March and July. 44 AF decrease in August. 1 AF decrease in April and May.	5 AF increase for November. 13 AF decrease for June.	✓
August 1977 deliveries – City of Roseville, San Juan Water District, and City of Folsom		✓	N/A	N/A

Note: “✓” refers to the same value of the evaluation metric for both scenarios.

Based on the deliveries data for the water delivery evaluation summarized in Table 5-15, 10 out of the 10 metrics were the same for the two models; therefore, the deliveries produced by Alternative 2 - Forecast-informed Operations were determined to be ‘consistent’ with deliveries from Fixed-400,000 af flood storage operation.

Table 1-15. American River Diversions and Consistency Formulation for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Evaluation Parameters	Evaluation Metrics and Summary of Effects	Results
American River Diversions - Folsom Pumping Plant and E.A. Fairbairn Water Treatment Plant (Consistency Formulation)		
Folsom Pumping Plant - April	Total occurrences where delivery fell below 95 percent of POR average of all Aprils – Same for both scenarios.	✓
Folsom Pumping Plant - April	Maximum number of years for any water year type where delivery fell below 95 percent of POR average of all Aprils – Same for both scenarios.	✓
Folsom Pumping Plant - July	Total occurrences where delivery fell below 95 percent of POR average of all Julys – Not the same for both scenarios.	✓
Folsom Pumping Plant - July	Maximum number of years for any water year type where delivery fell below 95 percent of POR average of all Julys – Not the same for both scenarios.	✓
FWTP - April	Total occurrences where delivery fell below 95 percent of POR average of all Aprils – Same for both scenarios.	✓
FWTP - April	Maximum number of years for any water year type where delivery fell below 95 percent of POR average of all Aprils – Same for both scenarios.	✓
FWTP - July	Total occurrences where delivery fell below 95 percent of POR average of all Julys – Same for both scenarios.	✓
FWTP - July	Maximum number of years for any water year type where delivery fell below 95 percent of POR average of all Julys – Same for both scenarios.	✓
Folsom Pumping Plant	Minimum diversion for any month – Same for both scenarios.	✓
FWTP	Minimum diversion for any month – Same for both scenarios.	✓

Note: “✓” refers to the same value of the evaluation metric for both scenarios.

As described earlier in the previous comparisons, MFR flows in the American River below Nimbus Dam are based on the regulated hydrology of the respective models. Changes in the Folsom Reservoir storages would cause changes in the fall MFR. However, as summarized in Table 5-16, for the two operations being compared here, the summer and October MFRs are similar. November through December show a very slight increase in MFR flows.

Given the consistency seen between Alternative 2 and the Fixed-400,000 af operation in storages, deliveries, and MFRs, it would be expected that water supply and delivery operations under Alternative 2 would be similar to operations under the Fixed-400,000 af operation.

Table 1-16. American River MFR for Summer and Fall Months for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Evaluation Parameters	Evaluation Metrics and Summary of Effects	Generalized Results
American River Minimum Release Requirement in Summer and Fall Months		

Evaluation Parameters	Evaluation Metrics and Summary of Effects	Generalized Results
June through September	Monthly exceedance distributions – Similar MFR.	✓
October through December	Monthly exceedance distributions.	MFR increases slightly for November and December.

Note: “✓” refers to similar value of the evaluation metric for both scenarios.

1.1.6 Hydropower

This section discusses hydropower comparisons between Alternative 2 – Forecast-informed Operations and the 1986 Fixed-400,000 af Flood Storage Operations scenario using an existing level of water demand in the CalSim II model. Significance criteria for hydropower effects would be the same as discussed in section 4.4.2.

USACE used Reclamation’s LTGen and DWR’s SWPGen models for CVP and SWP facilities, respectively, to quantify the hydropower generation and pumping energy under Fixed-400,000 af flood storage operation. USACE ran the respective models, as described in Section 3.2, for an 81-year POR extending from water year 1922 through water year 2002. The model output parameters selected for this comparison were based on their historical importance in characterizing the effects on hydropower in the CVP/SWP systems.

General Observations

Hydropower model outputs indicate that the CVP facilities’ long-term and driest-periods’ energy generation, capacity, and pumping energy use under Alternative 2 - Forecast-informed Operations would slightly increase or not change relative to Fixed-400,000 af flood storage operation. The long-term net generation at load center would slightly decrease. The magnitude of the change would be small, typically a difference of 1 percent or less. CVP foregone energy would not change for the long-term or the driest periods. Table 5-17 summarizes the results of the long-term and driest period hydropower effects evaluation. Table 5-18 summarizes the evaluation parameters and metrics for each monthly period.

