

1 **11.3.4.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and**
2 **Intake 1 (3,000 cfs; Operational Scenario C)**

3 The Sacramento River channel and bank would be affected by construction of one north Delta
4 intake, Intake 1, at RM 44 (south of Freeport). The locations, dimensions, and construction
5 footprints of Intake 1 are provided in Table 11-7, along with estimates of temporary and permanent
6 in-water habitat effects.

7 Alternative 5 is expected to result in the same suite of potential construction impacts as
8 Alternative 1A, except that the effects would be reduced in scale and extent commensurate with the
9 reduced scale of in-water construction activities. Alternative 5 includes construction of only one
10 intake (Intake 1) versus the five intakes planned under Alternative 1A. The total permanent in-
11 water footprint of the one intake would be about 1.0–3.8 acres, and the total length of permanent
12 bank protection would be approximately 2,050 feet (9,080 feet less than Alternative 1A) (see
13 Table 11-7). The six barge landings under Alternative 5 would be in the same locations, and operate
14 the same as the landings under Alternative 1A. As such, the effects of the barge landing construction
15 and operation would be identical to those described for Alternative 1A. All other upland
16 construction, except for the pipelines between Intake 1 and the intermediate forebay, are identical
17 to Alternative 1A. The conveyance system would be the same under Alternative 5 as under
18 Alternative 1A; therefore, all impacts related to construction of the conveyance tunnel and pipelines,
19 including those associated with barge unloading facilities, would be the same.

20 The number of barge trips required under Alternative 5 would be somewhat less than the estimated
21 3,000 barge trips under Alternative 1A, because one intake facility would be constructed under
22 Alternative 5 compared to five intakes under Alternative 1A. All other in-water aspects of
23 construction would be the same under Alternative 5 as described for Alternative 1A.

24 **Delta Smelt**

25 **Construction and Maintenance of CM1**

26 Small numbers of delta smelt eggs, larvae, and adults could be present in the north Delta in June
27 during a portion of the in-water construction period for the intake facilities. Small numbers could
28 also be present in June or July during construction of the barge landings in the east Delta and south
29 Delta (see Table 11-4).

30 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

31 **NEPA Effects:** The types of potential effects of construction of the water conveyance facilities on
32 delta smelt would be similar to those described for Alternative 1A (Impact AQUA-1) except that
33 Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects
34 would be proportionally less under this alternative. This would convert about 2,050 lineal feet of
35 existing shoreline habitat into intake facility structures and would require about 4.7 acres of dredge
36 and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
37 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-1
38 environmental commitments and mitigation measures would be available to avoid and minimize
39 potential effects, and the effect would not be adverse for delta smelt.

1 **CEQA Conclusion:** As described in Impact AQUA-1 in Alternative 1A, the impact of the construction
2 of water conveyance facilities on delta smelt would be less than significant except for construction
3 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A
4 because only one intake would be constructed rather than five. Implementation of Mitigation
5 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
6 significant.

7 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
8 **of Pile Driving and Other Construction-Related Underwater Noise**

9 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
10 Alternative 1A.

11 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
12 **and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
14 Alternative 1A.

15 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

16 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
17 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-2) except
18 that only one intake would need to be maintained in Alternative 5 rather than five under Alternative
19 1A. As concluded in Alternative 1A, Impact AQUA-2, the effect would not be adverse for delta smelt.

20 **CEQA Conclusion:** As described in Impact AQUA-2 in Alternative 1A, the impact of the maintenance
21 of water conveyance facilities on delta smelt would be less than significant and no mitigation is
22 required.

23 **Water Operations of CM1**

24 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

25 **Water Exports from SWP/CVP South Delta Facilities**

26 Overall, operational activities under Alternative 5 at the south Delta facilities would result in
27 minimal (<4%) changes in average proportional entrainment of delta smelt compared to NAA (Table
28 11-5-1, Figure 11-5-1 and Figure 11-5-2).

29 Average juvenile proportional entrainment across all water year types under Alternative 5 would be
30 0.15 (15% of the juvenile population), which is 0.006 greater than NAA (a 4% relative increase)
31 (Figure 11-5-1, Table 11-5-1). Average adult proportional entrainment would be 0.072 (7.2% of the
32 population), which is 0.003 less compared to NAA (a 3% relative decrease) (Figure 11-5-2, Table 11-
33 5-1). Differences by water year type were slight, with greater reductions under Alternative 5 in
34 wetter years for both juvenile and adult proportional entrainment

1 **Table 11-5-1. Proportional Entrainment Index of Delta Smelt at SWP/CVP South Delta Facilities**

Water Year Type	Proportional Entrainment ^a	
	Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
Total Population (December–June)		
Wet	0.021 (19%)	-0.005 (-4%)
Above Normal	0.024 (15%)	-0.004 (-2%)
Below Normal	0.037 (17%)	0.008 (3%)
Dry	0.030 (11%)	0.011 (4%)
Critical	0.009 (3%)	0.009 (3%)
All Years	0.024 (12%)	0.003 (1%)
Juvenile Delta Smelt (March–June)		
Wet	0.026 (68%)	0.0 (0%)
Above Normal	0.029 (35%)	0.0 (0%)
Below Normal	0.042 (30%)	0.010 (6%)
Dry	0.032 (18%)	0.012 (6%)
Critical	0.014 (6%)	0.009 (4%)
All Years	0.029 (23%)	0.006 (4%)
Adult Delta Smelt^b (December–March)		
Wet	-0.005 (-7%)	-0.005 (-7%)
Above Normal	-0.005 (-6%)	-0.004 (-5%)
Below Normal	-0.004 (-5%)	-0.002 (-3%)
Dry	-0.002 (-3%)	-0.001 (-1%)
Critical	-0.006 (-8%)	0.0 (-1%)
All Years	-0.004 (-6%)	-0.003 (-3%)
Shading indicates >5% or more increased entrainment.		
Note: Negative values indicate lower entrainment loss under Alternative than under existing biological conditions.		
^a Proportional entrainment index calculated in accordance with USFWS BiOp (U.S. Fish and Wildlife Service 2008a).		
^b Adult proportional entrainment adjusted according to Kimmerer (2011).		

2

3 **Water Exports from SWP/CVP North Delta Intake Facilities**

4 As described for Alternative 1A, potential entrainment and impingement risks at the proposed north
 5 Delta facilities would be limited since delta smelt rarely occur in the vicinity of the proposed intake
 6 site. The intake would be screened to exclude fish larger than 15mm. Alternative 5 would have only
 7 one SWP/CVP north delta intake, compared to five intakes for Alternative 1A (0–2% entrainment as
 8 modeled by PTM), and therefore potential entrainment and impingement risks would be even lower.

9 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

10 Potential entrainment of larval delta smelt at the NBA, as estimated by particle-tracking models was
 11 low, averaging 1.3% under Alternative 5 compared to 2.0% for NAA, a 35% relative reduction (Table
 12 11-5-2).

1 **Table 11-5-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt**
 2 **Entrained by the North Bay Aqueduct under Alternative 5 and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A5_LLТ	A5_LLТ vs. EXISTING CONDITIONS	A5_LLТ vs. NAA
2.1	2.0	1.3	-0.81 (-39%)	-0.71 (-35%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario.

3

4 ***Predation Associated with Entrainment***

5 Pre-screen loss at the south Delta facilities, typically attributed to predation and other unfavorable
 6 habitat conditions near the pumps (Castillo et al. 2012), would be negligibly changed under
 7 Alternative 5 commensurate with proportional entrainment estimates. Predation loss at the
 8 proposed north Delta intake would be limited because few delta smelt occur that far upstream.

9 ***NEPA Effects:*** Under Alternative 5 proportional delta smelt entrainment at the south Delta facilities
 10 would be similar to NAA. Potential entrainment of juvenile and adult delta smelt would be reduced
 11 at the NBA. Entrainment and impingement could potentially occur at the proposed north Delta
 12 intake, but the risk would be low due to the location, design, and operation of intakes. Furthermore,
 13 any potential effects would be reduced by real-time monitoring and adaptive management response
 14 by the Real-Time Response Team. Therefore, the effect on delta smelt entrainment would not be
 15 adverse.

16 ***CEQA Conclusion:*** As described above, under Alternative 5 average juvenile delta smelt proportional
 17 entrainment an associated pre-screen predation loss at the south Delta facilities would increase
 18 0.029 (2.9% of the juvenile population, a 23% relative increase). Average adult proportional
 19 entrainment would decrease 0.004 (a 6% relative decrease) compared to Existing Conditions (Table
 20 11-5-1). Furthermore, potential impacts would be reduced by monitoring and adaptive management
 21 by the Real-Time Response Team. This CEQA interpretation of the biological modeling differs from
 22 the NEPA analysis, which is likely attributable to different modeling assumptions (as described fully
 23 in Section 11.3.3 and Alternative 1A Impact AQUA-3). Because the action alternative modeling does
 24 not partition the effects of implementation of the alternative from the effects of sea level rise,
 25 climate change and future water demands, the comparison to Existing Conditions may not offer a
 26 clear understanding of the impact of the alternative on the environment. Note that the analysis for
 27 larvae and juveniles includes both OMR flows and X2 as predictors of proportional entrainment;
 28 primarily because of sea level rise assumptions, X2 would be further upstream in the ELT and LLT
 29 even with similar water operations, so that the comparison of the action alternative in the ELT and
 30 LLT to Existing Conditions is confounded.

31 Therefore, the impact analysis is better informed by the results from the NEPA analysis presented
 32 above, which accounts for sea level rise by considering the NAA in the LLT. When climate change is
 33 factored in, average delta smelt proportional entrainment under Alternative 5 is reduced for larvae
 34 and juveniles (0.006 less, a 4% relative decrease) and adults (3% relative decrease) compared to
 35 conditions without BDCP (Table 11-5A-1).

36 Modeled entrainment of larval delta smelt at the NBA facility under Alternative 5 would be similar to
 37 Existing Conditions (Table 11-5-2). Entrainment and impingement would potentially occur at the

1 proposed north Delta intake, but the magnitude of this effect would be low because delta smelt
2 occur infrequently here and the intake would be equipped with state-of-the-art screens to reduce
3 the entrainment risk. Overall, the impact would be less than significant, and no mitigation would be
4 required.

5 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
6 **Delta Smelt**

7 **NEPA Effects:** The effects of operations under Alternative 5 on abiotic spawning habitat would be
8 the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta
9 intake would not reduce available spawning habitat. In-Delta water temperatures, which can affect
10 spawning timing, would not change across Alternatives, because they would be in thermal
11 equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect
12 of Alternative 5 operations on spawning would not be adverse, because there would be little change
13 in abiotic spawning conditions for delta smelt.

14 **CEQA Conclusion:** As described above, operations under Alternative 5 would not reduce abiotic
15 spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the
16 impact would be less than significant, and no mitigation would be required.

17 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

18 **NEPA Effects:** As described for other Alternatives (Impact AQUA-5), rearing habitat conditions for
19 juvenile delta smelt were evaluated using the fall abiotic habitat index (Feyrer et al. 2011) with and
20 without the assumption that BDCP habitat restoration benefits are realized. Alternative 5 includes
21 the USFWS BiOp Fall X2 requirements, thus, the abiotic habitat index under Alternative 5 without
22 restoration would be similar to the NAA (Table 11-5-3, Figure 11-5-3). However, Alternative 5 may
23 also benefit delta smelt by habitat restoration (CM2 and CM4), particularly in the Suisun Marsh,
24 West Delta, and Cache Slough ROAs, which are closer to delta smelt's main area of occurrence.
25 Habitat restoration has the potential to increase suitable areas of spawning and rearing habitat and
26 is intended to supplement food production and export to other rearing areas.

27 The effect of Alternative 5 on delta smelt would depend on the extent to which restored habitats are
28 utilized by delta smelt. Assuming all the habitats restored under Alternative 5 are fully utilized by
29 delta smelt, there would be an increase in the abiotic habitat index of about 28%, compared to NAA,
30 when averaged across water year types. These effects are a result of the inundation of new areas of
31 the Delta resulting from habitat restoration, which is expected to open up additional habitat for
32 delta smelt. Alternative 5 includes restoration of 25,000 acres of tidal habitat restored compared to
33 the 55,000 acres under Alternative 1A. When analyzing effects by water year types, the relative
34 increase in abiotic habitat index would be greatest in dry years (34% NAA) and below normal years
35 (33% NAA).

1 **Table 11-5-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 5 and**
 2 **Baseline Scenarios, with and without Habitat Restoration, Averaged by Prior Water Year Type**

Water Year Type	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
All	948 (24%)	62 (1%)	2,264 (57%)	1,378 (28%)
Wet	2,136 (45%)	-60 (-1%)	4,010 (85%)	1,814 (26%)
Above Normal	1,639 (43%)	-29 (-1%)	3,128 (82%)	1,460 (27%)
Below Normal	59 (1%)	207 (5%)	1,186 (29%)	1,334 (33%)
Dry	118 (3%)	210 (6%)	1,081 (30%)	1,173 (34%)
Critical	21 (1%)	21 (1%)	718 (24%)	718 (24%)

Note: Negative values indicate lower habitat indices under alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

3

4 **CEQA Conclusion:** Alternative 5 would not result in less rearing habitat area for delta smelt. Without
 5 BDCP habitat restoration efforts, delta smelt fall abiotic habitat index under Alternative 5 would
 6 increase 24% relative to Existing Conditions. With the implementation of the BDCP habitat
 7 restoration actions (CM2, CM4, CM5, CM6, and CM7), the abiotic habitat index would increase by
 8 57% when averaged across all water year types. The increase in abiotic habitat would be most
 9 substantial in wetter water year types (an 82–85% increase).

10 Note that the CEQA analysis predicts a greater increase in the abiotic habitat index relative to
 11 baseline than the NEPA analysis. It is unclear whether this increase under Alternative 5 compared to
 12 Existing Conditions is a function of Project operations, or attributable to differences in modeling
 13 assumptions (Existing Conditions does not include Fall X2). The NEPA analysis is a better approach
 14 for isolating the effect of the Alternative from the effects of sea level rise, climate change, future
 15 water demands, and implementation of required actions such as the Fall X2 requirement. When
 16 compared to the NAA and informed by the NEPA analysis, the average delta smelt abiotic habitat
 17 index under Alternative 5 would be similar compared to NAA without restoration, and 28% greater
 18 with restoration (Table 11-5-3).

19 The impact on delta smelt rearing habitat would be considered less than significant and may provide
 20 a benefit to the species because of the increase in abiotic habitat with the planned habitat
 21 restoration measures. No mitigation would be required.

22 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

23 **NEPA Effects:** The effects of operations under Alternative 5 on migration conditions would be
 24 similar to those described for Alternative 1A (Impact AQUA-6). Alternative 5 would not affect the
 25 first flush of winter precipitation and the turbidity cues associated with adult delta smelt migration,
 26 although some amount of sediment may be removed by the north Delta facilities. Effects on
 27 suspended sediment concentrations at times of the year other than first flush will be minimized
 28 through the reintroduction of sediment collected at the north Delta intake into tidal natural
 29 communities restoration projects (CM4), consistent with the Environmental Commitment
 30 addressing Disposal and Reuse of Spoils, Reusable Tunnel Material (RTM), and Dredged Material.

1 In-Delta water temperatures would not change across Alternatives, because they would be in
2 thermal equilibrium with atmospheric conditions and not strongly influenced by the flow changes
3 under BDCP operations. There would be no substantial change in the number of stressful or lethal
4 condition days under Alternative 5. Thus the effect on delta smelt migration conditions is not
5 adverse.

6 **CEQA Conclusion:** As described above, operations under Alternative 5 would not substantially alter
7 the turbidity cues associated with winter flush events that may initiate migration, nor would there
8 be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt
9 migration conditions would be less than significant, and no mitigation would be required.

10 **Restoration Measures (CM2, CM4–CM7, and CM10)**

11 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

12 **NEPA Effects:** The types of potential effects of restoration construction activities under Alternative 5
13 would be less than that described for Alternative 1A because of the reduced acreage of tidal habitat
14 that would be restored (25,000 acres for Alternative 5 rather than 55,000 acres for Alternative 1A)
15 (see Impact AQUA-7 for Alternative 1A). As concluded in Alternative 1A, Impact AQUA-7, the effect
16 of restoration construction activities on delta smelt would not be adverse.

17 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-7 for delta smelt, the potential
18 impact of restoration construction activities would be less than significant, and no mitigation would
19 be required.

20 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta 21 Smelt**

22 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
23 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-8). Under
24 Alternative 5 there would be reduced acreage of tidal habitat that would be restored (25,000 acres
25 rather than 65,000 acres) but the effects on those acres and elsewhere would be the same as
26 described under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-8, the effects of
27 contaminants associated with restoration measures on delta smelt would not be adverse with
28 respect to selenium, copper, ammonia and pesticides. The effects of methylmercury on delta smelt
29 are uncertain.

30 **CEQA Conclusion:** As described in Impact AQUA-8 for delta smelt in Alternative 1A, the potential
31 impact of contaminants associated with restoration measures would be less than significant, and no
32 mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat
33 restoration (25,000 acres rather than 65,000 acres).

34 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

35 **NEPA Effects:** The types of potential effects of restored habitat conditions under Alternative 5 would
36 be the same as those described for Alternative 1A (see Impact AQUA-9). However, under Alternative
37 5, there would be reduced acreage of tidal habitat that would be restored (25,000 acres for
38 Alternative 5 rather than 55,000 acres for Alternative 1A). As concluded in Alternative 1A, Impact
39 AQUA-9 under Alternative 1A, restored tidal habitat may be beneficial for delta smelt although the
40 reduced acreage would reduce the benefit. Alternative 5 includes restored tidal habitat

1 proportionally distributed across the five ROAs that may provide proportionally less benefit based
2 on the reduced acreage compared to Alternative 1A. The Alternative 5 acreage is approximately
3 60% less than the Alternative 1A acreage.

4 The restored tidal habitat may provide benefits to delta smelt occupying the Suisun Marsh ROA and
5 Cache Slough ROA because of increased suitable habitat and because of improved food production,
6 Increased food production from all ROAs that is exported into the Delta may also benefit delta smelt,
7 especially in the low salinity zone. The overall improved habitat connectivity is intended to benefit
8 all species including delta smelt.

9 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-9 for delta smelt, the potential
10 impact of restored habitat conditions on delta smelt is considered to be beneficial although the
11 reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation
12 would be required.

13 **Other Conservation Measures (CM12–CM19 and CM21)**

14 Alternative 5 has the same other conservation measures as Alternative 1A. Because no substantial
15 differences in other conservation-related fish effects are anticipated in the affected environment
16 under Alternative 5 compared to those described in detail for Alternative 1A, the fish effects of other
17 conservation measures described for delta smelt under Alternative 1A (Impacts AQUA-10 through
18 AQUA-18) also appropriately characterize effects under Alternative 5.

19 The following impacts are those presented under Alternative 1A that are identical for Alternative 5.

20 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

21 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

22 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

23 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

24 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

25 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

26 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

27 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

28 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt** 29 **(CM21)**

30 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms
31 on delta smelt are the same as those described under Alternative 1A (Impacts AQUA-10 through
32 AQUA-18). The effects would range from no effect, to not adverse, to beneficial.

33 **CEQA Conclusion:** The impacts of the nine impact mechanisms listed above would range from no
34 impact, to less than significant, to beneficial, and no mitigation is required.

1 **Longfin Smelt**

2 **Construction and Maintenance of CM1**

3 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

4 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on longfin
5 smelt would be similar to those described for Alternative 1A (Impact AQUA-19) except that
6 Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects
7 would be proportionally less under this alternative. This would convert about 2,050 lineal feet of
8 existing shoreline habitat into intake facility structures and would require about 4.7 acres of dredge
9 and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
10 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-19,
11 environmental commitments and mitigation measures would be available to avoid and minimize
12 potential effects, and the effect would not be adverse for longfin smelt.

13 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-19, the impact of the construction of
14 water conveyance facilities on longfin smelt would be less than significant except for construction
15 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A
16 because only one intake would be constructed rather than five. Implementation of Mitigation
17 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
18 significant.

19 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
20 **of Pile Driving and Other Construction-Related Underwater Noise**

21 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
22 Alternative 1A.

23 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
24 **and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
26 Alternative 1A.

27 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

28 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
29 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-20) except
30 that only one intake would need to be maintained under Alternative 5 rather than five under
31 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-20, the effect would not be adverse for
32 delta smelt.

33 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-20, the impact of the maintenance
34 of water conveyance facilities on longfin smelt would be less than significant and no mitigation
35 would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

3 ***Water Exports from SWP/CVP South Delta Facilities***

4 For larval longfin smelt entrainment risk was simulated using particle tracking modeling. Average
 5 entrainment under Alternative 5 with the wetter starting distribution was 1.1% compared to 1.6%
 6 for NAA, a 35% relative reduction (Table 11-5-4). Under the drier starting distribution, average
 7 entrainment loss was 1.4% under Alternative 1 compared to 2.2A% for NAA, a 38% decrease in
 8 relative terms. Overall, larval longfin smelt entrainment at the south Delta intakes would be reduced
 9 under Alternative 5 compared to baseline conditions (NAA).