The SWP facilities’ long-term and monthly key quantities and metrics for energy generation and project use would slightly decrease; however, the net energy generation at load center would increase. The magnitude of the change would be small, typically less than 1 percent. During the SWP monthly driest-periods’ capacity, energy generation, pumping energy use, and net energy generation at load center would slightly decrease, a less than 1-percent difference. Foregone energy for SWP during the driest periods showed an increase in water bypassing the powerplants, representing an 18-percent difference between the two scenarios.

Table 1-17. CVP-SWP Hydropower Summary for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Evaluation Parameters		Long Term			Driest Periods		
	Metric	Change		percent Difference	Change		percent Difference
CVP Long-Term and Driest Periods							
Decrease to no change relative to the Fixed-400,000 af flood storage operation ELD condition. Magnitude of changes are small, typically representing a difference of 1 percent or less. Driest Period shows slightly greater variability, but difference typically less than 1 percent.	Capacity	0	MW	√	1	MW	√
	Energy Generation	0	GWh	√	1	GWh	√
	Energy Use	1	GWh	√	1	GWh	√
	Foregone Energy	0	GWh	√	0	GWh	√
	Net Generation	-1	GWh	√	0	GWh	√
SWP Long-Term and Driest Periods							
Slight increase to no change relative to the Fixed-400,000 af flood storage operation ELD condition. Magnitude of changes are small, typically representing a difference of 1 percent or less. Driest Period shows slightly greater variability, but difference typically less than 1 percent.	Capacity	-1	GWh	√	-2	GWh	√
	Energy Generation	-1	MW	√	-3	MW	√
	Energy Use	-2	GWh	√	-1	GWh	√
	Foregone Energy	1	GWh	1 percent	3	GWh	18 percent
	Net Generation	1	GWh	√	-1	GWh	√
Note: “√” refers to less than 1 percent difference in the evaluation metric for both scenarios							

Evaluation of Effects

The CVP and SWP facilities’ capacity and generation differences would be due in part to changes to the spring-refill WCD operations under Alternative 2 - Forecast-informed Operations whereby the CalSim II model predicts higher maximum allowable storages in spring and therefore storing more water in spring and releasing it in summer through early fall.

The changes are most apparent for the driest periods for the CVP facilities, which show a slight decrease in energy generation in spring and August followed by an increase in fall. The maximum reduction in energy generation would occur in March and August with the maximum increase occurring in November under the driest periods. These differences are due to the effect of adjusted spring-refill WCD operations under Alternative 2 - Forecast-informed Operations.

Comparisons of the hydropower metrics for the driest periods for the SWP facilities show a general decrease in all parameters. Under Alternative 2 - Forecast-informed Operations, foregone energy would increase slightly in the long term by 1 percent and would be most pronounced in the driest periods, showing an increase of 18 percent in foregone energy under Alternative 2 - Forecast-informed Operations.

Table 1-18. CVP-SWP Hydropower Monthly Summary for Alternative 2 - Forecast-informed Operations vs. Fixed-400,000 af flood storage operation.

Evaluation Parameters		Long Term			Driest Periods		
CVP Long-Term and Driest Periods	Metric	Change		percent Difference	Change		percent Difference
Decrease to no change relative to the Fixed-400,000 af flood storage operation ELD condition. Magnitude of changes are small, typically representing a difference of 1 percent or less. Driest Period shows slightly greater variability, but difference typically less than 1 percent.	Capacity	0	MW	√	1	MW	√
	Energy Generation	0	GWh	√	1	GWh	√
	Energy Use	1	GWh	√	1	GWh	√
	Foregone Energy	0	GWh	√	0	GWh	√
	Net Generation	-1	GWh	√	0	GWh	√
SWP Long-Term and Driest Periods							
Slight increase to no change relative to the Fixed-400,000 af flood storage operation ELD condition. Magnitude of changes are small, typically representing a difference of 1 percent or less. Driest Period shows slightly greater variability, but difference typically less than 1 percent.	Capacity	-1	GWh	√	-2	GWh	√
	Energy Generation	-1	MW	√	-3	MW	√
	Energy Use	-2	GWh	√	-1	GWh	√
	Foregone Energy	1	GWh	1 percent	3	GWh	18 percent
	Net Generation	1	GWh	√	-1	GWh	√
Note: “√” refers to less than 1 percent difference in the evaluation metric for both scenarios							

The increase in foregone energy can be attributed to a slightly more rapid drawdown of Oroville Lake during drier years under Alternative 2 - Forecast-informed Operations, leading to spills at the Oroville Dam more frequently. The incremental foregone loss on an average annual basis represents 0.02 percent of the historical average annual generation at Oroville Dam, and the incremental impact is marginal when compared against the overall scale of the project footprint. In addition, as noted in Section 2.2.2, the application of mean monthly flows and reservoir storages in the CalSim II model precludes the ability to quantify daily variations in operations that would be implemented under extreme hydrologic conditions (very wet or very dry) that could occur.

1.1.7 Recreation

This section discusses comparisons between recreation conditions under Alternative 2 – Forecast-informed Operations and the 1986 Fixed-400,000 af Flood Storage Operations using an existing level of water demand in the CalSim II model. Significance criteria for recreation effects would be the same as discussed in section 4.9.2.

General Observations

Folsom Reservoir

As shown in Table 5-19, the upper threshold of significance at an elevation of 466 feet would likely be met or exceeded less frequently with the Alternative 2 - Forecast-informed Operations

than with the existing Fixed-400,000 af flood storage operation condition. The lower threshold of significance at elevation 435 feet would be met or exceeded at a lower frequency with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed existing condition except for July and August.

Table 1-19. Key Reservoir Threshold Difference between the With-Project Alternative and Fixed-400,000 af flood storage operation Probability of Exceedance.

Key Reservoir Elevations Elevation (ft.)	Upper Threshold 466	Lower Threshold 435
May	0.1 percent	-1.1 percent
June	-5.3 percent	-1.0 percent
July	-2.6 percent	2.1 percent
August	*	1.4 percent
September	*	-0.4 percent

Note: * Threshold of significance is not crossed.

The thresholds of significance for the five boat ramps that provide access for on-lake recreation on Folsom Reservoir would generally be exceeded more frequently with the Alternative 2 - Forecast-informed Operations than with the 400-fixed existing condition (Table 5-20). Each of the five boat ramps would experience at least 1 month with a lower probability of exceedance with Alternative 2 - Forecast-informed Operations than with the 400-fixed existing condition.

Table 1-20. Boat Ramp Access Threshold Difference between the Alternative 2 and Fixed-400,000 af flood storage operation Probability of Exceedance.

Minimum Boat Ramp Elevation (ft.)	Beal's Point 420	Dike 8 405	Brown's Ravine Main 395	Hobie Cove 375	Granite Bay 360
May	-0.2 percent	0.0 percent	0.0 percent	*	*
June	1.1 percent	0.0 percent	0.0 percent	*	*
July	0.6 percent	-0.1 percent	-0.7 percent	-0.1 percent	*
August	1.2 percent	0.1 percent	-1.3 percent	0.0 percent	-0.1 percent
September	0.1 percent	0.2 percent	-0.7 percent	-0.2 percent	0.0 percent

Note: * Threshold of significance is not crossed.

The majority of the minimum thresholds of significance for the four primary swimming locations would be exceeded more frequently with the Alternative 2 - Forecast-informed Operations than with the 400-fixed existing condition (Table 5-21). The thresholds of significance would be exceeded less frequently for 1 month at each location with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed existing condition.

Table 1-21. Reservoir Swim Access Threshold Difference between Alternative 2-Forecast-informed operations and Fixed-400,000 af flood storage operation Probability of Exceedance.

Swim Beaches Minimum Elevation (ft.)	Granite Bay – Main Swim Beach 450	Granite Bay – Oak Point Swim Beach 440	Rattlesnake Bar – Jet Ski Cove 425	Rattlesnake Bar – Vista Shoreline Access 420
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May	6.9 percent	-1.1 percent	0.0 percent	-0.2 percent
June	5.2 percent	0.2 percent	-0.1 percent	1.1 percent
July	0.4 percent	2.0 percent	1.2 percent	0.6 percent
August	0.5 percent	0.0 percent	0.4 percent	1.2 percent
September	-0.7 percent	0.2 percent	0.2 percent	0.1 percent

Lower American River

The upper threshold of significance (the maximum optimal flow) for the lower American River would be met or exceeded at a higher frequency with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed existing condition (Table 5-22). Notably, the threshold would not be crossed in August and September. The minimum optimal threshold of significance for the lower American River would be met or exceeded at a lower frequency in July and at a higher frequency in other months with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed operation. The minimum adequate flow threshold of significance for the lower American River would be met or exceeded at a higher frequency with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed existing condition in every month.

Table 1-22. Lower American River Recreation Threshold Difference between the Alternative 2 and Fixed-400,000 af flood storage operation Probability of Exceedance.