10 **Table 11-5-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae**
 11 **Entrained by the South Delta Facilities under Alternative 5 and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A5_LL1	A5_LL1 vs. EXISTING CONDITIONS	A5_LL1 vs. NAA
Wetter	1.9	1.6	1.1	-0.78 (-42%)	-0.60 (-35%)
Drier	2.5	2.2	1.4	-1.13 (-45%)	-0.86 (-38%)

12
 13 Entrainment under Alternative 5 would be reduced compared to NAA, in above normal, below
 14 normal, and dry years, when it would be similar to the NAA. Entrainment for juvenile longfin smelt
 15 averaged across all water year types would be reduced slightly by 6% compared to NAA; adult
 16 longfin smelt entrainment would be reduced by 10% compared to NAA (Table 11-5-5). For
 17 Alternative 5 entrainment would be highest in dry and critical water year types for juvenile longfin
 18 smelt and in critical water year types for adult longfin smelt. In critical water year types, juvenile
 19 entrainment would be reduced by 18% and adult entrainment would be reduced by 15% compared
 20 to NAA. This reduction in entrainment is associated with reduced reverse OMR flows under
 21 Alternative 5 during December to May.

1
2

**Table 11-5-5. Longfin Smelt Entrainment Index^a at the SWP and CVP Salvage Facilities—
Differences (Absolute and Percentage) between Model Scenarios for Alternative 5**

Life Stage	Water Year Type	Absolute Difference (Percent Difference)	
		EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Juvenile (March–June)	Wet	2,571 (4%)	-2,871 (-4%)
	Above Normal	292 (6%)	3 (0%)
	Below Normal	301 (10%)	92 (3%)
	Dry	60,701 (11%)	2,394 (0%)
	Critical	-163,206 (-29%)	-89,335 (-18%)
	All Years	6,739 (3%)	-18,272 (-6%)
Adult (December–March)	Wet	-9 (-7%)	-12 (-9%)
	Above Normal	-6 (-1%)	-46 (-7%)
	Below Normal	-41 (-2%)	37 (2%)
	Dry	-178 (-15)	-112 (-10%)
	Critical	-5,427 (-22%)	-3,293 (-15%)
	All Years	-382 (-11%)	-346 (-10%)

Shading indicates entrainment increased by 10% or more.

^a Estimated annual number of fish lost, based on normalized data.

3

Water Exports from SWP/CVP North Delta Intake Facilities

The proposed north Delta intake could increase entrainment potential and locally attract piscivorous fish predators, but entrainment and predation losses of longfin smelt at the north Delta would be extremely low because this species is only expected to occur occasionally in very low numbers this far upstream on the Sacramento River.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Particle entrainment at the NBA, representing potential larval longfin smelt entrainment, was low for both starting distributions (wetter and drier), averaged 12-15% under Alternative 5, which was 0.04% more than NAA, or a 41-54% relative increase (Table 11-5-6; Table 11-5-7).

Table 11-5-6. Average Percentage (and Difference) of Particles Representing Larval Longfin Smelt Entrained by the North Bay Aqueduct under Alternative 5 and Baseline Scenarios

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A5_LLT	A5_LLT vs. EXISTING CONDITIONS	A5_LLT vs. NAA
Wetter	0.20	0.08	0.12	-0.08 (-39.3%)	0.04 (53.7%)
Drier	0.25	0.11	0.15	-0.10 (-39.1%)	0.04 (41.3%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

15

1 **Table 11-5-7. Average Difference (Number of Particle Tracking Runs) in Simulated Entrainment of**
 2 **Larval Longfin Smelt at the North Bay Aqueduct under Alternative 5 and Baseline Scenarios**

Starting Distribution of Particles in Wetter or Drier conditions	Average Difference in Percent Particles Entrained (Number of Runs)	
	A5_LL1 v. EXISTING CONDITIONS	A5_LL1 v. NAA
Wetter Distribution		
Higher entrainment	0.1 (4)	0.1 (8)
Lower entrainment	-0.2 (8)	0.0 (4)
Drier Distribution		
Higher entrainment	0.2 (5)	0.2 (4)
Lower entrainment	-2.9 (5)	-1.7 (6)

Note: 60-day runs of PTM. Average Values represent the difference in the percentage of particles reaching this destination. Negative values indicate lower entrainment under the alternative compared to the baseline scenario.

3

4 ***Predation Associated with Entrainment***

5 Pre-screen loss at the south Delta facilities, typically attributed to predation, would be negligibly
 6 changed under Alternative 5 commensurate with entrainment (similar to Impact AQUA-3).
 7 Predation loss at the proposed north Delta intake and the alternate NBA intake would be limited
 8 because only few longfin smelt would rarely occur that far upstream.

9 ***NEPA Effects:*** In conclusion, the effect on entrainment and entrainment-related predation loss
 10 under Alternative 5 would not be adverse, because of the slight reduction in entrainment and
 11 predation loss at the south Delta facilities. At the SWP/CVP south Delta facilities entrainment of
 12 juvenile longfin smelt would be slightly reduced compared to the NAA, while adult entrainment
 13 would be reduced, especially in critical water year types when longfin smelt distribution extends
 14 further into the Delta. Longfin smelt entrainment to the NBA would increase negligibly compared to
 15 the NAA. Entrainment loss of longfin smelt at the proposed north Delta intake would be rare since
 16 longfin smelt are not expected to occur in that area of the Sacramento River.

17 ***CEQA Conclusion:*** The results of the PTM model indicate slightly reduced larval entrainment at the
 18 south Delta facilities, agricultural diversions, and the NBA for all distributions (wetter and drier)
 19 compared to Existing Conditions. At the south Delta facilities, juvenile entrainment would be similar
 20 (<5% change) to Existing Conditions while adult entrainment would be reduced 11%. Entrainment
 21 to the north Delta intake would be low since longfin smelt would not occur in the vicinity of the
 22 intake. Predation loss at the south Delta facilities compared to Existing Conditions would be similar
 23 for juveniles, and reduced by 11% for adults. Predation loss at the proposed north Delta intake and
 24 the alternate NBA intake would be minimal because longfin smelt rarely occur in that vicinity. The
 25 impact for the risk of predation associated with the NPB structures would be the same as described
 26 for Alternative 1A.

27 The impact on longfin smelt would be less than significant and may provide a benefit to the species
 28 because of the reduced entrainment and predation loss for adults.

Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt

The indices of abundance of longfin smelt based on the Fall Midwater, Bay Otter, and Bay Midwater trawl data has been correlated to outflow (expressed as the location of X2) in the preceding winter and spring months, when spawning and rearing is occurring (January through June) (Kimmerer 2002a; Kimmerer et al. 2009; Rosenfield and Baxter 2007; Mac Nally et al. 2010; Thomson et al. 2010). Based on Kimmerer et al. (2009), reduced outflows in January through June under Alternative 5 (up to 10% lower than the NAA) has the potential to reduce longfin smelt abundance. However, other components of Alternative 5 have the potential to increase recruitment per unit of flow.

NEPA Effects: Modeling results based on Kimmerer et al. (2009) indicate that relative longfin smelt abundance averaged across all years would be 3% less (based on Fall Midwater Trawl indices) to 4% less (based on Bay Otter Trawl indices) under Alternative 5, compared to NAA (Table 11-5-8). When analyzing individual water year types, longfin smelt abundances are 10-11% lower in critical years, and 7-9% lower in above normal water years compared to NAA. This analysis does not take into account any potential changes in spawning or rearing conditions related to non-operational components of Alternative 5, including habitat restoration.

Table 11-5-8. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in the Fall Midwater Trawl or Bay Otter Trawl^a

Water Year Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
All	-1,606 (-31%)	-129 (-3%)	-5,154 (-36%)	-398 (-4%)
Wet	-5,697 (-31%)	667 (6%)	-23,519 (-36%)	2,630 (7%)
Above Normal	-3,245 (-38%)	-413 (-7%)	-11,437 (-43%)	-1,391 (-9%)
Below Normal	-1,499 (-35%)	-201 (-7%)	-4,614 (-40%)	-594 (-8%)
Dry	-648 (-31%)	-155 (-10%)	-1,742 (-35%)	-405 (-11%)
Critical	-180 (-19%)	-45 (-6%)	-418 (-22%)	-103 (-7%)

Shading indicates a decrease of 10% or greater in relative abundance.

^a Based on the X2-Relative Abundance Regressions of Kimmerer et al. (2009).

Longfin smelt may benefit from habitat restoration actions (CM2, *Yolo Bypass Fisheries Enhancement* and CM4, *Tidal Natural Communities Restoration*) intended to provide additional food production and export to longfin smelt rearing areas. This potential benefit is not reflected in the X2-longfin smelt abundance regression results presented above.

CEQA Conclusion: Average Delta outflows under Alternative 5 during January through April are similar to Existing Conditions, but reduced 18–19% in May and June.

Average longfin smelt relative abundance based on Kimmerer et al. (2009) is reduced 31–36% compared to Existing Conditions (Table 11-5-8), due to reduced spring Delta outflow.

Contrary to the NEPA conclusion set forth above, these results indicate that the difference between Existing Conditions and Alternative 5 could be significant because the alternative could substantially reduce relative abundance based on Kimmerer 2009. However, this interpretation of the biological

1 modeling results is likely attributable to different modeling assumptions for four factors: sea level
2 rise, climate change, future water demands, and implementation of the alternative. As discussed
3 above (Section 11.3.3), because of differences between the CEQA and NEPA baselines, it is
4 sometimes possible for CEQA and NEPA significance conclusions to vary between one another under
5 the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the
6 NOP was prepared. Both the action alternative and the NEPA baseline (NAA) models anticipated
7 future conditions that would occur in 2060 (LLT implementation period), including the projected
8 effects of climate change (precipitation patterns), sea level rise and future water demands, as well as
9 implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because
10 the action alternative modeling does not partition the effects of implementation of the alternative
11 from the effects of sea level rise, climate change and future water demands, the comparison to
12 Existing Conditions may not offer a clear understanding of the impact of the alternative on the
13 environment. This suggests that the NEPA analysis, which compares results between the alternative
14 and NAA, is a better approach because it isolates the effect of the alternative from those of sea level
15 rise, climate change, and future water demands.

16 When compared to NAA and informed by the NEPA analysis above, the average longfin smelt
17 abundance, based on Kimmerer et al. (2009), decreased 3-4% under Alternative 5 (Table 11-5-8).
18 These results represent the increment of change attributable to the alternative, and address the
19 limitations of the comparison the CEQA baseline (Existing Conditions).

20 In general, under Alternative 5 water operations, the quantity and quality of rearing habitat for
21 longfin smelt would be reduced relative to Existing Conditions. As described for Alternative 1A, the
22 differences between the anticipated future conditions under this alternative and Existing Conditions
23 are largely attributable to sea level rise and climate change, and not to the operational scenarios. As
24 a result, these differences may either overstate the effects of Alternative 5 or indicate significant
25 effects that are largely attributable to sea level rise and climate change, and not to Alternative 5.

26 Habitat restoration conservation measures (CM4) may also improve the quality of spawning and
27 rearing habitat for longfin smelt by increasing suitable habitat area and food production in the Delta.
28 However, given the uncertainty of the outcome related to habitat restoration, the uncertainty
29 regarding the actual mechanism for the outflow-abundance relationship included in Kimmerer et al.
30 (2009), and the modeled change in winter-spring outflow, the impact may be significant, and
31 mitigation would be required. With implementation of Mitigation Measures AQUA-22a through 22c,
32 habitat restoration and reduced larval entrainment would reduce this impact to less than significant,
33 so no additional mitigation would be required.

34 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**
35 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**
36 **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

37 Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

38 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**
39 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

40 Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

1 **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**
2 **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

3 Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

4 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

5 Discussion provided above, under Impact AQUA-22.

6 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

7 Discussion provided above, under Impact AQUA-22.

8 **Restoration Measures (CM2, CM4–CM7, and CM10)**

9 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

10 **NEPA Effects:** The potential effects of restoration construction activities under Alternative 5 would
11 be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that
12 would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-25 in Alternative 1A).
13 This would include potential effects of turbidity, exposure to methyl mercury, accidental spills,
14 disturbance of contaminated sediments, construction-related disturbance, and predation. However,
15 as concluded in Alternative 1A, Impact AQUA-25 in Alternative 1A, restoration construction
16 activities are not expected to adversely affect longfin smelt.

17 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-25 in Alternative 1A for longfin
18 smelt, the potential impact of restoration construction activities is considered less than significant,
19 and no mitigation would be required.

20 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**
21 **Smelt**

22 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
23 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-26). This
24 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
25 organophosphate pesticides, and organochlorine pesticides. Under Alternative 5 there would be
26 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but
27 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As
28 concluded in Alternative 1A, Impact AQUA-26, contaminants associated with restoration measures
29 are not expected to adversely affect longfin smelt with respect to selenium, copper, ammonia and
30 pesticides. The effects of mercury on longfin smelt are uncertain.

31 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-26 for longfin smelt, the potential
32 impact of contaminants associated with restoration measures is considered less than significant, and
33 no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat
34 restoration (25,000 acres rather than 65,000 acres).

35 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

36 **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 5 would be the
37 same as those described for Alternative 1A (see Impact AQUA-27). These would include CM2 Yolo
38 Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally

1 Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural
2 Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be
3 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As
4 concluded in Alternative 1A, Impact AQUA-27 under Alternative 1A, restored tidal habitat is
5 expected to be beneficial for longfin smelt although the reduced acreage would reduce the benefit.
6 The present discussion considers the restored tidal habitat to be proportionally distributed across
7 the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to
8 Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

9 The restored tidal habitat will provide benefits to longfin smelt primarily through the export of
10 improved food production from the five ROAs into the deeper channels of the Delta system. The
11 overall improved habitat connectivity will benefit all species including longfin smelt.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-27 for longfin smelt, the potential
13 impact of restored habitat conditions on longfin smelt is considered to be beneficial although the
14 reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation
15 would be required.

16 **Other Conservation Measures (CM12–CM19 and CM21)**

17 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

18 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**
19 **(CM13)**

20 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

21 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

22 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

23 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

24 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

25 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

26 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**
27 **(CM21)**

28 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms
29 on longfin smelt are the same as those described under Alternative 1A (Impacts AQUA-28 through
30 AQUA-36). The effects would range from no effect, to not adverse, to beneficial.

31 **CEQA Conclusion:** The impacts of the nine impact mechanisms listed above would range from no
32 impact, to less than significant, to beneficial, and no mitigation is required.

1 **Winter-Run Chinook Salmon**

2 **Construction and Maintenance of CM1**

3 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 4 **(Winter-Run ESU)**

5 **NEPA Effects:** The types of potential effects of construction of the water conveyance facilities on
6 winter-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-
7 37) except that Alternative 5 would include one intake compared to five intakes under Alternative
8 1A, so the construction effects would be proportionally less under this alternative. This would
9 convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would
10 require about 4.7 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert
11 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. As concluded for
12 Alternative 1A, Impact AQUA-37, environmental commitments and mitigation measures would be
13 available to avoid and minimize potential effects, and the effect would not be adverse for winter-run
14 Chinook salmon.

15 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-37, the impact of the construction of
16 water conveyance facilities on Chinook salmon would be less than significant except for
17 construction noise associated with pile driving. Potential pile driving impacts would be less than
18 Alternative 1A because only one intake would be constructed rather than five. Implementation of
19 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
20 less than significant.

21 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 22 **of Pile Driving and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
24 Alternative 1A.

25 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 26 **and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
28 Alternative 1A.

29 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 30 **(Winter-Run ESU)**

31 **NEPA Effects:** The types of potential effects of the maintenance of water conveyance facilities under
32 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-38) except
33 that only one intake would need to be maintained for Alternative 5, rather than five under
34 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for
35 Chinook salmon.

36 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance
37 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
38 would be required.

Water Operations of CM1

Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 5 would reduce entrainment and associated pre-screen predation losses at the SWP/CVP south Delta facilities compared to NAA by about 9% averaged across all water year types compared to NAA (Table 11-5-9). As discussed for Alternative 1A (Impact AQUA-39), entrainment would be highest in wet years and would decrease with reduced flows. The greatest relative reductions under Alternative 5 would occur in wet and above normal years decrease 11-12% compared to NAA (Table 11-5-9).

Table 11-5-9. Juvenile Winter-Run Chinook Salmon Annual Entrainment Index^a at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 5

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
Wet	-1,008 (-9%)	-1,428 (-12%)
Above Normal	-633 (-10%)	-757 (-11%)
Below Normal	-818 (-11%)	-394 (-6%)
Dry	-359 (-9%)	-52 (-1%)
Critical	-163 (-13%)	-24 (-2%)
All Years	-661 (-10%)	-602 (-9%)

^a Estimated annual number of fish lost, based on normalized data.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar in type to Alternative 1A (with five intakes), but the degree of the effect would be less because Alternative 5 has only one intake. The state-of-the-art, positive barrier screen would be designed and built to specifications developed to reduce the risk of entrainment and impingement, and are expected to be effective at excluding all life stages of winter-run Chinook salmon that would occur in the vicinity. Combined with an adaptive management program, this effect is expected to be minimal.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because the intake would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 5 would reduce overall entrainment losses of juvenile winter-run Chinook salmon relative to NAA. This effect would not be adverse and may provide a benefit to the species because of the reductions in entrainment loss and mortality.

CEQA Conclusion: As described above, entrainment losses of juvenile winter-run Chinook salmon at the south Delta facilities would decrease under Alternative 5 compared to Existing Conditions (Table 11-5-9). Overall, impacts of water operations on entrainment of juvenile Chinook salmon

1 (winter-run ESU) would be less than significant and may be beneficial. No mitigation would be
2 required.

3 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
4 **Chinook Salmon (Winter-Run ESU)**

5 In general, Alternative 5 would not affect the quantity and quality of spawning and egg incubation
6 habitat for winter-run Chinook salmon relative to NAA.

7 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were
8 examined during the May through September winter-run spawning period (Appendix 11C, *CALSIM II*
9 *Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for
10 spawning and egg incubation. Flows under A5_LLT would generally be similar to or greater than
11 flows under NAA, except in dry years during August (14% to 15% lower) and below normal water
12 years during September (14% to 15% lower).

13 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the
14 May through September winter-run spawning and egg incubation period. Storage under A5_LLT
15 would be similar to or greater than storage under NAA for all water year types (Table 11-5-10).

16 **Table 11-5-10. Difference and Percent Difference in May Water Storage Volume (thousand**
17 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-11 (-0.2%)	23 (1%)
Above Normal	-53 (-1%)	33 (1%)
Below Normal	-91 (-2%)	107 (3%)
Dry	-220 (-6%)	224 (7%)
Critical	-241 (-10%)	343 (18%)

18
19 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the
20 Sacramento River under A5_LLT would be lower than mortality under NAA in all water years except
21 below normal (53% higher) (Table 11-5-11). However, the change in below normal years would be
22 1%, indicating that this effect would be negligible to the winter-run population.

23 **Table 11-5-11. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook**
24 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	1 (253%)	-0.1 (-7%)
Above Normal	1 (317%)	-0.2 (-8%)
Below Normal	2 (186%)	1 (53%)
Dry	5 (343%)	-1 (-8%)
Critical	39 (146%)	-5 (-7%)
All	8 (167%)	-1 (-6%)

25
26 SacEFT predicts that there would be a 9% decrease in the percentage of years with good spawning
27 availability, measured as weighted usable area, under A5_LLT relative to NAA, which would be

1 negligible at an absolute scale (3% difference) (Table 11-5-12). SacEFT predicts that the percentage
 2 of years with good (lower) redd scour risk under A5_LLT would be similar to the percentage of
 3 years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions
 4 under A5_LLT would be similar to (<5% difference) that under NAA. SacEFT predicts that the
 5 percentage of years with good (lower) redd dewatering risk under A5_LLT would be similar to the
 6 percentages under NAA. These results indicate that there would be negligible positive effects of
 7 Alternative 5 on spawning and egg incubation habitat.

8 **Table 11-5-12. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
 9 **for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Spawning WUA	-29 (-50%)	-3 (-9%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-22 (-23%)	1 (1%)
Redd Dewatering Risk	5 (20%)	1 (3%)
Juvenile Rearing WUA	-24 (-48%)	1 (4%)
Juvenile Stranding Risk	5 (25%)	-6 (-19%)

WUA = Weighted Usable Area.

10

11 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
 12 Alternative 1A, Impact AQUA-40 which indicates that there would generally be no effects on water
 13 temperature in the Sacramento River.

14 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
 15 not have the potential to substantially reduce suitable spawning habitat or substantially reduce the
 16 number of fish as a result of egg mortality. All flow and temperature effects under Alternative 5 are
 17 negligible or small relative to NAA such that they would not affect winter-run Chinook salmon at a
 18 biologically meaningful level.

19 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of
 20 spawning and egg incubation habitat for winter-run Chinook salmon would not be affected relative
 21 to the CEQA baseline.

22 CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined
 23 during the May through September winter-run spawning and egg incubation period (Appendix 11C,
 24 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar
 25 to or greater than flows under Existing Conditions, except in wet and below normal water years
 26 during May (18% to 23% and 6% to 7% lower, depending on location), critical years during July
 27 (10% to 11% lower), dry and critical years during August (11% to 12% and 23% to 26% lower,
 28 respectively), and below normal and dry years during September (12% to 13% and 24% to 27%
 29 lower, respectively).

30 Shasta Reservoir storage volume at the end of May under A5_LLT would be similar to Existing
 31 Conditions in all water years, except dry (6% lower) and critical water years (10% lower) (Table 11-
 32 5-10). This indicates that there would be a small to negligible effect of Alternative 5 on flows during
 33 the spawning and egg incubation period relative to Existing Conditions.

1 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the
2 Sacramento River under A5_LLT would be 146% to 343% greater than mortality under Existing
3 Conditions depending on water year type (Table 11-5-11). These increases would only affect the
4 winter-run population during dry and critical years, in which the absolute percent increase of the
5 winter-run population would be 5 and 39%, respectively. These results indicate that Alternative 5
6 would cause increased winter-run Chinook salmon mortality in the Sacramento River during drier
7 water years.

8 SacEFT predicts that there would be a 50% decrease in the percentage of years with good spawning
9 availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table
10 11-5-12). SacEFT predicts that the percentage of years with good (lower) redd scour risk under
11 A5_LLT would be similar to the percentage of years under Existing Conditions. SacEFT predicts that
12 the percentage of years with good egg incubation conditions under A5_LLT would be 23% lower
13 than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd
14 dewatering risk under A5_LLT would 20% greater than the percentage of years under Existing
15 Conditions. These results indicate that Alternative 5 would cause moderate reductions in spawning
16 WUA and egg incubation conditions.

17 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
18 Alternative 1A, Impact AQUA-40, which indicates there would be increased exceedances of NMFS
19 temperature thresholds in the Sacramento River relative to Existing Conditions.

20 **Summary of CEQA Conclusion**

21 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between
22 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
23 alternative could substantially reduce suitable spawning habitat and substantially reduce the
24 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. The
25 extent of spawning habitat would be 50% lower due to Alternative 5 compared to Existing
26 Conditions (Table 11-5-12), which represents a substantial reduction in spawning habitat and,
27 therefore, in adult spawner and redd carrying capacity. Further, egg mortality in drier years, during
28 which winter-run Chinook salmon would already be stressed due to reduced flows and increased
29 temperatures. This effect was also found by SacEFT in that egg incubation habitat would be reduced
30 under Alternative 5 (Table 11-5-12). There were also higher exceedances under Alternative 5 above
31 NMFS temperature thresholds.

32 These results are primarily caused by four factors: differences in sea level rise, differences in climate
33 change, future water demands, and implementation of the alternative. The analysis described above
34 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
35 alternative from those of sea level rise, climate change and future water demands using the model
36 simulation results presented in this chapter. However, the increment of change attributable to the
37 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
38 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
39 implementation period, which does include future sea level rise, climate change, and water
40 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
41 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
42 effect of the alternative from those of sea level rise, climate change, and water demands.

43 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
44 term implementation period and Alternative 5 indicates that flows in the locations and during the

1 months analyzed above would generally be similar between Existing Conditions during the LLT and
2 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
3 found above would generally be due to climate change, sea level rise, and future demand, and not
4 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
5 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
6 result in a significant impact on spawning habitat for winter-run Chinook salmon. This impact is
7 found to be less than significant and no mitigation is required.

8 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon** 9 **(Winter-Run ESU)**

10 In general, Alternative 5 would not affect the quantity and quality of rearing habitat for fry and
11 juvenile winter-run Chinook salmon relative to NAA.

12 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
13 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
14 *in the Fish Analysis*). Flows under A5_LLТ would generally be similar to or greater than flows under
15 NAA during August through October and December.

16 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
17 measured as weighted usable area, under A5_LLТ would be similar (<5% difference) to percentage
18 under NAA (Table 11-5-12). The percentage of years with good (low) juvenile stranding risk under
19 A5_LLТ is predicted to be 19% lower than that under NAA, although this would be 6% difference on
20 an absolute scale.

21 SALMOD predicts that mean winter-run smolt equivalent habitat-related mortality under A5_LLТ
22 would be have a negligible (<5%) difference in habitat-related mortality between A5_LLТ and NAA.

23 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
24 Alternative 1A, Impact AQUA-41, which indicates that there would be no effect on mean monthly
25 temperatures during the winter-run juvenile rearing period relative to Existing Conditions.

26 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
27 not have the potential to substantially reduce the amount of suitable habitat or substantially
28 interfere with the movement of fish. The effects of Alternative 5 on flows and temperatures would
29 not affect winter-run Chinook salmon fry and juvenile rearing habitat in a biologically meaningful
30 way. Although there is a small reduction in stranding risk predicted by SacEFT, combined with all
31 other results indicating that Alternative 5 would have no effect on winter-run Chinook salmon
32 rearing, it is concluded that the effect would not be adverse.

33 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of fry
34 and juvenile rearing habitat for winter-run Chinook salmon would not be affected relative to the
35 CEQA baseline.

36 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
37 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
38 *in the Fish Analysis*). Flows under A5_LLТ would generally be similar to or greater than flows under
39 Existing Conditions during August through October and December, although flows would generally
40 be up to 10% lower during November.

1 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
2 measured as weighted usable area, under A5_LLTT would be 48% lower than under Existing
3 Conditions (Table 11-5-12). In addition, the percentage of years with good (low) juvenile stranding
4 risk under A5_LLTT is predicted to be 25% greater than under Existing Conditions, although this
5 difference is 5% on an absolute scale. These results indicate that the quantity of juvenile rearing
6 habitat in the Sacramento River would be substantially lower under A5_LLTT relative to Existing
7 Conditions although risk of stranding would be marginally higher.

8 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A5_LLTT would
9 be 17% higher than under Existing Conditions.

10 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
11 Alternative 1A, Impact AQUA-41, which indicates that there would be small temperature increases
12 under Alternative 1A relative to Existing Conditions during some months in the Sacramento River.

13 **Summary of CEQA Conclusion**

14 Collectively, the results of the Impact AQUA-41 CEQA analysis indicate that the difference between
15 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
16 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set
17 forth above. The 48% reduction in rearing habitat availability under Alternative 5 would reduce
18 upstream habitat conditions for winter-run fry and juveniles. SALOD also predicts increased habitat-
19 related mortality.

20 These results are primarily caused by four factors: differences in sea level rise, differences in climate
21 change, future water demands, and implementation of the alternative. The analysis described above
22 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
23 alternative from those of sea level rise, climate change and future water demands using the model
24 simulation results presented in this chapter. However, the increment of change attributable to the
25 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
26 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
27 implementation period, which does include future sea level rise, climate change, and water
28 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
29 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
30 effect of the alternative from those of sea level rise, climate change, and water demands.

31 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
32 term implementation period and Alternative 5 indicates that flows in the locations and during the
33 months analyzed above would generally be similar between Existing Conditions during the LLT and
34 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
35 found above would generally be due to climate change, sea level rise, and future demand, and not
36 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
37 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
38 result in a significant impact on rearing habitat for winter-run Chinook salmon. This impact is found
39 to be less than significant and no mitigation is required.

1 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**
2 **(Winter-Run ESU)**

3 In general, the effects of Alternative 5 on winter-run Chinook salmon migration conditions relative
4 to the NAA are uncertain.

5 **Upstream of the Delta**

6 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November
7 juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run
8 Chinook salmon to migrate effectively down the Sacramento River. Flows under A5_LLT would be up to
9 17% lower than under NAA during November depending on water year type (Appendix 11C, *CALSIM*
10 *II Model Results utilized in the Fish Analysis*). However, except for very few water year types each
11 month, flows under A5_LLT would be similar to or greater than flows under NAA during the rest of
12 the juvenile winter-run Chinook salmon migration period (July through October).

13 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run
14 Chinook salmon upstream migration period (December through August). A reduction in flows may
15 reduce the olfactory cues needed by adult winter-run to return to natal spawning grounds in the
16 upper Sacramento River. Flows under A5_LLT would generally be similar to or greater than those
17 under NAA except in dry water years during January (5% lower) and August (14% lower).

18 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
19 Alternative 1A, Impact AQUA-42 which indicates there would be no differences in water
20 temperatures between NAA and Alternative 1A.

21 **Through-Delta**

22 ***Juveniles***

23 During the juvenile winter-run Chinook salmon emigration period (November to early May), mean
24 monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged
25 across years would be lower (up to 17% lower) compared to NAA. Flows would be up to 23% lower
26 in November of above normal years.

27 The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish
28 around the intake structures. The single new intake would remove or modify habitat along that
29 portion of the migration corridor (3.8 acres aquatic habitat and 2,050 linear feet of shoreline).
30 Bioenergetics modeling of a single intake with a median predator density predicts a predation loss
31 of about 0.3% of the juvenile winter-run juvenile population (Table 11-5-13). A conservative
32 assumption of 5% loss per intake would result in a loss of 4% of juvenile winter-run Chinook that
33 reach the north Delta.

1 **Table 11-5-13. Chinook Salmon Predation Loss at the Proposed North Delta Diversion Intake**
2 **(One Intake)**

Striped Bass Numbers Per 1,000 Feet of Intake	Total	Estimated Number of Juvenile Salmon Consumed				Percentage of Annual Juvenile Production (%) Consumed			
		Winter	Spring	Fall	Late Fall	Winter	Spring	Fall	Late Fall
18 (Low)	20	1,005	1,407	21,571	4,082	0.04	0.03	0.04	0.09
119 (Median)	131	6,647	9,301	142,610	26,983	0.26	0.22	0.23	0.63
219 (High)	241	12,233	17,117	262,451	49,658	0.47	0.41	0.43	1.15

3

4 Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon was
5 modeled by the DPM. Average survival under Alternative 5 would be 34% across all years, 27% in
6 drier years, and 45% in wetter years, which is similar to survival under baseline conditions (Table
7 11-5-14).

8 **Table 11-5-14. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon**
9 **under Alternative 5**

Year Types	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A5_LLТ	EXISTING CONDITIONS vs. A5_LLТ	NAA vs. A5_LLТ
Wetter Years	46.3	46.1	45.3	-1.0 (-2%)	-0.8 (-2%)
Drier Years	28.0	27.1	26.7	-1.3 (-5%)	-0.4 (-2%)
All Years	34.9	34.2	33.7	-1.2 (-3%)	-0.6 (-2%)

Note: Delta Passage Model results for survival to Chipps Island.
Wetter = Wet and above normal water years (6 years).
Drier = Below normal, dry and critical water years (10 years).

10

11 **Adults**

12 The importance of attraction flows and olfactory cues to adult Chinook salmon migrating upstream
13 through the Delta is described in detail in Impact AQUA-42 for Alternative 1A. During the adult
14 winter-run Chinook salmon migration period in the Delta (December to February), olfactory cues,
15 based on the proportion of Sacramento River flows, would be similar (<7% difference) compared to
16 NAA (Table 11-5-15).

1 **Table 11-5-15. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
 2 **San Joaquin River during the Adult Chinook Migration Period for Alternative 5**

Month	EXISTING CONDITIONS	NAA	A5_LLТ	EXISTING CONDITIONS vs. A5_LLТ	NAA vs. A5_LLТ
Sacramento River					
September	60	65	67	7	2
October	60	68	66	6	-2
November	60	66	65	5	-1
December	67	66	72	5	6
January	76	75	70	-6	-5
February	75	72	71	-4	-1
March	78	76	70	-8	-6
April	77	75	62	-15	-13
May	69	65	59	-10	-6
San Joaquin River					
September	0.3	0.1	0.5	0.2	0.4
October	0.2	0.3	1.3	1.1	1.0
November	0.4	1.0	2.4	2.0	1.4
December	0.9	1.0	1.9	1.0	0.9
January	1.6	1.7	2.0	0.4	0.3
February	1.4	1.5	1.7	0.3	0.2
March	2.6	2.8	3.0	0.4	0.2
April	6.3	6.6	6.8	0.5	0.2

Shading indicates 10% or greater absolute difference.

Source: DSM2-QUAL fingerprinting analysis (monthly time step, October 1976-September 1991). *BDCP Effects Analysis – Appendix 5.C, Section 5C.5.3. Passage, Movement, and Migration Results.*

3
 4 **NEPA Effects:** Overall, the effect of Alternative 5 is uncertain due to absence of information
 5 regarding the near-field effects of a new intake structure in the north Delta on migrating juvenile
 6 winter-run Chinook salmon.

7 Upstream flows and water temperatures would generally be similar between Alternative 5 and NAA
 8 during the juvenile and adult migration periods. Although some small to moderate reductions in
 9 upstream flows would occur in November (up to 17% lower), there are generally no effects of
 10 Alternative 5 on flows or temperatures in the Sacramento River.

11 Adult attraction flows in the Delta under Alternative 5 would be lower than those under NAA, but
 12 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

13 Near-field effects of Alternative 5 NDD on winter-run Chinook salmon related to impingement and
 14 predation associated with three new intake structures could result in negative effects on juvenile
 15 migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall
 16 effects. It is expected that the level of near-field impacts would be directly correlated to the number
 17 of new intake structures in the river and thus the level of impacts associated with 1 new intake
 18 would be considerably lower than those expected from having 5 new intakes in the river. Estimates
 19 within the effects analysis range from very low levels of effects (<1% mortality) to larger effects (~

1 4% mortality above current baseline levels). CM15 would be implemented with the intent of
2 providing localized and temporary reductions in predation pressure at the NDD. Additionally,
3 several pre-construction surveys to better understand how to minimize losses associated with the 1
4 new intake structure will be implemented as part of the final NDD screen design effort. Alternative 5
5 also includes an Adaptive Management Program and Real-Time Operational Decision-Making
6 Process to evaluate and make limited adjustments intended to provide adequate migration
7 conditions for winter-run Chinook. However, at this time, due to the absence of comparable facilities
8 anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field
9 effects at the NDD remains highly uncertain.

10 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
11 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
12 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5
13 predict improvements in smolt condition and survival associated with increased access to the Yolo
14 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
15 of each of these factors and how they might interact and/or offset each other in affecting salmonid
16 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

17 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
18 all of these elements of BDCP operations and conservation measures to predict smolt migration
19 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
20 migration survival under Alternative 5 would be similar to those estimated for NAA. Further
21 refinement and testing of the DPM, along with several ongoing and planned studies related to
22 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
23 future. These efforts are expected to improve our understanding of the relationships and
24 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
25 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
26 However, until these efforts are completed and their results are fully analyzed, the overall
27 cumulative effect of Alternative 5 on winter-run Chinook salmon migration remains uncertain.

28 **CEQA Conclusion:** In general, Alternative 5 would not affect migration conditions for winter-run
29 Chinook salmon relative to Existing Conditions.

30 **Upstream of the Delta**

31 Flows in the Sacramento River upstream of Red Bluff were examined during the July through
32 November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
33 Analysis*). Flows under A5_LL1T for juvenile migrants would generally be greater than or similar to
34 flows under Existing Conditions during all months except November, in which flows would be up to
35 10% lower depending on water year type.

36 Flows in the Sacramento River upstream of Red Bluff were examined during the December through
37 August adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
38 Flows under A5_LL1T would generally be similar to or greater than flows under Existing Conditions
39 with few exceptions.

40 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
41 Alternative 1A, Impact AQUA-42, which indicates that there would be small increase in water
42 temperatures under Alternative 5 relative to Existing Conditions during large portions of the
43 juvenile and adult migration periods.

1 **Through-Delta**

2 During the juvenile winter-run Chinook salmon emigration period (November to early May), mean
3 monthly flows in the Sacramento River below the north Delta intake would be reduced (6% to 20%
4 lower) under Alternative 5 compared to Existing Conditions. Potential predation losses across the
5 single intake structure would be less than 5%. Through-Delta survival to Chipps Island by
6 emigrating juvenile winter-run Chinook salmon would be about 1% lower (2% to 5% relative
7 decrease) than under Existing Conditions (Table 11-5-14).

8 **Adults**

9 As described above, during the adult winter-run Chinook salmon migration period in the Delta
10 (December to February), olfactory cues, based on the proportion of Sacramento River flows, would
11 be similar (<7% difference) compared to Existing Conditions (Table 11-5-15).

12 **Summary of CEQA Conclusion**

13 Collectively, the impact would be less than significant and no mitigation would be necessary.
14 Upstream flows and water temperatures, during the juvenile and adult migration periods, would
15 generally be similar between Alternative 5 and Existing Conditions. There would be no upstream
16 flow-related effects on winter-run Chinook salmon juvenile and adult migration. Water
17 temperatures would increase slightly during the migration periods, but these small increases are not
18 expected to substantially affect migratory abilities of either life stage. Due to the similarity in
19 through-Delta migration flows between Alternative 5 and the baselines, migration habitat
20 conditions and movement are not substantially reduced.

21 **Restoration Measures (CM2, CM4–CM7, and CM10)**

22 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**
23 **(Winter-Run ESU)**

24 **NEPA Effects:** The types of potential effects of restoration construction activities under Alternative 5
25 would be similar to Alternative 1A, but of a lesser magnitude because of the reduced acreage of tidal
26 habitat that would be restored (25,000 acres under Alternative 5 rather than 55,000 acres under
27 Alternative 1A) (see Impact AQUA-43 in Alternative 1A). This would include potential effects of
28 turbidity, exposure to methyl mercury, accidental spills, disturbance of contaminated sediments,
29 construction-related disturbance, and predation. However, as concluded in Alternative 1A, Impact
30 AQUA-43, restoration construction activities are not expected to adversely affect Chinook salmon.

31 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-43 for winter-run Chinook salmon,
32 the potential impact of restoration construction activities is considered less than significant, and no
33 mitigation would be required.

34 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**
35 **Salmon (Winter-Run ESU)**

36 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
37 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-44). This
38 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
39 organophosphate pesticides, and organochlorine pesticides. Under Alternative 5 there would be
40 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 55,000 acres) but

1 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As
2 concluded in Alternative 1A, Impact AQUA-44, contaminants associated with restoration measures
3 are not expected to adversely affect Chinook salmon with respect to selenium, copper, ammonia and
4 pesticides. The effects of methylmercury on Chinook salmon are uncertain.

5 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-44 for Chinook salmon, the
6 potential impact of contaminants associated with restoration measures is considered less than
7 significant, and no mitigation would be required. The same conclusion applies to the reduced acres
8 of tidal habitat restoration (25,000 acres rather than 65,000 acres).

9 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**
10 **ESU)**

11 **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 5 would be the
12 same as those described for Alternative 1A (see Impact AQUA-45). These would include CM2 Yolo
13 Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally
14 Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural
15 Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be
16 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 55,000 acres). As
17 concluded in Impact AQUA-45 under Alternative 1A, restored tidal habitat is expected to be
18 beneficial for Chinook salmon although the reduced acreage would reduce the benefit. The restored
19 tidal habitat under Alternative 5 would be proportionally distributed across the five ROAs and
20 would provide proportionally less benefit based on the reduced acreage compared to Alternative 1A.
21 The Alternative 5 acreage is approximately 60% less than the Alternative 1A acreage.

22 The restored tidal habitat may provide benefits to juvenile Chinook salmon occupying all ROAs
23 (except the Cosumnes/Mokelumne) because of increased acreage providing additional habitat and
24 because of improved food production. Increased food production from all ROAs that is exported into
25 the Delta may also benefit Chinook salmon. The overall improved habitat connectivity is likely to
26 benefit all species including Chinook salmon.

27 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-45 for Chinook salmon, the
28 potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial
29 although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%.
30 No mitigation would be required.

31 **Other Conservation Measures] (CM12–CM19 and CM21)**

32 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**
33 **ESU) (CM12)**

34 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
35 **(Winter-Run ESU) (CM13)**

36 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**
37 **Run ESU) (CM14)**

38 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
39 **(Winter-Run ESU) (CM15)**

1 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**
2 **(CM16)**

3 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**
4 **(CM17)**

5 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**
6 **(CM18)**

7 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**
8 **ESU) (CM19)**

9 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
10 **(Winter-Run ESU) (CM21)**

11 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms
12 on winter-run Chinook salmon are the same as those described under Alternative 1A (Impacts
13 AQUA-46 through AQUA-54). The effects would range from no effect, to not adverse, to beneficial.