Lower American River Thresholds of Significance Flows (cfs)	Maximum Optimal 6,000	Minimum Optimal 3,000	Minimum Adequate 1,750
May	0.3 percent	1.7 percent	18.2 percent
June	2.8 percent	1.8 percent	9.3 percent
July	1.0 percent	-2.6 percent	1.2 percent
August	*	0.0 percent	10.0 percent
September	*	1.8 percent	1.9 percent

Note: * Threshold of significance is not crossed.

Shasta Reservoir

The upper threshold of significance and the optimum recreation WSE (1,020 feet) would be met or exceeded at the same or higher frequency in every month with the Alternative 2 - Forecast-informed Operations to the 400-fixed existing condition (Table 5-23). The lower threshold of significance, the minimum recreation WSE, at elevation 941 feet, and the shoreline recreation WSE threshold of significance (1,007 feet) would be met or exceeded more frequently in every month with the Alternative 2 - Forecast-informed Operations than with the 400-fixed operation, except in May for the minimum recreation WSE (941 feet) and in June and August for the lower shoreline recreation WSE (1,007 feet).

Table 1-23. Key Shasta Reservoir Threshold Difference between the Alternative 2 and Fixed-400,000 af flood storage operation Probability of Exceedance.

Key Reservoir Thresholds Elevation (ft.)	Optimum Shoreline Recreation	Lower Shoreline Recreation	Minimum Recreation
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	1,020	1,007	941
May	0.0 percent	0.0 percent	–0.1 percent
June	0.0 percent	–0.6 percent	0.0 percent
July	1.0 percent	0.1 percent	0.2 percent
August	0.0 percent	–0.2 percent	0.2 percent
September	*	1.0 percent	0.0 percent

Sacramento River

The mean monthly flows on the Sacramento River below Keswick Dam would drop below the threshold of significance of 5,000 cfs during May and September. In May, the mean monthly flow probability of exceedance would not change with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed existing condition. In September, the mean monthly flow probability of exceedance would change by –1.2 percent with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed existing condition. The threshold of significance would not be crossed for the remainder of the recreation season.

The mean monthly flow on the Sacramento River at the Freeport gage would not drop below the threshold of significance of 5,000 cfs during the recreation season.

Evaluation of Effects

Folsom Reservoir

The Alternative 2 - Forecast-informed Operations would have minimal positive effects relative to the 400-fixed existing condition for the upper threshold of significance for Folsom Reservoir. The maximum water surface elevation (466 feet) would be met less frequently for June and July (up to 5.3 percent less) and not crossed at all in August and September. The decrease in frequency would indicate an increase in time at the maximum elevation for recreational activities.

With the Alternative 2 - Forecast-informed Operations, the probability of exceeding the lower threshold of significance (435 feet) would increase in 2 months (up to 2.1 percent) and decrease for 3 months (1.1 percent or less). The differences between the two conditions are functionally equivalent.

In general, the probability of exceeding the minimum elevation at which the various reservoir boat ramps and swim beaches would be usable would increase by up to a 1.2 percent at boat ramps and 6.9 percent at swim beaches with the Alternative 2 - Forecast-informed Operations. The general increase in the probability of exceedance indicates an increase in the amount of time that the boat ramps and swim beaches would be usable.

Lower American River

The lower American River would experience mostly positive effects with the Alternative 2 - Forecast-informed Operations relative to the 400-fixed existing condition. The probability of exceeding the lower thresholds of significance (minimum, adequate, and optimal) would increase with the Alternative 2 - Forecast-informed Operations over the 400-fixed existing condition up to 18.2 percent, indicating a positive effect for on-river recreation. The only negative effect would be relative to the maximum optimal flow (6,000 cfs) where the probability of exceeding the threshold of significance is higher, but only slightly (up to 2.8 percent).

Shasta Reservoir

The differences in the probability of exceedance for the Shasta Reservoir elevations between the Alternative 2 - Forecast-informed Operations and the 400-fixed existing condition for all three thresholds would be functionally equivalent (1.0 percent or less).

Sacramento River

The thresholds of significance for the Sacramento River would be exceeded at similar frequencies for the two conditions for May and September below Keswick Dam. The remainder of the thresholds of significance for the Sacramento River at Keswick Dam and the Freeport gage would not be crossed, a result that gives no indication of the benefit or detriment for either condition in this comparison.

1.1.8 Cultural Resources

This section discusses the cumulative effects to cultural resources including both the anticipated effects of the Alternative 2 – Forecast-informed Operations, as discussed in Chapter 4.9, and the effects that were incurred under the 1986 Fixed-400,000 af Flood Storage Operations scenario. In addition, Alternative 2 is compared to the No Action/No Project while using a future level of water demand condition in the CalSim II model. Significance criteria for cultural resources effects would be the same as discussed in section 4.9.2.