14 *CEQA Conclusion:* The impacts of the nine impact mechanisms listed above would range from no
15 impact, to less than significant, to beneficial, and no mitigation is required.

16 **Spring-Run Chinook Salmon**

17 **Construction and Maintenance of CM1**

18 The construction- and maintenance-related effects of Alternative 5 would be identical for all four
19 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the
20 discussion of these effects for winter-run Chinook.

21 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
22 **(Spring-Run ESU)**

23 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on spring-run
24 Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except
25 that Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the
26 effects would be proportionally less under this alternative. This would convert about 2,050 lineal
27 feet of existing shoreline habitat into intake facility structures and would require about 4.7 acres of
28 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
29 shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-
30 55, environmental commitments and mitigation measures would be available to avoid and minimize
31 potential effects, and the effect would not be adverse for spring-run Chinook salmon.

32 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-55, the impact of the construction of
33 water conveyance facilities on Chinook salmon would be less than significant except for
34 construction noise associated with pile driving. Potential pile driving impacts would be less than
35 under Alternative 1A because only one intake would be constructed rather than five.
36 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
37 that noise impact to less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
4 Alternative 1A.

5 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
6 **and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
8 Alternative 1A.

9 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
10 **(Spring-Run ESU)**

11 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
12 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-56) except
13 that only one intake would need to be maintained under Alternative 5 rather than five under
14 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-56, the effect would not be adverse for
15 Chinook salmon.

16 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-56, the impact of the maintenance
17 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
18 would be required.

19 **Water Operations of CM1**

20 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**
21 **ESU)**

22 ***Water Exports from SWP/CVP South Delta Facilities***

23 Overall entrainment of juvenile spring-run Chinook salmon at the south Delta export facilities,
24 averaged across all water year types, would be similar under Alternative 5 compared to NAA (Table
25 11-5-16). As discussed for Alternative 1A (Impact AQUA-57), entrainment is highest in wet years
26 and lowest in below normal water years. Under Alternative 5, entrainment would be reduced or
27 similar (<10% difference) to NAA in all water year types, except for a 12% increase in dry years
28 (Table 11-5-16). Pre-screen losses, typically attributed to predation, would be expected to change
29 commensurate with entrainment at the south Delta facilities. The proportion of the annual
30 production lost to entrainment was similar for both Alternative 5 and NAA, averaging about 5%
31 across all years

32 ***Water Exports from SWP/CVP North Delta Intake Facilities***

33 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
34 entrainment of juvenile salmonids at the north Delta intake would be greater than baseline, but the
35 effects would be minimal because it would have state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because the intake would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 5 would reduce the total numbers of juvenile Chinook salmon of all races entrained relative to NAA, which would be a beneficial impact. This effect would not be adverse and would provide a benefit to the species because of the reductions in entrainment loss and mortality.

CEQA Conclusion: Entrainment losses of juvenile Chinook salmon at the south Delta facilities would slightly increase (~3%) across all water years under Alternative 5 compared to Existing Conditions (Table 11-5-16; Existing Conditions). The greatest increase is expected to occur during dry water years (~20%) with the greatest decrease occurring during critical water years (~13%). Overall, impacts on juvenile spring-run Chinook salmon would be less than significant and no mitigation would be required.

Table 11-5-16. Juvenile Chinook Salmon Annual Entrainment Index^a at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 5

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-3,140 (-4%)	-6,768 (-7%)
Above Normal	2,123 (8%)	-945 (-3%)
Below Normal	859 (13%)	65 (1%)
Dry	3,324 (20%)	2,130 (12%)
Critical	-1,545 (-13%)	76 (1%)
All Years	1,162 (3%)	-448 (-1%)

Shading indicates 10% or greater increased annual entrainment.

^a Estimated annual number of fish lost, based on normalized data.

Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Spring-Run ESU)

In general, the effects of Alternative 5 on spawning and egg incubation habitat conditions for spring-run Chinook salmon relative to NAA are uncertain.

Sacramento River

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-58, which indicates that there would generally be no effects of Alternative 5 on water temperatures during the spring-run spawning and egg incubation period in the Sacramento River relative to NAA.

Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook salmon spawning and incubation period (September through January). Flows under A5_LLT would generally be similar to or greater than flows under NAA during all months except November, in

1 which flows would be up to 14% lower than under NAA (Appendix 11C, *CALSIM II Model Results*
2 *utilized in the Fish Analysis*).

3 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam
4 during the spring-run spawning and egg incubation period (September through January). Storage
5 under A5_LLT would be similar to (<5% difference) storage under NAA in all water year types
6 (Table 11-5-17).

7 **Table 11-5-17. Difference and Percent Difference in September Water Storage Volume (thousand**
8 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-623 (-19%)	-111 (-4%)
Above Normal	-661 (-21%)	-46 (-2%)
Below Normal	-450 (-16%)	-96 (-4%)
Dry	-493 (-20%)	18 (1%)
Critical	-374 (-32%)	8 (1%)

9

10 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
11 Sacramento River under A5_LLT would be lower than or similar to mortality under NAA in above
12 normal, dry, and critical years, but greater in wet (14% greater) and below normal (32% greater)
13 water years. Absolute scale increases of 3% of the spring-run population in wet water years would
14 be negligible to the overall population (Table 11-5-18). However, the 13% increase in mortality in
15 below normal years is considered a small effect on the spring-run population. Combining all water
16 years, there would be no effect of Alternative 5 on egg mortality (3% absolute change).

17 **Table 11-5-18. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**
18 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	18 (180%)	3 (14%)
Above Normal	23 (171%)	1 (2%)
Below Normal	43 (359%)	13 (32%)
Dry	56 (284%)	-1 (-1%)
Critical	22 (30%)	0 (0%)
All	32 (143%)	3 (7%)

19

20 SacEFT predicts that there would be no difference in the percentage of years with good spawning
21 availability, measured as weighted usable area, under A5_LLT relative to NAA (Table 11-5-19).
22 SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd
23 scour risk under A5_LLT relative to NAA. SacEFT predicts that there would be a 41% decrease (14%
24 on an absolute scale) in the percentage of years with good (lower) egg incubation conditions under
25 A5_LLT relative to NAA. SacEFT predicts that there would be an 18% decrease (6% on an absolute
26 scale) in the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to
27 NAA. These results indicate that there would be a small to moderate reduction in egg incubation
28 conditions and redd dewatering risk under Alternative 5 relative to NAA.

1 **Table 11-5-19. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
2 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Spawning WUA	-21 (-30%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-66 (-77%)	-14 (-41%)
Redd Dewatering Risk	-21 (-43%)	-6 (-18%)
Juvenile Rearing WUA	3 (14%)	3 (14%)
Juvenile Stranding Risk	-2 (-11%)	3 (21%)

WUA = Weighted Usable Area.

3
4 There is an apparent discrepancy in results of the SacEFT model and Reclamation egg mortality
5 model with regard to conditions for spring-run salmon eggs. SacEFT predicts that egg incubation
6 habitat would decrease (14% absolute scale decrease) and the Reclamation egg mortality model
7 predicts that overall egg mortality would be unaffected by Alternative 5, except in below normal
8 water years. The SacEFT uses mid-August through early March as the egg incubation period, based
9 on Vogel and Marine (1991), and the reach between ACID Dam and Battle Creek for redd locations.
10 The Reclamation egg mortality model uses the number of days after Julian week 33 (mid-August)
11 that it takes to accumulate 750 temperature units to hatching and another 750 temperature units to
12 emergence. Temperatures units are calculated by subtracting 32°F from daily river temperature and
13 are computed on a daily basis. As a result, egg incubation duration is generally mid-August through
14 January, but is dependent on river temperature. The Reclamation model uses the reach between
15 ACID Dam and Jelly’s Ferry (approximately 5 river miles downstream of Battle Creek), which
16 includes 95% of Sacramento River spawning locations based on 2001–2004 redd survey data
17 (Reclamation 2008). These differences in egg incubation period and location likely account for the
18 difference between model results. Although the SacEFT model has been peer-reviewed, the
19 Reclamation egg mortality model has been extensively reviewed and used in prior biological
20 assessments and BiOps. Therefore, both results are considered valid and were considered in
21 drawing conclusions about spring-run egg mortality in the Sacramento River.

22 **Clear Creek**

23 Flows in Clear Creek were examined during the spring-run Chinook salmon spawning and egg
24 incubation period (September through January). Flows under A5_LLT would be similar to or greater
25 than flows under NAA in all months and water years (Appendix 11C, *CALSIM II Model Results utilized*
26 *in the Fish Analysis*).

27 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
28 comparing the magnitude of flow reduction each month over the incubation period compared to the
29 flow in September when spawning is assumed to occur. The greatest reduction in flows under
30 A5_LLT would be the same or of a lower magnitude as that under NAA in all water year types (Table
31 11-5-20).

32 Water temperatures were not modeled in Clear Creek.

1 **Table 11-5-20. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
 2 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
 3 **January Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

4

5 **Feather River**

6 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)
 7 where spring-run primarily spawn during September through January (Appendix 11C, *CALSIM II*
 8 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would not differ from NAA because
 9 minimum Feather River flows are included in the FERC settlement agreement and would be met for
 10 all model scenarios.

11 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam
 12 during the spring-run spawning and egg incubation period. Storage under A5_LLT would be similar
 13 to or greater than storage under NAA depending on water year type (Table 11-5-21). This indicates
 14 that the majority of reduction in storage volume would be due to climate change rather than
 15 Alternative 5.

16 **Table 11-5-21. Difference and Percent Difference in September Water Storage Volume (thousand**
 17 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-885 (-31%)	129 (7%)
Above Normal	-630 (-27%)	161 (10%)
Below Normal	-549 (-27%)	60 (4%)
Dry	-178 (-13%)	175 (17%)
Critical	-76 (-8%)	112 (14%)

18

19 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
 20 comparing the magnitude of flow reduction each month over the egg incubation period compared to
 21 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
 22 during October through January were identical among A5_LLT and NAA (Appendix 11C, *CALSIM II*
 23 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 5 on
 24 redd dewatering in the Feather River low-flow channel.

1 Water temperatures in the Feather River under Alternative 5 would be the same as those under
2 Alternative 1A, Impact AQUA-58, which indicates that there would be no effect of Alternative 1A on
3 water temperatures in the Feather River relative to NAA during the spring-run spawning and egg
4 incubation period.

5 **NEPA Effects:** Available analytical tools show conflicting results regarding the temperature effects of
6 relatively small changes in predicted summer and fall flows in the Sacramento River. Several models
7 (CALSIM, SRWQM, and Reclamation Egg Mortality Model) generally show no change in upstream
8 conditions as a result of Alternative 5. However, one model, SacEFT, shows adverse effects under
9 some conditions. After extensive investigation of these results, they appear to be a function of high
10 model sensitivity to relatively small changes in estimated upstream conditions, which may or may
11 not accurately predict adverse effects. The new NDD structures allow for spring time deliveries of
12 water south of the Delta that are currently constrained under the NAA. For this reason, additional
13 spring storage criteria may be necessary to ensure Shasta Reservoir operations similar to what was
14 modeled. These discussions will occur in the Section 7 consultation with Reclamation on Shasta
15 Reservoir and system-wide operations, which is outside the scope of BDCP. In conclusion,
16 Alternative 5 modeling results support a finding that effects are uncertain. Modeled results are
17 mixed and operations that match the CALSIM modeling are not assured. Model results will be
18 submitted to independent peer review to confirm that adverse effects are not reasonably anticipated
19 to occur.

20 There would be no effects of Alternative 5 on spawning and egg incubation habitat for spring-run
21 Chinook salmon in the Feather River or in Clear Creek relative to the NAA.

22 **CEQA Conclusion:** In general, Alternative 5 would not affect spawning and egg incubation habitat
23 conditions for spring-run Chinook salmon relative to Existing Conditions.

24 **Sacramento River**

25 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
26 Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the
27 exceedances of NMFS temperature thresholds under Alternative 5 relative to Existing Conditions.

28 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook
29 salmon spawning and incubation period (September through January). Flows under A5_LLT would
30 generally be similar to or greater than flows under Existing Conditions during all months of the
31 period except November with few exceptions (up to 24% lower, depending on month and water
32 year type) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT
33 would generally be lower (up to 10%, depending on water year type) than those under Existing
34 Conditions during November.

35 Shasta Reservoir Storage volume at the end of September would be 16% to 32% lower under
36 A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-17).

37 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
38 Sacramento River under A5_LLT would be 30% to 359% greater than mortality under Existing
39 Conditions depending on water year type (22% to 56% increase on an absolute scale) (Table 11-5-
40 18).

41 SacEFT predicts that there would be a 30% decrease in the percentage of years with good spawning
42 availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table

1 11-5-19). SacEFT predicts that there would be no difference in the percentage of years with good
2 (lower) redd scour risk under A5_LLT relative to Existing Conditions. SacEFT predicts that there
3 would be a 77% decrease in the percentage of years with good (lower) egg incubation conditions
4 under A5_LLT relative to Existing Conditions. SacEFT predicts that there would be a 43% decrease
5 in the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to Existing
6 Conditions. These results indicate that spawning and egg incubation conditions for spring-run
7 Chinook salmon would be poor relative to Existing Conditions.

8 **Clear Creek**

9 Water temperatures were not modeled in Clear Creek.

10 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
11 (September through January) under A5_LLT would generally be similar to or greater than flows
12 under Existing Conditions except in critical years during September and October (28% and 7%
13 lower, respectively) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II*
14 *Model Results utilized in the Fish Analysis*).

15 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
16 comparing the magnitude of flow reduction each month over the incubation period compared to the
17 flow in September when spawning is assumed to occur (Table 11-5-20). The greatest reduction in
18 flows under A5_LLT would be 50% lower (more negative) than Existing Conditions in critical years
19 and be 27% and 67% lower (could not calculate relative change because dividing by 0) in above
20 normal and dry years, respectively.

21 **Feather River**

22 Water temperatures in the Feather River under Alternative 5 would be the same as those under
23 Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the
24 exceedances of NMFS temperature thresholds under Alternative 5 relative to Existing Conditions.

25 Flows in the Feather River low-flow channel under A5_LLT are not different from Existing
26 Conditions during the spring-run spawning and egg incubation period (September through January)
27 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through
28 January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for
29 all model scenarios.

30 Oroville Reservoir storage volume at the end of September would be 8% to 31% lower under
31 A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-21).

32 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
33 comparing the magnitude of flow reduction each month over the incubation period compared to the
34 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
35 during October through January were identical between A5_LLT and Existing Conditions (Appendix
36 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of
37 Alternative 5 on redd dewatering in the Feather River low-flow channel.

38 **Summary of CEQA Conclusion**

39 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between
40 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
41 alternative could substantially reduce suitable spawning habitat and substantially reduce the

1 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. The
2 quality and quantity of spawning and incubation habitat for spring-run Chinook salmon in the
3 Sacramento River would be lower under Alternative 5 relative to Existing Conditions (Table 11-5-
4 19), which would reduce the ability of spring-run Chinook salmon to spawn successfully. SacEFT
5 and the Reclamation egg mortality both predict lower spawning and egg incubation conditions
6 under Alternative 5 in the Sacramento River. Water temperatures would be higher in both the
7 Sacramento and Feather Rivers.

8 These results are primarily caused by four factors: differences in sea level rise, differences in climate
9 change, future water demands, and implementation of the alternative. The analysis described above
10 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
11 alternative from those of sea level rise, climate change and future water demands using the model
12 simulation results presented in this chapter. However, the increment of change attributable to the
13 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
14 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
15 implementation period, which does include future sea level rise, climate change, and water
16 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
17 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
18 effect of the alternative from those of sea level rise, climate change, and water demands.

19 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
20 term implementation period and Alternative 5 indicates that flows in the locations and during the
21 months analyzed above would generally be similar between Existing Conditions during the LLT and
22 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
23 found above would generally be due to climate change, sea level rise, and future demand, and not
24 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
25 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
26 result in a significant impact on spawning habitat for spring-run Chinook salmon. This impact is
27 found to be less than significant and no mitigation is required.

28 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring- 29 Run ESU)**

30 In general, Alternative 5 would not affect the quantity and quality of rearing habitat for fry and
31 juvenile spring-run Chinook salmon relative to NAA.

32 ***Sacramento River***

33 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
34 Alternative 1A, Impact AQUA-59, which indicates that there would be no differences (<5%) in mean
35 monthly water temperature between NAA and Alternative 1A in any month or water year type
36 throughout the period.

37 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
38 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
39 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LL
40 T would mostly be similar to or greater than flows under NAA, although flows would be up to 9%
41 lower in some months and water year types. During November, flows under A5_LL
42 T would be 6% to 21% lower than flows under NAA depending on location and water year type.

1 As reported in Impact AQUA-40, May Shasta storage volume under A5_LLT would be similar to or
2 greater than storage under NAA for all water year types (Table 11-5-10).

3 As reported in Impact AQUA-58, September Shasta storage volume would be similar to (<5%
4 difference) storage under NAA in all water year types (Table 11-5-17).

5 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under
6 A5_LLT would be greater than that under NAA (Table 11-5-19). The percentage of years with good
7 (lower) juvenile stranding risk conditions under A5_LLT would be 21% greater than under NAA.

8 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A5_LLT would be
9 7% lower than NAA.

10 **Clear Creek**

11 Flows in Clear Creek during the November through March rearing period under A5_LLT would
12 generally be similar to or greater than flows under NAA except for below normal water years during
13 March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Water temperatures were not modeled in Clear Creek.

15 **Feather River**

16 Water temperatures in the Feather River under Alternative 5 would be the same as those under
17 Alternative 1A Impact AQUA-59, which indicates that mean monthly water temperatures would
18 generally be similar between NAA and Alternative 1A during the period.

19 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
20 channel) during November through June were reviewed to determine flow-related effects on larval
21 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
22 Analysis*). Relatively constant flows in the low-flow channel throughout this period under A5_LLT
23 would not differ from those under NAA. Flows under A5_LLT would be mostly similar to or greater
24 than flows under NAA during the entire period with some exceptions (up to 12% lower depending
25 on month and water year type).

26 May Oroville storage under A5_LLT would be similar to storage under NAA in wet and above normal
27 water years (Table 11-5-22). Storage under A5_LLT would be similar to storage under NAA in all
28 water year types.

29 As reported in Impact AQUA-58, September Oroville storage volume under A5_LLT would be similar
30 to or greater than storage under NAA depending on water year type (Table 11-5-21). This indicates
31 that the majority of reduction in storage volume would be due to climate change rather than
32 Alternative 5.

1 **Table 11-5-22. Difference and Percent Difference in May Water Storage Volume (thousand**
2 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-45 (-1%)	1 (0.03%)
Above Normal	-140 (-4%)	16 (0.5%)
Below Normal	-282 (-9%)	71 (2%)
Dry	-504 (-18%)	16 (1%)
Critical	-332 (-18%)	-16 (-1%)

3
4 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
5 habitat would not be substantially reduced. There would be no substantial effects of Alternative 5 on
6 flows in the Sacramento, Feather Rivers or in Clear Creek and no substantial effects on water
7 temperatures in the Sacramento and Feather Rivers that would affect spring-run Chinook salmon
8 rearing habitat.

9 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of
10 rearing habitat for fry and juvenile spring-run Chinook salmon would not be affected relative to the
11 CEQA baseline.

12 **Sacramento River**

13 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
14 Alternative 1A Impact AQUA-59, which indicates that there would be no differences in mean
15 monthly water temperature between Existing Conditions and Alternative 1A.

16 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
17 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
18 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT
19 would be generally similar to or greater than those under Existing Conditions with some exceptions
20 for all months (up to 27% lower), except during February (Keswick only) and November (up to 14%
21 lower).

22 As reported in Impact AQUA-59, Shasta Reservoir storage volume at the end of May under A5_LLT
23 would be similar to Existing Conditions except in dry and critical water years (6% and 10% lower,
24 respectively)(Table 11-5-10). As reported in Impact AQUA-58, storage volume at the end of
25 September under A5_LLT would be 16% to 32% lower relative to Existing Conditions depending on
26 water year type (Table 11-5-17).

27 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under
28 A5_LLT would be 14% greater than that under Existing Conditions (Table 11-5-19). The percentage
29 of years with good (lower) juvenile stranding risk conditions under A5_LLT would be 11% lower
30 than under Existing Conditions. On an absolute scale, neither of these results (3% for rearing WUA
31 and 2% for stranding risk) would be biologically meaningful.

32 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A5_LLT would be
33 37% lower than under Existing Conditions.

1 **Clear Creek**

2 Flows in Clear Creek during the November through March rearing period under A5_LLT would
3 generally be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II*
4 *Model Results utilized in the Fish Analysis*).

5 Water temperatures were not modeled in Clear Creek.

6 **Feather River**

7 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
8 channel) during November through June were reviewed to determine flow-related effects on larval
9 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
10 *Analysis*). Relatively constant flows in the low-flow channel throughout this period under A5_LLT
11 would not differ from those under Existing Conditions. In the high-flow channel, flows under A5_LLT
12 would be mostly lower (up to 45%) during November and January and similar to or greater than
13 flows under Existing Conditions during the rest of the year with some exceptions, during which
14 flows would be up to 59% lower under A5_LLT.

15 May Oroville storage volume under A5_LLT would be similar to storage under Existing Conditions in
16 wet and above normal water years (Table 11-5-22). Storage volume under A5_LLT would be 9% to
17 18% lower than storage under Existing Conditions in below normal, dry, and critical water years.

18 As reported in Impact AQUA-58 under Alternative 1A, September Oroville storage volume would be
19 8% to 31% lower under A5_LLT relative to Existing Conditions depending on water year type (Table
20 11-5-21).

21 Water temperatures in the Feather River under Alternative 5 would be the same as those under
22 Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the
23 exceedances of NMFS temperature thresholds Alternative 5 relative to Existing Conditions.

24 **Summary of CEQA Conclusion**

25 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between
26 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
27 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set
28 forth above. Rearing habitat conditions in the Sacramento River would be somewhat reduced by
29 Alternative 5 in some months. Although SacEFT predicts no effects on rearing habitat, SALMOD
30 predicts that habitat-related mortality would be substantially lower under Alternative 5 relative to
31 the Existing Conditions. There would be substantial increases in the exceedances of NMFS
32 temperature thresholds Alternative 5 relative to Existing Conditions.

33 These results are primarily caused by four factors: differences in sea level rise, differences in climate
34 change, future water demands, and implementation of the alternative. The analysis described above
35 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
36 alternative from those of sea level rise, climate change and future water demands using the model
37 simulation results presented in this chapter. However, the increment of change attributable to the
38 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
39 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
40 implementation period, which does include future sea level rise, climate change, and water
41 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
4 term implementation period and Alternative 5 indicates that flows in the locations and during the
5 months analyzed above would generally be similar between Existing Conditions during the LLT and
6 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
7 found above would generally be due to climate change, sea level rise, and future demand, and not
8 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
9 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
10 result in a significant impact on rearing habitat for spring-run Chinook salmon. This impact is found
11 to be less than significant and no mitigation is required.

12 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon** 13 **(Spring-Run ESU)**

14 In general, the effects of Alternative 5 on spring-run Chinook salmon migration conditions relative
15 to the NAA are uncertain.

16 **Upstream of the Delta**

17 ***Sacramento River***

18 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
19 Alternative 1A Impact AQUA-60, which indicates that there would be no differences (<5%) in mean
20 monthly water temperature between NAA and Alternative 1A.

21 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through
22 May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results*
23 *utilized in the Fish Analysis*). Flows under A5_LLTP during December through May would nearly
24 always be similar to or greater than flows under NAA, except in dry years during January (5%
25 lower).

26 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through
27 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*
28 *Model Results utilized in the Fish Analysis*). Flows under A5_LLTP would be similar to or greater than
29 flows under NAA during all months except August in dry years (14% lower) (Appendix 11C, *CALSIM*
30 *II Model Results utilized in the Fish Analysis*).

31 ***Clear Creek***

32 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
33 migration period under A5_LLTP would generally be similar to or greater than flows under NAA
34 except in critical years during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
35 *the Fish Analysis*).

36 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
37 migration period under A5_LLTP would be similar to or greater than flows under NAA in all months
38 and water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

39 Water temperatures were not modeled in Clear Creek.

1 **Feather River**

2 Water temperatures in the Feather River under Alternative 5 would be the same as those under
3 Alternative 1A Impact AQUA-60, which indicates that there would be no differences in mean
4 monthly water temperature between NAA and Alternative 1A.

5 Flows in the Feather River at the confluence with the Sacramento River were examined during the
6 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
7 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be mostly similar to
8 or greater than under NAA except in above normal years during November and December (6%
9 lower for both).

10 Flows in the Feather River at the confluence with the Sacramento River were examined during the
11 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
12 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during April through July
13 would generally be similar to or greater than flows under NAA except in dry and critical water year
14 types during July (19% and 34% lower, respectively). Flows during August under A5_LLT would
15 generally be lower than flows under NAA (up to 31% lower).

16 **Through-Delta**

17 **Juveniles**

18 During the juvenile spring-run Chinook salmon emigration period (November to May), mean
19 monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged
20 across years would be 6% to 11% lower in most months, and 17% lower in November compared to
21 NAA. Flows would be up to 23% lower in November of above normal years compared to NAA.

22 As described above in Impact AQUA-39, the north Delta export facilities would replace aquatic
23 habitat and likely attract piscivorous fish around the intake structures. Estimates of potential
24 predation losses at the single intake range from about 0.2% (bioenergetics model, Table 11-5-13) to
25 4.2% (based on a fixed 5% loss per intake) of the juvenile spring-run population that reaches the
26 Delta (Appendix 5F, *Biological Stressors*).

27 Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon was
28 modeled by the DPM. Average survival under Alternative 5 would be 30% across all years, 24% in
29 drier years, and 39% in wetter years, which is similar to modeled survival under baseline conditions
30 (Table 11-5-23).

1 **Table 11-5-23. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon**
 2 **under Baseline and Alternative 5 Scenarios, by Year Type**

Year Types	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A5_LLT	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wetter Years	42.1	40.4	38.8	-3.4 (-8%)	-1.7 (-4%)
Drier Years	24.8	24.3	24.3	-0.5 (-2%)	0.0 (0%)
All Years	31.3	30.3	29.7	-1.6 (-5%)	-0.6 (-2%)

Note: Delta Passage Model results for survival to Chipps Island.
 Wetter = Wet and above normal water years (6 years).
 Drier = Below normal, dry and critical water years (10 years).

3

4 **Adults**

5 The importance of attraction flows and olfactory cues to adult Chinook salmon migrating upstream
 6 is described in detail in Impact AQUA-42 for Alternative 1A. Olfactory cues, based on the proportion
 7 of Sacramento River flows during the spring-run adult migration, the proportion of Sacramento
 8 River flows at Collinsville would be 59% to 70% during March to May (the peak of the migration is
 9 March and April), 6% to 13% lower than NAA (Table 11-5-9). As suggested by adult sockeye salmon,
 10 attraction due to olfactory cues could be adversely affected by dilution greater than 20%, but was
 11 not been discernibly affected by dilution of 10% or less (Fretwell 1989).

12 **NEPA Effects:** Upstream of the Delta, the results indicate that the effects of water operations on
 13 migration conditions under Alternative 5 would not be adverse because it would not have the
 14 potential to substantially interfere with the movement of fish. Flows under A5_LLT would generally
 15 be similar to or greater than flows under NAA, with exceptions during some months and water year
 16 types. However, this frequency of reduced flows would not be enough to cause population level
 17 effects. There would be no effects on water temperatures in the Sacramento and Feather Rivers.

18 Near-field effects of Alternative 5 NDD on spring-run Chinook salmon related to impingement and
 19 predation associated with three new intake structures could result in negative effects on juvenile
 20 migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall
 21 effects. It is expected that the level of near-field impacts would be directly correlated to the number
 22 of new intake structures in the river and thus the level of impacts associated with 1 new intake
 23 would be considerably lower than those expected from having 5 new intakes in the river. Estimates
 24 within the effects analysis range from very low levels of effects (<1% mortality) to larger effects (~
 25 4% mortality above current baseline levels). CM15 would be implemented with the intent of
 26 providing localized and temporary reductions in predation pressure at the NDD. Additionally,
 27 several pre-construction surveys to better understand how to minimize losses associated with the 1
 28 new intake structure will be implemented as part of the final NDD screen design effort. Alternative 5
 29 also includes an Adaptive Management Program and Real-Time Operational Decision-Making
 30 Process to evaluate and make limited adjustments intended to provide adequate migration
 31 conditions for spring-run Chinook. However, at this time, due to the absence of comparable facilities
 32 anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field
 33 effects at the NDD remains highly uncertain.

1 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
2 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
3 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5
4 predict improvements in smolt condition and survival associated with increased access to the Yolo
5 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
6 of each of these factors and how they might interact and/or offset each other in affecting salmonid
7 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

8 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
9 all of these elements of BDCP operations and conservation measures to predict smolt migration
10 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
11 migration survival under Alternative 5 would be similar to those estimated for NAA. Further
12 refinement and testing of the DPM, along with several ongoing and planned studies related to
13 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
14 future. These efforts are expected to improve our understanding of the relationships and
15 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
16 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
17 However, until these efforts are completed and their results are fully analyzed, the overall
18 cumulative effect of Alternative 5 on spring-run Chinook salmon migration remains uncertain.

19 **CEQA Conclusion:** In general, Alternative 5 would not affect migration conditions for spring-run
20 Chinook salmon relative to Existing Conditions.

21 **Upstream of the Delta**

22 ***Sacramento River***

23 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
24 Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in mean
25 monthly water temperature between NAA and Alternative 1A.

26 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through
27 May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results*
28 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows
29 under Existing Conditions, except in wet and below normal water years during December (9% and
30 6% lower, respectively) and May (18% and 6% lower, respectively) and below normal years during
31 March (10% lower).

32 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through
33 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*
34 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or
35 greater than Existing Conditions with occasional exceptions (up to 23% lower).

36 ***Clear Creek***

37 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
38 migration period under A5_LLT would always be similar to or greater than flows under Existing
39 Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

40 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
41 migration period under A5_LLT would almost always be similar to or greater than flows under

1 Existing Conditions except during August in critical water years (17% lower) (Appendix 11C,
2 *CALSIM II Model Results utilized in the Fish Analysis*).

3 Water temperatures were not modeled in Clear Creek.

4 **Feather River**

5 Water temperatures in the Feather River under Alternative 5 would be the same as those under
6 Alternative 1A Impact AQUA-60, which indicates flows under Alternative 1A would be 5% greater
7 than those under Existing Conditions in November and December, but similar during January
8 through May.

9 Flows were examined for the Feather River at the confluence with the Sacramento River during the
10 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
11 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November under A5_LLTT would
12 generally be lower than flows under Existing Conditions by up to 21%. Flows under A5_LLTT during
13 December through May would generally be similar to or greater than flows under Existing
14 Conditions, with some exceptions (up to 28% lower).

15 Flows were examined for the Feather River at the confluence with the Sacramento River during the
16 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
17 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during the entire period under A5_LLTT
18 would generally be similar to or greater than flows under Existing Conditions with some exceptions
19 (up to 51% lower), especially in critical water years.

20 **Through-Delta**

21 During the juvenile spring-run Chinook salmon emigration period (November to May), mean
22 monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged
23 across years would be 6% to 11% lower in most months, and 20% lower in November compared to
24 Existing Conditions. Flows would be up to 23% lower in November of above normal years and 31%
25 lower in May of wet years compared to Existing Conditions.

26 As described above, estimates of potential predation losses at the single intake range from about
27 0.2% to 4.2% of the juvenile spring-run population that reaches the Delta.

28 Through-Delta survival to Chipps Island by emigrating juvenile spring-run Chinook salmon under
29 Alternative 5 would be slightly decreased under Existing Conditions, up to 3.4% lower (8% relative
30 decrease) in wetter years (Table 11-5-23).

31 Attraction flows and olfactory cues for adults migrating through the Delta, as indicated by the
32 proportion of Sacramento River flow at Collinsville during March to May, would be 8% to 15% lower
33 than under Existing Conditions, but would still make up 59% to 70% of overall flows.

34 **Summary of CEQA Conclusion**

35 Collectively, the results indicate that the effect would be less than significant because the alternative
36 would not substantially reduce suitable migration habitat or interfere with the movement of fish. No
37 mitigation would be necessary. Flows would generally be similar between Existing Conditions and
38 Alternative 5 in the Sacramento and Feather Rivers and in Clear Creek. Additionally, water
39 temperatures would generally not differ between Existing Conditions and Alternative 5 in the

1 Sacramento and Feather Rivers. In addition, through-Delta survival of juvenile Chinook salmon and
2 olfactory cues under Alternative 5 would be similar to those under NAA.

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**
5 **(Spring-Run ESU)**

6 The effects on construction of restoration measures on spring-run Chinook would be identical to
7 those on winter-run Chinook; please refer to the discussion of Alternative 5, Impact AQUA-43 above.

8 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**
9 **Salmon (Spring-Run ESU)**

10 The effects of contaminants associated with restoration measures would be the same for all four
11 ESUs. Accordingly, please refer to the discussion of Alternative 5, Impact AQUA-44 for winter-run
12 Chinook salmon.

13 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

14 The effects of restored habitat conditions on spring-run Chinook would be the same as for described
15 for winter-run Chinook salmon, please refer to the discussion under Alternative 5, Impact AQUA-45
16 above. The only difference is that spring run Chinook also occur in the Cosumnes/Mokelumne ROA
17 and would receive the benefits of increased habitat acreage and food production in this location.

18 **CEQA Conclusion:** As described in Alternative 5, Impact AQUA-45 for winter-run Chinook salmon,
19 the potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial
20 although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%.
21 No mitigation would be required.

22 **Other Conservation Measures (CM12–CM19 and CM21)**

23 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**
24 **ESU) (CM12)**

25 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
26 **(Spring-Run ESU) (CM13)**

27 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**
28 **Run ESU) (CM14)**

29 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
30 **(Spring-Run ESU) (CM15)**

31 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**
32 **(CM16)**

33 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**
34 **(CM17)**

1 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**
2 **(CM18)**

3 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**
4 **ESU) (CM19)**

5 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
6 **(Spring-Run ESU) (CM21)**

7 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms
8 on spring-run Chinook salmon are the same as those described under Alternative 1A (Impacts
9 AQUA-64 through AQUA-72). The effects would range from no effect, to not adverse, to beneficial.

10 *CEQA Conclusion:* The impacts of the nine impact mechanisms listed above would range from no
11 impact, to less than significant, to beneficial, and no mitigation is required.

12 **Fall-/Late Fall–Run Chinook Salmon**

13 **Construction and Maintenance of CM1**

14 The construction- and maintenance-related effects of Alternative 5 would be identical for all four
15 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the
16 discussion of these effects for winter-run Chinook.

17 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
18 **(Fall-/Late Fall–Run ESU)**

19 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on fall-
20 run/late-fall run Chinook salmon would be similar to those described for Alternative 1A (Impact
21 AQUA-73) except that Alternative 5 would include one intake compared to five intakes under
22 Alternative 1A, so the effects would be proportionally less under this alternative. This would convert
23 about 2,050 lineal feet of existing shoreline habitat into intake facility structures and would require
24 about 4.7 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900
25 lineal feet of shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A,
26 Impact AQUA-73, environmental commitments and mitigation measures would be available to avoid
27 and minimize potential effects, and the effect would not be adverse for fall-run/late-fall run Chinook
28 salmon.

29 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-37, the impact of the construction of
30 water conveyance facilities on Chinook salmon would be less than significant except for
31 construction noise associated with pile driving. Potential pile driving impacts would be less than
32 Alternative 1A because only one intake would be constructed rather than five. Implementation of
33 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
34 less than significant.

35 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
36 **of Pile Driving and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
38 Alternative 1A.

1 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
2 **and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
4 Alternative 1A.

5 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
6 **(Fall-/Late Fall-Run ESU)**

7 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
8 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-38) except
9 that only one intake would need to be maintained under Alternative 5 rather than five under
10 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for
11 Chinook salmon.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance
13 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
14 would be required.

15 **Water Operations of CM1**

16 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**
17 **Fall-Run ESU)**

18 ***Water Exports from SWP/CVP South Delta Facilities***

19 *Fall-Run*

20 Alternative 5 would reduce overall entrainment of juvenile fall-run Chinook salmon at the south
21 Delta export facilities compared to NAA. Under Alternative 5, juvenile fall-run Chinook salmon
22 entrainment, estimated as salvage density, would be reduced by 30% (Table 11-5-24) across all
23 water year types compared to NAA. The greatest reduction in juvenile fall-run Chinook salmon
24 entrainment under Alternative 5 would occur in wet years (76% decrease). Entrainment would
25 increase 6% in dry years compared to NAA. Overall, Alternative 5 would provide a beneficial effect
26 on juvenile fall-run Chinook salmon due to the reduction in entrainment and associated pre-screen
27 predation loss at the south Delta export facilities compared to NAA (Table 11-5-24).

28 *Late Fall-Run*

29 Average entrainment of juvenile late fall-run Chinook salmon at the south Delta export facilities
30 under Alternative 5 would be reduced by 6% compared to NAA (Table 11-5-24). The greatest
31 relative reduction would occur in above normal (10% decrease) and critical years (14% decrease).

32 ***Water Exports from SWP/CVP North Delta Intake Facilities***

33 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
34 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the
35 effects would be minimal because the single north Delta intake under Alternative 5 would have
36 state-of-the-art screens to exclude juvenile fish.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential entrainment and impingement effects for juvenile salmonids would be minimal because the intake would have state-of-the-art screens installed.

NEPA Effects: In conclusion, Alternative 5 would reduce overall entrainment of juvenile Chinook salmon relative to NAA. This effect would be beneficial.

CEQA Conclusion: Entrainment losses of juvenile fall-run and late fall-run Chinook salmon at the south Delta export facilities would generally be reduced under Alternative 5 compared to Existing Conditions (Table 11-5-24). Overall, impacts of water operations on fall-run Chinook salmon would be beneficial and impacts of water operations on late fall-run Chinook salmon would be less than significant and may be beneficial because of the reductions in entrainment loss at the south Delta facilities compared to Existing Conditions (Table 11-5-24). No mitigation would be required.

Table 11-5-24. Juvenile Chinook Salmon Annual Entrainment Index^a at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 5

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
Fall-Run Chinook Salmon		
Wet	-96,754 (-76%)	-96,931 (-76%)
Above Normal	-1,662 (-5%)	-2,136 (-6%)
Below Normal	-38 (0%)	-397 (-3%)
Dry	2,836 (14%)	1,188 (6%)
Critical	-10,063 (-25%)	-4,886 (-14%)
All Years	-16,453 (-30%)	-16,509 (-30%)
Late Fall-Run Chinook Salmon		
Wet	-468 (-8%)	-381 (-6%)
Above Normal	-68 (-12%)	-54 (-10%)
Below Normal	-3 (-6%)	0 (1%)
Dry	-11 (-8%)	5 (4%)
Critical	-34 (-21%)	-21 (-14%)
All Years	-189 (-10%)	-108 (-6%)
Shading indicates 10% or greater increased entrainment.		
^a Estimated annual number of fish lost, based on normalized data.		

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall-Run ESU)

In general, Alternative 5 would not affect the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon relative to NAA.

1 **Sacramento River**

2 Water temperatures in the Sacramento River for Alternative 5 are not different from those for
3 Alternative 1A, Impact AQUA-76, which indicates that there would be no differences in mean
4 monthly water temperature between NAA and Alternative 1A.

5 *Fall-Run*

6 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-
7 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
8 *utilized in the Fish Analysis*). Flows under A5_LLT during October, December, and January would
9 generally be greater than or similar to NAA, except in dry years during January (5% lower).

10 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning
11 and egg incubation period. As reported in Impact AQUA-58, storage under A5_LLT would be similar
12 to (<5% difference) storage under NAA in all water year types (Table 11-5-17).

13 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
14 Sacramento River under A5_LLT would be lower than or similar to mortality under NAA in all water
15 year types including below normal years (14% greater relative to NAA, but absolute increase of 3%
16 of fall-run population) (Table 11-5-25). These results indicate that climate change would increase
17 fall-run Chinook salmon egg mortality, but Alternative 5 would have negligible effects.

18 **Table 11-5-25. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
19 **Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	11 (110%)	1 (6%)
Above Normal	12 (108%)	1 (3%)
Below Normal	14 (134%)	3 (14%)
Dry	17 (118%)	0.5 (1%)
Critical	9 (32%)	-0.2 (-1%)
All	13 (91%)	1 (4%)

20
21 SacEFT predicts that there would be a 29% increase in the percentage of years with good spawning
22 availability for fall-run Chinook salmon, measured as weighted usable area, under A5_LLT relative to
23 NAA (Table 11-5-26). SacEFT predicts that there would be a 12% reduction in the percentage of
24 years with good (lower) redd scour risk under A5_LLT relative to NAA. SacEFT predicts that there
25 would be a negligible difference (<5%) in the percentage of years between A5_LLT and NAA. SacEFT
26 predicts that there would be no difference in the percentage of years with good (lower) redd
27 dewatering risk under A5_LLT relative to NAA.

1 **Table 11-5-26. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
2 **for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Spawning WUA	-3 (-6%)	10 (29%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-28 (-30%)	-3 (-4%)
Redd Dewatering Risk	1 (4%)	1 (4%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-11 (-35%)	0 (0%)

WUA = Weighted Usable Area.

3

4 *Late Fall–Run*

5 Sacramento River flows upstream of Red Bluff were examined for the February through May late
6 fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model*
7 *Results utilized in the Fish Analysis*). Flows under A5_LLT would be greater than or similar to flows
8 under NAA throughout the period.

9 Shasta Reservoir storage at the end of September would affect flows during the late fall–run
10 spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta
11 Reservoir storage would be similar to storage under NAA in all water year types (Table 11-5-17).

12 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the
13 Sacramento River under A5_LLT would similar to mortality under NAA in all water years, including
14 below normal water years in which, although there would be a 10% relative increase, the absolute
15 increase would be 1% of the late fall–run population (Table 11-5-27).

16 **Table 11-5-27. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook**
17 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	4 (201%)	-0.2 (-2%)
Above Normal	4 (153%)	-1 (-12%)
Below Normal	5 (308%)	1 (10%)
Dry	5 (173%)	-0.2 (-3%)
Critical	3 (147%)	0.05 (1%)
All	4 (191%)	-0.1 (-2%)

18

19 SacEFT predicts that there would be a 4% decrease in the percentage of years with good spawning
20 availability for late fall–run Chinook salmon, measured as weighted usable area, under A5_LLT
21 relative to NAA (Table 11-5-28). SacEFT predicts that there would be a 0% reduction in the
22 percentage of years with good (lower) redd scour risk under A5_LLT relative to NAA. SacEFT
23 predicts that there would be no or negligible (<5%) differences in the percentage of years with good
24 (lower) egg incubation conditions and redd dewatering risk between A5_LLT and NAA.

1 **Table 11-5-28. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
2 **for Late Fall–Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Spawning WUA	-6 (-12%)	-2 (-4%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-3 (-5%)	2 (4%)
Juvenile Rearing WUA	-2 (-4%)	-20 (-32%)
Juvenile Stranding Risk	-24 (-33%)	2 (4%)

WUA = Weighted Usable Area.

3

4 **Clear Creek**

5 No water temperature modeling was conducted in Clear Creek.

6 *Fall-Run*

7 Clear Creek flows below Whiskeytown Reservoir were examined for the September through
8 February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
9 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to or greater than
10 flows under NAA throughout the period.

11 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
12 flow reduction each month over the incubation period compared to the flow in September when
13 spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during
14 September through February under A5_LLT would be to the same as the reduction under NAA for all
15 water year types (Table 11-5-29).

16 **Table 11-5-29. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
17 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
18 **February Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

19

1 **Feather River**

2 Water temperatures in the Feather River under Alternative 5 would be the same as those under
3 Alternative 1A, Impact AQUA-76, which indicates that temperatures conditions under Alternative 1A
4 would be similar to or better than those under NAA.

5 *Fall-Run*

6 Flows in the Feather River in the low-flow and high-flow channels were examined for the October
7 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,
8 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A5_LLT
9 would be identical to those under NAA. Flows in the high-flow channel under A5_LLT would
10 generally be similar to or greater than those under NAA except in wet and above normal years
11 during November (5% and 10% lower, respectively), above normal years during December (11%
12 lower), and critical years in January (12% lower).

13 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
14 comparing the magnitude of flow reduction each month over the incubation period compared to the
15 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during
16 November through January were identical between A5_LLT and NAA (Appendix 11C, *CALSIM II*
17 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 5 on
18 redd dewatering in the Feather River low-flow channel.

19 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
20 Feather River under A5_LLT would be similar (<5% difference on an absolute scale) to or lower than
21 mortality under NAA in all water years (Table 11-5-30).

22 **Table 11-5-30. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
23 **Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	15 (1,058%)	-4 (-21%)
Above Normal	7 (654%)	-5 (-37%)
Below Normal	12 (684%)	-1 (-6%)
Dry	16 (731%)	-3 (-13%)
Critical	23 (460%)	-1 (-3%)
All	15 (695%)	-3 (-15%)

24

25 **American River**

26 Water temperatures in the American River under Alternative 5 would be the same as those under
27 Alternative 1A, which indicates that there would be no differences in mean monthly water
28 temperature between NAA and Alternative 1A.

29 *Fall-Run*

30 Flows in the American River at the confluence with the Sacramento River were examined during the
31 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
32 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT during November through January
33 would generally be similar to or greater than flows under NAA, except in above and below normal

1 years during November (9% lower for both) and dry years during January (8% lower). Flows during
2 October would generally be up to 15% lower than those under NAA.

3 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
4 comparing the magnitude of flow reduction each month over the incubation period compared to the
5 flow in October when spawning is assumed to occur. The greatest reduction under A5_LLT would
6 generally be similar to or greater than NAA flows except in below normal and critical years (33%
7 and 52% lower, respectively) (Table 11-5-31).

8 **Table 11-5-31. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
9 **in Instream Flow in the American River at Nimbus Dam during the October through January**
10 **Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-24 (-111%)	1 (2%)
Above Normal	-3 (-10%)	7 (18%)
Below Normal	-43 (-224%)	-16 (-33%)
Dry	5 (10%)	2 (6%)
Critical	-9 (-18%)	-21 (-52%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

11

12 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
13 American River under A5_LLT would be similar to mortality under NAA in all water years (Table 11-
14 5-32).

15 **Table 11-5-32. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
16 **Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	24 (157%)	0 (0%)
Above Normal	22 (212%)	-0.2 (-1%)
Below Normal	21 (174%)	-1 (-2%)
Dry	16 (96%)	-1 (-2%)
Critical	9 (41%)	-1 (-4%)
All	19 (127%)	-0.4 (-1%)

17

18 ***Stanislaus River***

19 *Fall-Run*

20 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
21 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
22 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 5 would be
23 similar to flows under NAA throughout the period.

1 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 5
2 throughout the October through January period (Appendix 11D, *Sacramento River Water Quality*
3 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

4 ***San Joaquin River***

5 *Fall-Run*

6 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
7 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
8 *utilized in the Fish Analysis*). Flows under Alternative 5 would be similar to flows under NAA
9 throughout the period.

10 Water temperature modeling was not conducted in the San Joaquin River.

11 ***Mokelumne River***

12 *Fall-Run*

13 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
14 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
15 *utilized in the Fish Analysis*). Flows under Alternative 5 would be similar to flows under NAA
16 throughout the period.

17 Water temperature modeling was not conducted in the Mokelumne River.

18 ***NEPA Effects:*** Collectively, it is concluded that the effect would not be adverse because habitat
19 conditions are not substantially reduced. There are no reductions in flows under Alternative 5 or
20 increases in temperatures that would translate into adverse biological effects on fall-run or late fall-
21 run Chinook salmon spawning and egg incubation habitat.

22 ***CEQA Conclusion:*** In general, under Alternative 5 water operations, the quantity and quality of
23 spawning and egg incubation habitat for fall-/late fall-run Chinook salmon would not be affected
24 relative to the CEQA baseline.

25 ***Sacramento River***

26 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
27 Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large effects of
28 Alternative 1A on temperature in the Sacramento River relative to Existing Conditions.

29 *Fall-Run*

30 Flows in the Sacramento River upstream of Red Bluff were examined during the October through
31 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
32 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be greater than or
33 similar to Existing Conditions during October, December, and January, except in wet and below
34 normal years during December (9% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model*
35 *Results utilized in the Fish Analysis*). During November, flows under A5_LLT would be generally
36 lower than under Existing Conditions (up to 10% lower).

37 Storage volume at the end of September would be 16% to 32% lower under A5_LLT relative to
38 Existing Conditions (Table 11-5-17).

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
2 Sacramento River under A5_LLT would be 32% to 134% greater (9% to 17% greater on an absolute
3 difference scale) than mortality under Existing Conditions (Table 11-5-28).

4 SacEFT predicts that there would be a 6% reduction in the percentage of years with good spawning
5 availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table
6 11-5-26). SacEFT predicts that there would be a 5% reduction in the percentage of years with good
7 (lower) redd scour risk under A5_LLT relative to Existing Conditions. SacEFT predicts that there
8 would be a 30% decrease in the percentage of years with good (lower) egg incubation conditions
9 under A5_LLT relative to Existing Conditions. SacEFT predicts that there would be a 4% increase in
10 the percentage of years with good (lower) redd dewatering risk under A5_LLT relative to Existing
11 Conditions.

12 *Late Fall–Run*

13 Flows in the Sacramento River upstream of Red Bluff were examined during the February through
14 May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be greater than or
16 similar to flows under Existing Conditions, except in below normal years during March and May
17 (10% and 6% lower, respectively) and wet years during March (18% lower).

18 Storage volume at the end of September would be 16% to 32% lower under A5_LLT relative to
19 Existing Conditions (Table 11-5-17).

20 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the
21 Sacramento River under A5_LLT would be 147% to 308% greater than mortality under Existing
22 Conditions (Table 11-5-29). However, absolute differences in the percent of the late-fall population
23 subject to mortality would be minimal in all but below normal and dry years, in which there is a 5%
24 increase in mortality.

25 SacEFT predicts that there would be a 12% decrease in the percentage of years with good spawning
26 availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table
27 11-5-30). SacEFT predicts that there would be a 7% decrease in the percentage of years with good
28 (lower) redd scour risk under A5_LLT relative to Existing Conditions. SacEFT predicts that there
29 would be no difference in the percentage of years with good (lower) egg incubation conditions
30 between A5_LLT and Existing Conditions. SacEFT predicts that there would be a 5% decrease in the
31 percentage of years with good (lower) redd dewatering risk under A5_LLT relative to Existing
32 Conditions.

33 *Clear Creek*

34 No water temperature modeling was conducted in Clear Creek.

35 *Fall-Run*

36 Flows in Clear Creek below Whiskeytown Reservoir were reviewed during the September through
37 February fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
38 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows
39 under Existing Conditions, except in below normal and critical water years during September (6%
40 and 7% lower, respectively).

1 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
2 flow reduction each month over the incubation period compared to the flow in September when
3 spawning occurred. The greatest monthly reduction in Clear Creek flows during September through
4 January under A5_LLT would be similar to or lower magnitude than those under Existing Conditions
5 in wet and below normal water years, but the reduction would be 27%, 67%, and 33% greater
6 (absolute, not relative, differences) under A5_LLT in above normal, dry, and critical water years,
7 respectively (Table 11-5-29).

8 **Feather River**

9 Water temperatures in the Feather River under Alternative 5 would be the same as those under
10 Alternative 1A, which indicates there would be moderate to large effects of Alternative 1A on
11 temperatures relative to Existing Conditions.

12 *Fall-Run*

13 Flows in the Feather River in the low-flow and high-flow channels were examined for the October
14 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,
15 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel A5_LLT would be
16 identical to those under Existing Conditions. Flows during October and December in the high-flow
17 channel under A5_LLT would be generally similar to or greater than flows under Existing Conditions
18 with some exceptions (up to 33% lower). During November and January, flows under A5_LLT would
19 generally be lower by up to 45% than flows under Existing Conditions.

20 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
21 comparing the magnitude of flow reduction each month over the incubation period compared to the
22 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were
23 identical between A5_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in*
24 *the Fish Analysis*). Therefore, there would be no effect of Alternative 5 on redd dewatering in the
25 Feather River low-flow channel.

26 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
27 Feather River under A5_LLT would be 460% to 1,058% greater than mortality under Existing
28 Conditions (Table 11-5-30).

29 **American River**

30 Water temperatures in the American River under Alternative 5 would be the same as those under
31 Alternative 1A, Impact AQUA-76, which indicates there would be moderate to large effects of
32 Alternative 1A on temperatures relative to Existing Conditions.

33 *Fall-Run*

34 Flows in the American River at the confluence with the Sacramento River were examined during the
35 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
36 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower by up to
37 33% than flows under NAA during the entire period.

38 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
39 comparing the magnitude of flow reduction each month over the incubation period compared to the
40 flow in October when spawning is assumed to occur. The greatest monthly reduction in American

1 River flows under A5_LLT during November through January would be up to 224% lower
2 magnitude than under Existing Conditions in all but dry water years (Table 11-5-31).

3 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
4 American River under A5_LLT would be 41% to 212% greater than mortality under Existing
5 Conditions (Table 11-5-32).

6 **Stanislaus River**

7 *Fall-Run*

8 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
9 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
10 *Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 5 would be 6% to
11 7% lower than those under Existing Conditions in all months except January, in which mean flows
12 would be similar between Existing Conditions and Alternative 5.

13 Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under
14 Alternative 1A. Conclusions from Alternative 1A, Impact 76 indicate that mean monthly water
15 temperatures under Alternative 1A would not be different from those under Existing Conditions
16 during October, but 6% higher during November through January.

17 **San Joaquin River**

18 *Fall-Run*

19 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
20 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
21 *utilized in the Fish Analysis*). Mean monthly flows under Alternative 5 would be similar in all months
22 of the period except October, in which flows would be 5% lower under Alternative 5, and January, in
23 which flows would be 5% greater under Alternative 5.

24 Water temperature modeling was not conducted in the San Joaquin River.

25 **Mokelumne River**

26 *Fall-Run*

27 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
28 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
29 *utilized in the Fish Analysis*). Flows under Alternative 5 would be up to 14% lower than flows under
30 Existing Conditions during October and November and up to 18% greater than flows under Existing
31 Conditions during December and January.

32 Water temperature modeling was not conducted in the Mokelumne River.

33 **Summary of CEQA Conclusion**

34 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between
35 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
36 alternative could substantially reduce the amount of suitable habitat for fish, contrary to the NEPA
37 conclusion set forth above. There would be flow reductions in the Feather and American Rivers due
38 to Alternative 5 relative to Existing Conditions that would affect the fall-run population. These

1 reductions would reduce the quantity and quality of spawning and egg incubation habitat for fall-
2 run Chinook salmon in these rivers. The Reclamation egg mortality model predicted substantial
3 increases in fall- and late fall-run egg mortality in the Sacramento, Feather, and American Rivers
4 under Alternative 5 relative to the CEQA baseline.

5 These results are primarily caused by four factors: differences in sea level rise, differences in climate
6 change, future water demands, and implementation of the alternative. The analysis described above
7 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
8 alternative from those of sea level rise, climate change and future water demands using the model
9 simulation results presented in this chapter. However, the increment of change attributable to the
10 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
11 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
12 implementation period, which does include future sea level rise, climate change, and water
13 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
14 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
15 effect of the alternative from those of sea level rise, climate change, and water demands.

16 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
17 term implementation period and Alternative 5 indicates that flows in the locations and during the
18 months analyzed above would generally be similar between Existing Conditions during the LLT and
19 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
20 found above would generally be due to climate change, sea level rise, and future demand, and not
21 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
22 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
23 result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact
24 is found to be less than significant and no mitigation is required.

25 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon** 26 **(Fall-/Late Fall-Run ESU)**

27 In general, Alternative 5 would not reduce the quantity and quality of larval and juvenile rearing
28 habitat for fall-/late fall-run Chinook salmon relative to NAA.

29 ***Sacramento River***

30 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
31 Alternative 1A, Impact AQUA-77, which indicates there would be no effects of Alternative 1A on
32 temperatures relative to NAA.

33 ***Fall-Run***

34 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
35 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
36 *Analysis*). Flows under A5_LLТ would nearly always be greater than or similar to flows under NAA
37 except in dry years during January (5% lower).

38 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and
39 juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage
40 would be similar to storage under NAA in all water year types (Table 11-5-17).

1 SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile
2 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A5_LLT
3 relative to NAA (Table 11-5-28). SacEFT predicts that there would be no change relative to NAA.

4 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A5_LLT would be
5 similar to mortality under NAA.

6 *Late Fall–Run*

7 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run
8 Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results*
9 *utilized in the Fish Analysis*). Flows under A5_LLT during the period would be generally similar to or
10 greater than those under NAA with two exceptions (5% and 15% lower).

11 Shasta Reservoir storage at the end of September and May would affect flows during the late fall–
12 run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta
13 Reservoir storage would be similar to storage under NAA in all water year types (Table 11-5-17).

14 As reported in Impact AQUA-40, Shasta storage at the end of May under A5_LLT would be similar to
15 or greater than storage under NAA for all water year types (Table 11-5-10).

16 SacEFT predicts that there would be 32% decrease in the percentage of years with good juvenile
17 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under
18 A5_LLT relative to NAA (Table 11-5-30). SacEFT predicts that there would be a negligible change in
19 the percentage of years with “good” (lower) juvenile stranding risk under A5_LLT relative to NAA.

20 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A5_LLT would
21 be similar to mortality under NAA.

22 *Clear Creek*

23 No water temperature modeling was conducted in Clear Creek.

24 *Fall-Run*

25 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall–
26 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
27 *Analysis*). Flows under A5_LLT would nearly always be similar to or greater than flows under NAA,
28 except in below normal years during March (6% lower).

29 *Feather River*

30 Water temperatures in the Feather River under Alternative 5 would be the same as those under
31 Alternative 1A, which indicates there would be no effects of Alternative 1A on temperatures relative
32 to NAA.

33 *Fall-Run*

34 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
35 channel) during December through June were reviewed to determine flow-related effects on larval
36 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
37 *Analysis*). Relatively constant flows in the low-flow channel throughout this period under A5_LLT
38 would not differ from those under NAA. In the high-flow channel, flows under A5_LLT would

1 generally be similar to or greater than flows under NAA except in above normal years during
2 December (11% lower), critical years during January (12% lower), and below normal years during
3 March (11% lower).

4 As reported in Impact AQUA-59, May Oroville storage under A5_LLTP would be similar to storage
5 under NAA in all water year types (Table 11-5-22).

6 As reported in AQUA-58, September Oroville storage volume would be similar to or greater than
7 storage under NAA depending on water year type (Table 11-5-21). This indicates that the majority
8 of reduction in storage volume would be due to climate change rather than Alternative 5.

9 ***American River***

10 Water temperatures in the American River under Alternative 5 would be the same as those under
11 Alternative 1A, Impact AQUA-77, which indicates there would be no effects of Alternative 1A on
12 temperatures relative to NAA.

13 ***Fall-Run***

14 Flows in the American River at the confluence with the Sacramento River were examined for the
15 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
16 *Results utilized in the Fish Analysis*). Flows under A5_LLTP would nearly always be similar to or
17 greater than flows under NAA, except in dry years during January (8% lower).

18 ***Stanislaus River***

19 ***Fall-Run***

20 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 5 would
21 not be different from those under NAA for the January through May fall-run Chinook salmon juvenile
22 rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 Mean monthly water temperatures in the Stanislaus River under alternative 5 would be similar to
24 those under Alternative 1A. Conclusions for Alternative 1A, Impact AQUA-77 indicate that there
25 would be no difference in mean monthly water temperatures between NAA and Alternative 1A
26 throughout the January through May fall-run Chinook salmon juvenile rearing period.

27 ***San Joaquin River***

28 ***Fall-Run***

29 Flows in the San Joaquin River at Vernalis for Alternative 5 would not be different from those under
30 NAA, for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C,
31 *CALSIM II Model Results utilized in the Fish Analysis*)

32 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 *Fall-Run*

3 Flows in the Mokelumne River at the Delta for Alternative 5 would not be different from those under
4 NAA, for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C,
5 *CALSIM II Model Results utilized in the Fish Analysis*)

6 Water temperature modeling was not conducted in the Mokelumne River.

7 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
8 not have the potential to substantially reduce the amount of suitable habitat for fish. Changes in flow
9 rates and water temperatures are generally small and infrequent under Alternative 5 relative to the
10 NAA. Therefore, there would be no biologically meaningful effects to fall- or late fall-run Chinook
11 salmon, except for a moderate reduction in juvenile rearing habitat for late fall-run Chinook salmon
12 as predicted by SacEFT. Because this effect is isolated, it would not cause the impact to be adverse,
13 particularly in combination with modeled flow outputs indicating that flows, which drive rearing
14 habitat availability, would increase during the rearing period. Additionally, SALMOD does not
15 predict habitat-related effects on late fall-run Chinook salmon in the Sacramento River. There would
16 be no other substantial changes fall-/late fall-run Chinook salmon rearing habitat for under
17 Alternative 5.

18 **CEQA Conclusion:** In general, Alternative 5 would not affect the quantity or quality of larval and
19 juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to Existing Conditions.

20 **Sacramento River**

21 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
22 Alternative 1A, Impact AQUA-77, which indicates there would be no effects of Alternative 1A on
23 temperatures relative to Existing Conditions.

24 *Fall-Run*

25 Flow Sacramento River flows upstream of Red Bluff were examined for the January through May
26 fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*
27 *the Fish Analysis*). Flows under A5_LLT would generally be greater than or similar to flows under
28 Existing Conditions, except in below normal years during March and May (10% and 6% lower,
29 respectively) and wet years during May (18%).

30 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 16% to 32%
31 lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-17).

32 SacEFT predicts that there would be a 15% increase in the percentage of years with good juvenile
33 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A5_LLT
34 relative to Existing Conditions (Table 11-5-26). SacEFT predicts that there would be a 35%
35 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A5_LLT
36 relative to Existing Conditions.

37 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A5_LLT would be
38 8% lower than mortality under Existing Conditions.

1 **Late Fall–Run**

2 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run
3 Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results*
4 *utilized in the Fish Analysis*). Flows under A5_LLT during most months would generally be similar to
5 or greater than those under Existing Conditions with six exceptions (6%, 7%, 7%, 11%, 18%, and
6 23% lower).

7 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 16% to 32%
8 lower under A5_LLT relative to Existing Conditions depending on water year type (Table 11-5-17).

9 As reported in Impact AQUA-40, end of May Shasta storage under A5_LLT would be similar to
10 Existing Conditions in all water years, except dry (6% lower) and critical water years (10% lower)
11 (Table 11-5-10).

12 SacEFT predicts that there would be a 4% decrease in the percentage of years with good juvenile
13 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under
14 A5_LLT relative to Existing Conditions (Table 11-5-30). SacEFT predicts that there would be a 33%
15 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A5_LLT
16 relative to Existing Conditions.

17 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A5_LLT would
18 be 8% higher than mortality under Existing Conditions.

19 **Clear Creek**

20 No temperature modeling was conducted in Clear Creek.

21 **Fall-Run**

22 Flows in Clear Creek below Whiskeytown Reservoir were examined during the January through May
23 fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
24 *Analysis*). Flows under A5_LLT would be similar to or greater than flows under Existing Conditions
25 for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 **Feather River**

27 Water temperatures in the Feather River under Alternative 5 would be the same as those under
28 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher during
29 substantial portions of the periods evaluated relative to Existing Conditions.

30 **Fall-Run**

31 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
32 channel) during December through June were reviewed to determine flow-related effects on larval
33 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
34 *Analysis*). Relatively constant flows in the low-flow channel throughout the period under A5_LLT
35 would not differ from those under Existing Conditions. In the high-flow channel, flows under A5_LLT
36 would generally be similar to or greater than flows under Existing Conditions during December and
37 from February through June with some exceptions (up to 48% lower). Flows during January under
38 A5_LLT would generally be lower than under Existing Conditions (up to 45% lower).

1 As reported in Impact AQUA-59, May Oroville storage volume under A5_LLТ would be similar to
2 storage under Existing Conditions in wet and above normal water years (Table 11-5-22). Storage
3 volume under A5_LLТ would be 9% to 18% lower than storage under Existing Conditions in below
4 normal, dry, and critical water years

5 As reported in Impact AQUA-58, September Oroville storage volume would be 8% to 31% lower
6 under A5_LLТ relative to Existing Conditions depending on water year type (Table 11-5-21).

7 **American River**

8 Water temperatures in the American River under Alternative 5 would be the same as those under
9 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher under
10 Alternative 1A in 3 months during the 5-month period evaluated relative to Existing Conditions.

11 *Fall-Run*

12 Flows in the American River at the confluence with the Sacramento River were examined for the
13 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
14 *Results utilized in the Fish Analysis*). Flows under A5_LLТ would generally be similar to or greater
15 than flows under Existing Conditions during February through April, except in critical years during
16 February and March (18% and 7% lower, respectively) and above and below normal years during
17 April (9% and 7% lower, respectively). Flows under A5_LLТ would be mostly lower (by up to 34%)
18 than flows under Existing Conditions during January and May.

19 **Stanislaus River**

20 *Fall-Run*

21 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 5 would be
22 up to 36% lower than Existing Conditions in January through May fall-run larval and juvenile
23 rearing period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
24 *Analysis*).

25 Mean monthly water temperatures in the Stanislaus River under Alternative 5 would be similar to
26 those under Alternative 1A. Conclusions for Alternative 1A, Impact AQUA-77, indicate that mean
27 monthly water temperatures under Alternative 1A would be 6% greater than those under Existing
28 Conditions in all months during the period.

29 **San Joaquin River**

30 *Fall-Run*

31 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run
32 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*
33 *the Fish Analysis*). Mean monthly flows under Alternative 5 would be similar to flows under Existing
34 Conditions throughout the period except during January, in which flows would be greater under
35 Alternative 5.

36 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 *Fall-Run*

3 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook
4 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
5 *Analysis*). Mean monthly flows under Alternative 5 would be 14% and 12% greater than flows under
6 Existing Conditions during January and February, respectively, similar to flows under Existing
7 Conditions during March, and 8% and 12% lower than flows under Existing Conditions during April
8 and May, respectively.

9 Water temperature modeling was not conducted in the Mokelumne River.

10 **Summary of CEQA Conclusion**

11 Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between
12 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
13 alternative could substantially reduce rearing habitat, contrary to the NEPA conclusion set forth
14 above. There are substantial flow reductions and water temperature increases in multiple
15 waterways, as well as substantial reductions in rearing conditions predicted by biological models.

16 These results are primarily caused by four factors: differences in sea level rise, differences in climate
17 change, future water demands, and implementation of the alternative. The analysis described above
18 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
19 alternative from those of sea level rise, climate change and future water demands using the model
20 simulation results presented in this chapter. However, the increment of change attributable to the
21 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
22 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
23 implementation period, which does include future sea level rise, climate change, and water
24 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
25 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
26 effect of the alternative from those of sea level rise, climate change, and water demands.

27 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
28 term implementation period and Alternative 5 indicates that flows in the locations and during the
29 months analyzed above would generally be similar between Existing Conditions during the LLT and
30 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
31 found above would generally be due to climate change, sea level rise, and future demand, and not
32 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
33 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
34 result in a significant impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is
35 found to be less than significant and no mitigation is required.

36 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**
37 **(Fall-/Late Fall-Run ESU)**

38 In general, the effects of Alternative 5 on fall- and late fall-run Chinook salmon migration conditions
39 relative to the NAA are uncertain.

1 **Upstream of the Delta**

2 **Sacramento River**

3 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
4 Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on
5 temperatures throughout the period evaluated relative to NAA.

6 *Fall-Run*

7 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants
8 during February through May. Flows under A5_LLT would be similar to or greater than flows under
9 NAA throughout the juvenile fall-run migration period in all water year types) (Appendix 11C,
10 *CALSIM II Model Results utilized in the Fish Analysis*).

11 Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run
12 Chinook salmon upstream migration period (September through October). Flows under A5_LLT
13 would almost always be similar to or greater than those under NAA except in below normal years
14 during September (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 *Late Fall-Run*

16 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January
17 through March) under A5_LLT would generally be similar to or greater than flows under NAA except
18 in dry years during January (5% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
19 Analysis*).

20 Flows in the Sacramento River upstream of Red Bluff were examined during the adult late fall-run
21 Chinook salmon upstream migration period (December through February). Flows under A5_LLT
22 would nearly always be similar to or greater than flows under NAA except in dry years during
23 January (5% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 **Clear Creek**

25 Water temperature modeling was not conducted in Clear Creek.

26 *Fall-Run*

27 Flows in Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run migrants
28 during February through May. Flows under A5_LLT would almost always be similar to or greater
29 than those under NAA, except in below normal years during March (6% lower) (Appendix 11C,
30 *CALSIM II Model Results utilized in the Fish Analysis*).

31 Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run
32 Chinook salmon upstream migration period (September through October). Flows under A5_LLT
33 would always be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the
34 Fish Analysis*).

35 **Feather River**

36 Water temperatures in the Feather River under Alternative 5 would be the same as those under
37 Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on
38 temperatures throughout the period evaluated relative to NAA.

1 *Fall-Run*

2 Flows in the Feather River at the confluence with the Sacramento River were reviewed during the
3 February through May fall-run juvenile migration period (Appendix 11C, *CALSIM II Model Results*
4 *utilized in the Fish Analysis*). Flows under A5_LLT would always be similar to or greater than flows
5 under NAA.

6 Flows in the Feather River at the confluence with the Sacramento River during the September
7 through October fall-run Chinook salmon adult migration period under A5_LLT would generally be
8 lower by up to 47% than flows under NAA during September and similar to or greater than flows
9 under NAA during October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 **American River**

11 Water temperatures in the American River under Alternative 5 would be the same as those under
12 Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on
13 temperatures throughout the period evaluated relative to NAA.

14 *Fall-Run*

15 Flows in the American River at the confluence with the Sacramento River were examined during the
16 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
17 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would always be similar to or
18 greater than flows under NAA.

19 Flows in the American River at the confluence with the Sacramento River were examined during the
20 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
21 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during September and October under
22 A5_LLT would generally be similar to flows under NAA during September except during wet and
23 below normal years (8% and 16% lower, respectively). Flows during October under A5_LLT would
24 generally be lower than flows under NAA (up to 15% lower).

25 **Stanislaus River**

26 Flows and water temperatures in the Stanislaus River for Alternative 5 are not different from those
27 for Alternative 1A, AQUA-78, which indicates there would be no effect of Alternative 1A on
28 temperatures throughout the period evaluated relative to NAA.

29 *Fall-Run*

30 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
31 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
32 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be nearly identical to flows
33 under NAA throughout the period.

34 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
35 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
36 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be nearly identical
37 to flows under NAA throughout the period.

1 **San Joaquin River**

2 *Fall-Run*

3 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
4 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
5 *Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months and water
6 year types throughout the period.

7 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
8 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
9 *in the Fish Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months
10 and water year types throughout the period.

11 Water temperature modeling was not conducted in the San Joaquin River.

12 **Mokelumne River**

13 Flows in the Mokelumne River at the Delta were examined during the February through May
14 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
15 *the Fish Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months and
16 water year types throughout the period.

17 Flows in the Mokelumne River at the Delta were examined during the September and October adult
18 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
19 *in the Fish Analysis*). Flows under Alternative 5 would be similar to those under NAA in all months
20 and water year types throughout the period.

21 Water temperature modeling was not conducted in the Mokelumne River.

22 **Through-Delta**

23 **Sacramento River**

24 *Fall-Run*

25 *Juveniles*

26 During the juvenile fall-run Chinook salmon emigration period (November to early May), mean
27 monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged
28 across years would be 6% to 11% lower in most months, and 17% lower in November compared to
29 NAA. Flows would be up to 23% lower in November of above normal years compared to NAA.

30 As described above in Impact AQUA-39, the north Delta export facilities would replace aquatic
31 habitat and likely attract piscivorous fish around the intake structures. Estimates of potential
32 predation losses at the single intake range from about 0.2% (bioenergetics model, Table 11-5-13) to
33 4.5% (based on a fixed 5% loss per intake) of the juvenile fall-run population that reaches the Delta
34 (Appendix 5F, *Biological Stressors*).

35 Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5
36 (A5_LLT) would average 24.6% across all years. Under Alternative 5, juvenile survival was similar to
37 NAA (Table 11-5-33).

1 **Table 11-5-33. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**
2 **Baseline and Alternative 5 Scenarios**

Year Types	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A5_LLТ	EXISTING CONDITIONS vs. A5_LLТ	NAA vs. A5_LLТ
Sacramento River					
Wetter Years	34.5	31.1	30.1	-4.4 (-13%)	-1.0 (-3%)
Drier Years	20.6	20.8	21.3	0.8 (4%)	0.6 (3%)
All Years	25.8	24.7	24.6	-1.2 (-4%)	0.0 (0%)
Mokelumne River					
Wetter Years	17.2	15.7	15.6	-1.6 (-9%)	-0.1 (-1%)
Drier Years	15.6	15.9	15.8	0.2 (1%)	-0.1 (-1%)
All Years	16.2	15.9	15.7	-0.5 (-3%)	-0.1 (-1%)
San Joaquin River					
Wetter Years	19.3	20.3	19.3	0.0 (0%)	-0.9 (-5%)
Drier Years	10.0	9.5	9.8	-0.1 (-1%)	0.3 (3%)
All Years	13.5	13.6	13.4	-0.1 (-1%)	-0.2 (-1%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

3

4 *Adults*

5 The adult fall-run migration extends from September-December. The proportion of Sacramento
6 River water in the Delta under Alternative 5 would be similar (<10% change) to NAA during the
7 entire migration period (Table 11-5-15). Olfactory cues for fall-run adults would likely still be
8 strong, as the proportion of Sacramento River under Alternative 5 would still represent 66–72% of
9 Delta outflows. Flows at Rio Vista would be greater (1–121% increase) under Alternative 5 than
10 under Alternative 1A in September, November and December, but substantially lower (25%) in
11 October. However, because the proportion of Sacramento River water in the Delta would not
12 substantially change during the peak adult migration period under Alternative 5, there would not be
13 an adverse effect on adult fall-run migration success through the Delta.

14 *Late Fall–Run*

15 *Juveniles*

16 During the juvenile late fall-run Chinook salmon emigration period (October-February), mean
17 monthly flows in the Sacramento River below the north Delta intake under Alternative 5 averaged
18 across years would be 6% to 9% lower in most months, and 17% lower in November compared to
19 NAA. Flows would be up to 23% lower in November of above normal years compared to NAA.

20 Estimates of potential predation losses at the single intake range from about 0.2% (bioenergetics
21 model, Table 11-5-13) to 4.5% (based on a fixed 5% loss per intake) of the juvenile late fall-run
22 population that reaches the Delta (Appendix 5F, *Biological Stressors*).

1 Through-Delta survival by emigrating juvenile late fall–run Chinook salmon under Alternative 5
 2 (A5_LLTT) would average 23% across all years, ranging from 21% in drier years to 27% in wetter
 3 years. Under Alternative 5, juvenile survival would be slightly greater (0.4% greater survival, or 3%
 4 more in relative percentage) compared to NAA (Table 11-5-34). Overall, Alternative 5 would not
 5 have an adverse effect on late fall–run Chinook salmon juvenile survival through the Delta.

6 **Table 11-5-34. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon**
 7 **under Baseline and Alternative 5 Scenarios**

Year Types	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A5_LLTT	EXISTING CONDITIONS vs. A5_LLTT	NAA vs. A5_LLTT
Wetter Years	28.8	27.3	27.4	-1.4 (-5%)	0.1 (<1%)
Drier Years	18.8	20.2	20.8	2.1 (11%)	0.6 (3%)
All Years	22.5	22.9	23.3	0.8 (3%)	0.4 (2%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

8

9 *Adults*

10 The adult late fall–run migration is from November through March, peaking in January through
 11 March. Mean monthly flows in Sacramento River at Rio Vista under Alternative 5 would be similar in
 12 December through March, and reduced about 20% in November compared to NAA. The proportion
 13 of Sacramento River water in the Delta would be similar (<10%) to NAA throughout the migration
 14 period (Table 11-5-15). Based on the similarity in Sacramento River olfactory cues and increase in
 15 Rio Vista flows during the adult late fall–run migration, it is assumed that adult migration success
 16 through the Delta would be similar or improved relative to those described for Alternative 1A.
 17 Therefore, Alternative 5 would not have an adverse effect on late fall–run adult migration.

18 ***Mokelumne River***

19 *Juveniles*

20 Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5 would
 21 be 15.7%, which is similar to NAA (Table 11-5-33).

22 ***San Joaquin River***

23 *Fall-Run*

24 *Juveniles*

25 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of
 26 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.
 27 There no flow changes associated with the alternatives. Alternative 5 would have no effect on fall-
 28 run migration success through the Delta (Table 11-5-33).

1 *Adults*

2 Alternative 5 would slightly increase the proportion of San Joaquin River water in the Delta in
3 September through December by 0.4 to 1.4 % (compared to NAA) (Table 11-5-15). The proportion
4 of San Joaquin River water would be similar to or slightly more than NAA. Therefore migration
5 conditions under Alternative 5 would be similar to slightly improved to those described for
6 Alternative 1A. Alternative 5 would have no effect to a slight beneficial effect on the fall-run adult
7 migration, because of the relative increase in olfactory cues from the San Joaquin River basin.

8 **NEPA Effects:** Upstream of the Delta, the results indicate that the impact would be adverse because
9 it has the potential to substantially reduce the quantity or quality of migration habitat or interfere
10 with the movement of fish. Upstream flows under Alternative 5 would be 47% lower in the Feather
11 River and 15% lower in the American River during one of two months of the fall-run Chinook
12 salmon adult migration period, compared to NAA, Combined, these reductions represent an adverse
13 effect of the alternative on fall-/late fall-run Chinook salmon migration. There would be no other
14 effects of Alternative 5 on flow or temperatures in upstream rivers. Near-field effects of Alternative
15 5 NDD on fall- and late fall-run Chinook salmon related to impingement and predation associated
16 with three new intake structures could result in negative effects on juvenile migrating fall- and late
17 fall-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is
18 expected that the level of near-field impacts would be directly correlated to the number of new
19 intake structures in the river and thus the level of impacts associated with 1 new intake would be
20 considerably lower than those expected from having 5 new intakes in the river. Estimates within the
21 effects analysis range from very low levels of effects (<1% mortality) to larger effects (~ 5%
22 mortality above current baseline levels). CM15 would be implemented with the intent of providing
23 localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-
24 construction surveys to better understand how to minimize losses associated with the 1 new intake
25 structure will be implemented as part of the final NDD screen design effort. Alternative 5 also
26 includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to
27 evaluate and make limited adjustments intended to provide adequate migration conditions for fall-
28 and late fall-run Chinook. However, at this time, due to the absence of comparable facilities
29 anywhere in the lower Sacramento River/Delta, the degree of mortality expected from near-field
30 effects at the NDD remains highly uncertain.

31 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
32 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
33 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5
34 predict improvements in smolt condition and survival associated with increased access to the Yolo
35 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
36 of each of these factors and how they might interact and/or offset each other in affecting salmonid
37 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

38 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
39 all of these elements of BDCP operations and conservation measures to predict smolt migration
40 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
41 migration survival under Alternative 5 would be similar to those estimated for NAA. Further
42 refinement and testing of the DPM, along with several ongoing and planned studies related to
43 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
44 future. These efforts are expected to improve our understanding of the relationships and

1 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
2 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

3 Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 5 on
4 fall-/late fall-run Chinook salmon migration conditions would be adverse. While the implementation
5 of the mitigation measures described below would address these impacts, these measures are not
6 anticipated to reduce the impact to a level considered not adverse.

7 ***CEQA Conclusion:***

8 In general, Alternative 5 would reduce migration conditions for fall-/late fall-run Chinook salmon
9 relative to Existing Conditions.

10 **Upstream of the Delta**

11 ***Sacramento River***

12 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
13 Alternative 1A, Impact AQUA-78, which indicates there would be no effect of Alternative 1A on
14 temperatures throughout the period evaluated.

15 ***Fall-Run***

16 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants
17 were evaluated during February through May. Flows under A5_LLT would generally be similar to or
18 greater than those under Existing Conditions, except in wet years during May (18% lower) and
19 below normal years during March and May (10% and 6% lower, respectively) (Appendix 11C,
20 *CALSIM II Model Results utilized in the Fish Analysis*).

21 Flows in the Sacramento River upstream of Red Bluff were evaluated during the adult fall-run
22 Chinook salmon upstream migration period (September through October). Flows would generally
23 be similar to or greater than those under Existing Conditions except in below normal and dry years
24 (12% and 24% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
25 *Analysis*).

26 ***Late Fall-Run***

27 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile late fall-run
28 migrants (January through March). Flows under A5_LLT would almost always be similar to or
29 greater than flows under Existing Conditions, except in below normal water years during March
30 (10% reduction) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Flows in the Sacramento River upstream of Red Bluff were examined during the adult late fall-run
32 Chinook salmon upstream migration period (December through February). Flows under A5_LLT
33 would generally be similar to or greater than those under Existing Conditions except in wet and
34 below normal years during December (9% and 6% lower, respectively) (Appendix 11C, *CALSIM II*
35 *Model Results utilized in the Fish Analysis*).

36 ***Clear Creek***

37 Water temperature modeling was not conducted in Clear Creek.

1 **Fall-Run**

2 Flows in Clear Creek below Whiskeytown Reservoir were examined during the juvenile fall-run
3 Chinook salmon upstream migration period (February through May). Flows under A5_LLT would be
4 similar to or greater than those under Existing Conditions throughout the period (Appendix 11C,
5 *CALSIM II Model Results utilized in the Fish Analysis*).

6 Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run
7 Chinook salmon upstream migration period (September through October). Flows under A5_LLT
8 would generally be similar to or greater than those under Existing Conditions except in critical years
9 during September and October (28% and 7% lower, respectively) and below normal years during
10 October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 **Feather River**

12 Water temperatures in the Feather River under Alternative would be the same as those under
13 Alternative 1A, Impact AQUA-78, which indicates that there would be no differences in
14 temperatures under Alternative 1A during the periods evaluated.

15 **Fall-Run**

16 Flows in the Feather River at the confluence with the Sacramento River were evaluated during the
17 fall-run juvenile migration period (February through May) (Appendix 11C, *CALSIM II Model Results*
18 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows
19 under Existing Conditions, except in below normal years during February and March (12% and 18%
20 lower, respectively) and wet and above normal years during May (18% and 14% lower,
21 respectively).

22 Flows in the Feather River at the confluence with the Sacramento River during the September
23 through October fall-run Chinook salmon adult migration period under A5_LLT would generally be
24 similar to or greater than flows under Existing Conditions except in below normal and dry water
25 years during September (30% and 34% lower, respectively) and in wet years during October (7%
26 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 **American River**

28 Water temperatures in the American River under Alternative 5 would be the same as those under
29 Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher during
30 substantial portions of the periods evaluated.

31 **Fall-Run**

32 Flows in the American River at the confluence with the Sacramento River were examined during the
33 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
34 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT during February through April
35 would generally be similar to or greater than flows under Existing Conditions, except for critical
36 years during February and March (18% and 7% lower, respectively) and above and below normal
37 years during April (9% and 7% lower, respectively). Flows during May under A5_LLT would
38 generally be up to 34% lower than flows under Existing Conditions.

39 Flows in the American River at the confluence with the Sacramento River were examined during the
40 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,

1 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower
2 than flows under Existing Conditions by up to 47%.

3 **Stanislaus River**

4 Water temperatures in the Stanislaus River for Alternative 5 are not different from those for
5 Alternative 1A, which indicates that temperatures under Alternative 1A would be higher during
6 substantial portions of the periods evaluated relative to Existing Conditions.

7 *Fall-Run*

8 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
9 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
10 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would predominantly be lower than
11 flows under Existing Conditions by up to 36%.

12 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
13 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
14 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT during September would
15 generally be similar to flows under Existing Conditions, except during wet and above normal years
16 (17% and 6% lower, respectively). Flows under A5_LLT during October would be 5% to 10% lower
17 than flows under Existing Conditions.

18 **San Joaquin River**

19 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
20 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
21 *Analysis*). Mean monthly flows under Alternative 5 would generally be similar to flows under
22 Existing Conditions in all months. Wetter water years under Alternative 5 would have similar or
23 greater flows than those under Existing Conditions, whereas drier years would have lower flows
24 under Alternative 5.

25 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
26 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
27 *in the Fish Analysis*). Mean monthly flows under Alternative 5 would be 8% lower than those under
28 Existing Conditions in September and similar in October.

29 Water temperature modeling was not conducted in the San Joaquin River.

30 **Mokelumne River**

31 *Fall-Run*

32 Flows in the Mokelumne River at the Delta were examined during the February through May
33 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
34 *the Fish Analysis*). Flows under Alternative 5 would be similar to or up to 15% greater than those
35 under Existing Conditions during February and March, but up to 18% lower than flows under
36 Existing Conditions during April and May.

37 Flows in the Mokelumne River at the Delta were examined during the September and October adult
38 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*

1 *in the Fish Analysis*). Mean monthly flows under Alternative 5 would be 27% and 5% lower than
2 under Existing Conditions during September and October, respectively.

3 Water temperature modeling was not conducted in the Mokelumne River.

4 **Through-Delta**

5 ***Sacramento River***

6 As described above, Sacramento River flows below the north Delta intake would be reduced under
7 Alternative 5 compared to Existing Conditions. Estimates of potential predation losses at the single
8 intake range from 0.2% to 4.5% of the population that reaches the Delta. Compared to Existing
9 Conditions, through-Delta survival by emigrating juveniles under Alternative 5 would be 2.1%
10 greater (11% relative increase) in drier years for late-fall run Chinook salmon and 4.4% lower (13%
11 relative decrease) in wetter years for fall-run Chinook salmon (Table 11-5-33).

12 ***Mokelumne River***

13 Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5 would
14 be 15.7% (Table 11-5-33). Compared to Existing Conditions, survival would be similar in most
15 years, but 1.6% lower (9% relative decrease) in wetter years.

16 ***San Joaquin River***

17 Through-Delta survival by emigrating juvenile fall-run Chinook salmon under Alternative 5 would
18 be similar to Existing Conditions (Table 11-5-33).

19 **Summary of CEQA Conclusion**

20 Collectively, the upstream impacts of Alternative 5 would be significant because the alternative
21 could substantially reduce rearing habitat. Flows in the American, Stanislaus, Mokelumne, and San
22 Joaquin Rivers would be lower than flows in under the CEQA baseline during substantial portions of
23 the migration periods evaluated. Water temperatures in the Feather, American, and Stanislaus
24 Rivers would be lower during most or all of the periods evaluated. Through-Delta migration
25 conditions for juvenile fall-run and juvenile and adult late fall-run Chinook salmon under Alternative
26 5 would be similar to Existing Conditions.

27 This impact is a result of the specific reservoir operations and resulting flows associated with this
28 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
29 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
30 change the alternative, thereby making it a different alternative than that which has been modeled
31 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
32 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
33 severity of impact though not necessarily to a less-than-significant level.

34 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional** 35 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine** 36 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

37 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have
38 significant and unavoidable adverse effects on migration habitat, this conclusion was based on
39 the best available scientific information at the time and may prove to have been over- or

1 understated. Upon the commencement of operations of CM1 and continuing through the life of
2 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine
3 whether such effects would be as extensive as concluded at the time of preparation of this
4 document and to determine any potentially feasible means of reducing the severity of such
5 effects. This mitigation measure requires a series of actions to accomplish these purposes,
6 consistent with the operational framework for Alternative 5

7 The development and implementation of any mitigation actions shall be focused on those
8 incremental effects attributable to implementation of Alternative 5 operations only.
9 Development of mitigation actions for the incremental impact on migration habitat attributable
10 to climate change/sea level rise are not required because these changed conditions would occur
11 with or without implementation of Alternative 5.

12 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**
13 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**
14 **of CM1**

15 Following commencement of initial operations of CM1 and continuing through the life of the
16 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
17 modified operations could reduce impacts to migration habitat under Alternative 5. The analysis
18 required under this measure may be conducted as a part of the Adaptive Management and
19 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

20 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**
21 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**
22 **Migration Conditions Consistent with CM1**

23 In order to determine the feasibility of reducing the effects of CM1 operations on fall-run/late
24 fall-run Chinook salmon habitat, the BDCP proponents will consult with USFWS and the
25 Department of Fish and Wildlife to identify and implement any feasible operational means to
26 either effects on migration habitat. Any such action will be developed in conjunction with the
27 ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-
28 78a.

29 If feasible means are identified to reduce impacts on migration habitat consistent with the
30 overall operational framework of Alternative 5 without causing new significant adverse impacts
31 on other covered species, such means shall be implemented. If sufficient operational flexibility
32 to reduce effects on fall-run/late fall-run Chinook salmon habitat is not feasible under
33 Alternative 5 operations, achieving further impact reduction pursuant to this mitigation
34 measure would not be feasible under this Alternative, and the impact on fall-run/late fall-run
35 Chinook salmon would remain significant and unavoidable.

36 **Restoration Measures (CM2, CM4–CM7, and CM10)**

37 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**
38 **(Fall-/Late Fall-Run ESU)**

39 The effects on construction of restoration measures on fall-/late-fall-run Chinook would be identical
40 to those on winter-run Chinook; please refer to the discussion of Alternative 5, Impact AQUA-43
41 above.

1 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**
2 **Salmon (Fall-/Late Fall-Run ESU)**

3 The effects of contaminants associated with restoration measures would be the same for all four
4 ESUs. Accordingly, please refer to the discussion of Alternative 5, Impact AQUA-44 for winter-run
5 Chinook salmon.

6 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**
7 **Run ESU)**

8 The effects of restored habitat conditions on fall-/late fall-run Chinook would be the same as for
9 described for winter-run Chinook salmon, please refer to the discussion under Alternative 5, Impact
10 AQUA-45 above. The only difference is that fall-/late fall-run Chinook also occur in the
11 Cosumnes/Mokelumne ROA and would receive the benefits of increased habitat acreage and food
12 production in this location.

13 **CEQA Conclusion:** As described in Alternative 5, Impact AQUA-45 for winter-run Chinook salmon,
14 the potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial
15 although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%.
16 No mitigation would be required.

17 **Other Conservation Measures (CM12–CM19 and CM21)**

18 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**
19 **Run ESU) (CM12)**

20 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
21 **(Fall-/Late Fall-Run ESU) (CM13)**

22 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**
23 **/Late Fall-Run ESU) (CM14)**

24 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-**
25 **/Late Fall-Run ESU) (CM15)**

26 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**
27 **Run ESU) (CM16)**

28 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**
29 **ESU) (CM17)**

30 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**
31 **ESU) (CM18)**

32 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**
33 **Fall-Run ESU) (CM19)**

34 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
35 **(Fall-/Late Fall-Run ESU) (CM21)**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact
2 mechanisms on Chinook salmon are the same as those described under Alternative 1A (Impacts
3 AQUA-82 through AQUA-90). The effects would range from no effect, to not adverse, to
4 beneficial.

5 **CEQA Conclusion:** The impacts of the nine impact mechanisms listed above would range from no
6 impact, to less than significant, to beneficial, and no mitigation is required.

7 **Steelhead**

8 **Construction and Maintenance of CM1**

9 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

10 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on steelhead
11 would be similar to those described for Alternative 1A (Impact AQUA-91) except that Alternative 5
12 would include one intake compared to five intakes under Alternative 1A, so the effects would be
13 proportionally less under this alternative. This would convert about 2,050 lineal feet of existing
14 shoreline habitat into intake facility structures and would require about 4.7 acres of dredge and
15 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
16 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-91,
17 environmental commitments and mitigation measures would be available to avoid and minimize
18 potential effects, and the effect would not be adverse for steelhead.

19 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-91, the impact of the construction of
20 water conveyance facilities on steelhead would be less than significant except for construction noise
21 associated with pile driving. Potential pile driving impacts would be less than Alternative 1A
22 because only one intake would be constructed rather than five. Implementation of Mitigation
23 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
24 significant.

25 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 26 **of Pile Driving and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
28 Alternative 1A.

29 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 30 **and Other Construction-Related Underwater Noise**

31 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
32 Alternative 1A.

33 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

34 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
35 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-92) except
36 that only one intake would need to be maintained under Alternative 5 rather than five under
37 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-92, the effect would not be adverse for
38 steelhead.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance
2 of water conveyance facilities on steelhead would be less than significant and no mitigation would
3 be required.

4 **Water Operations of CM1**

5 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

6 **Water Exports from SWP/CVP South Delta Facilities**

7 Under Alternative 5, average entrainment of juvenile steelhead at the south Delta export facilities,
8 estimated by the salvage density method across all years, would be reduced 9% compared to NAA
9 (Table 11-5-35). Pre-screen losses typically attributed to predation would also be expected to
10 decrease commensurate with entrainment.

11 **Table 11-5-35. Juvenile Steelhead Annual Entrainment Index^a at the SWP and CVP Salvage**
12 **Facilities—Differences between Model Scenarios for Alternative 5**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-605 (-10%)	-697 (-11%)
Above Normal	-958 (-7%)	-1,302 (-10%)
Below Normal	-1,467 (-12%)	-736 (-7%)
Dry	-683 (-9%)	-92 (-1%)
Critical	-253 (-4%)	98 (2%)
All Years	-904 (-10%)	-763 (-9%)

^a Estimated annual number of fish lost, based on non-normalized data.

13

14 **Water Exports from SWP/CVP North Delta Intake Facilities**

15 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
16 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the
17 effects would be minimal because the north Delta intake would have state-of-the-art screens to
18 exclude juvenile fish.

19 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

20 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
21 entrainment and impingement effects for juvenile salmonids would be minimal because the intake
22 would have state-of-the-art screens installed.

23 **NEPA Effects:** Because entrainment loss would be reduced at the south Delta facilities and
24 minimized at the north Delta intake and NBA, the effect under Alternative 5 would not be adverse.

25 **CEQA Conclusion:** Entrainment losses of juvenile steelhead would be reduced 10% under
26 Alternative 5 compared to Existing Conditions (Table 11-5-35). Overall, impacts would be less than
27 significant and may be beneficial to steelhead because of the reduction in entrainment loss and no
28 mitigation would be required.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, effects of Alternative 5 on steelhead spawning conditions would be negligible relative to the NAA.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds, leading to mortality. Flows under A5_LLT throughout the period would generally be similar to those under NAA except in below normal years during January (11% higher) and critical years in March and below normal years in April (6% higher) and during above normal and dry years during January (8% and 9% lower) and during dry years in March (5% lower).

SacEFT predicts that there would be negligible effects (4%) on the percentage of years with good spawning availability (measured as weighted usable area), and the same redd scour risk and egg incubation conditions under A5_LLT relative to NAA (Table 11-5-36). These results indicate that there would be a low effect of Alternative 5 on spawning habitat quantity but no difference in redd scour risk or temperature related egg incubation conditions.

Water temperatures in the Sacramento River under Alternative 5 would be the same as those under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude and frequency of water temperatures potentially affecting the quantity and quality of spawning and incubation habitat under Alternative 1A and NAA would be comparable and would therefore not affect long-term habitat conditions relative to NAA.

Overall in the Sacramento River, Alternative 5 would have negligible effects on water temperatures, negligible effects (<5%) on mean monthly flows, and negligible (<5%) to small effects (<10%) on egg survival, redd scour, and redd dewatering habitat metrics computed using SacEFT, resulting in no biologically meaningful effects on steelhead spawning in the Sacramento River.

Table 11-5-36. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Spawning WUA	1 (2%)	-2 (-4%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	2 (4%)	5 (9%)
Juvenile Rearing WUA	-3 (-7%)	-7 (-16%)
Juvenile Stranding Risk	-14 (-41%)	0 (0%)

WUA = Weighted Usable Area.

1 **Clear Creek**

2 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
3 (January through April). Flows under A5_LLT would generally be similar to flows under NAA
4 throughout the period, except in critical years during February (7% higher), and below normal years
5 during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
7 monthly flow reduction would be identical between NAA and A5_LLT for all water year types except
8 for a small difference in critical years (Table 11-5-37).

9 No water temperature modeling was conducted for Clear Creek.

10 Overall in Clear Creek, Alternative 5 would have primarily negligible effects (<5%) on mean monthly
11 flows for the January to April steelhead spawning and egg incubation period, and project-related
12 effects on flow reductions during the incubation period would be negligible (<5%) with the
13 exception of an infrequent flow reduction of relatively small magnitude in critical years that would
14 not pose substantial redd dewatering risk.

15 **Table 11-5-37. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**
16 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**
17 **Incubation Period^a**

Water Year Type	A5_LLT vs. EXISTING CONDITIONS	A5_LLT vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	-19 (NA)	-19 (NA)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

18

19 **Feather River**

20 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
21 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
22 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
23 Flows in the low-flow channel under A5_LLT would not differ from NAA because minimum Feather
24 River flows are included in the FERC settlement agreement and would be met for all model
25 scenarios (California Department of Water Resources 2006). Flows under A5_LLT at Thermalito
26 Afterbay would generally be similar to or greater than flows under NAA (up to 34% higher), except
27 in critical years during January (12% lower) and in below normal years during March (11% lower).

28 Oroville Reservoir storage volume at the end of September and end of May influences flows
29 downstream of the dam during the steelhead spawning and egg incubation period. Storage volume
30 at the end of September under A5_LLT would be similar to or up to 17% greater than storage under

1 NAA depending on water year type (Table 11-5-21). May Oroville storage under A5_LLT would be
2 similar to storage under NAA (Table 11-5-22).

3 Water temperatures in the Feather River under Alternative 5 would be the same as those under
4 Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude
5 and frequency of water temperatures potentially affecting the quantity and quality of spawning and
6 incubation habitat under Alternative 1A and NAA would be comparable and would therefore not
7 affect long-term habitat conditions relative to NAA.

8 Overall in the Feather River low-flow channel, Alternative 5 would not have any effect (0% change)
9 on mean monthly flows and negligible effects on water temperatures. Overall in the Feather River
10 above Thermalito Afterbay, Alternative 5 would result primarily in negligible effects (<5%) on mean
11 monthly flow or increases in flow (to 34%) that would have a beneficial effect on spawning
12 conditions, with two isolated occurrences of small flow reductions (to -12%) that would not have
13 biologically meaningful effects, and negligible effects on water temperatures.

14 ***American River***

15 Water temperatures in the American River under Alternative 5 would be the same as those under
16 Alternative 1A, Impact AQUA-94, which indicates there would be no effects of Alternative 1A on
17 temperatures during the periods evaluated.

18 Flows in the American River at the confluence with the Sacramento River were examined for the
19 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
20 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to flows
21 under NAA during the period except in critical and dry years during January and February (12% and
22 10% higher, respectively) and dry years during March (8% lower) (Appendix 11C, *CALSIM II Model*
23 *Results utilized in the Fish Analysis*).

24 ***San Joaquin River***

25 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

26 ***Stanislaus River***

27 Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under
28 Alternative 1A, Impact AQUA-94, which indicates there would be no effects of Alternative 1A on
29 temperatures during the periods evaluated relative to NAA.

30 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
31 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
32 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to flows under
33 NAA.

34 ***Mokelumne River***

35 Flows in the Mokelumne River at the confluence were examined for the January through April
36 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
37 *Fish Analysis*). Flows under A5_LLT would be the same as flows under NAA.

38 Water temperature modeling was not conducted in the Mokelumne River.

1 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
2 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
3 as a result of egg mortality. Effects of Alternative 5 on flow consist of negligible effects (<5%), small
4 decreases in mean monthly flow (up to -12%) that would not have biologically meaningful effects, or
5 increases in mean monthly flow (up to 12% for all locations, with more substantial increases up to
6 34% in the Feather River) that would have a beneficial effect on steelhead spawning conditions.
7 Results of SacEFT and flow reduction analyses indicate negligible (<5%) or small effects (up to 9%
8 change) that would not have biologically meaningful effects on redd scour risk for all locations
9 analyzed.

10 **CEQA Conclusion:** In general, effects of Alternative 5 on steelhead spawning conditions would be
11 negligible relative to Existing Conditions.

12 **Sacramento River**

13 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
14 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
15 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*
16 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
17 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows
18 under A5_LLT would generally be similar to under Existing Conditions in April, and mixed in the
19 other months with both lower and higher flows depending on the water year type. In January flows
20 would be lower in above normal and dry years (9% and 7%, respectively) and higher in wet and
21 critical years (12% and 16%, respectively), in February flow would be lower in below normal, dry
22 and critical years (9%, 5%, and 6%, respectively) and higher in wet and above normal years (12%
23 and 6%, respectively), and in March flows would be lower in below normal and dry years (18% and
24 7%, respectively) and higher in wet and critical years (6% and 9%, respectively). Upstream of Red
25 Bluff Diversion Dam, A5_LLT flows would generally be similar to or higher than Existing Conditions
26 throughout the period with lower flows in below normal years during March (10%).

27 SacEFT predicts no differences in spawning habitat, egg incubation, redd scour and dewatering risk
28 between Existing Conditions and Alternative 5 (Table 11-5-36).

29 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
30 Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude
31 and frequency of water temperatures potentially affecting the quantity and quality of spawning and
32 incubation habitat under Existing Conditions and Alternative 1A would be comparable.

33 Overall in the Sacramento River, Alternative 5 would have negligible effects (<5%) or cause small
34 increases in mean monthly flow (11%) that would not affect steelhead spawning conditions in a
35 biologically meaningful way. SacEFT indicates that steelhead egg incubation and redd survival
36 metrics would not be affected by Alternative 5. Effects of Alternative 5 on water temperature would
37 be negligible.

38 **Clear Creek**

39 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
40 (January through April). Flows under A5_LLT would be similar to or greater than flows under
41 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*
42 *Fish Analysis*).

1 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
2 monthly flow reduction would be identical between Existing Conditions and A5_LLT for all water
3 year types except wet, in which the reduction would be 38% lower (worse) under A5_LLT than
4 under Existing Conditions (Table 11-5-37).

5 No temperature modeling was conducted for Clear Creek.

6 Overall in Clear Creek, Alternative 5 would have negligible effects (<5%) or contribute to increases
7 in mean monthly flow (to 54%) that would be beneficial for steelhead spawning conditions.
8 Alternative 5 would have primarily negligible effects (<5%) on flow reductions with the exception of
9 a moderate flow reduction (-38%) during wet years when effects on spawning conditions would not
10 be as critical, and a small reduction in critical years (-13%) that would not have biologically
11 meaningful effects.

12 **Feather River**

13 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
14 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
15 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
16 Flows in the low-flow channel under A5_LLT would not differ from Existing Conditions because
17 minimum Feather River flows are included in the FERC settlement agreement and would be met for
18 all model scenarios (California Department of Water Resources 2006). Flows under A5_LLT at
19 Thermalito Afterbay would generally be similar to or greater than flows under Existing Conditions,
20 except in above, below normal and dry water years during January (38%, 45% and 18% lower,
21 respectively), above and below normal years during February (8% and 46% lower, respectively),
22 below normal years during March (48% lower), and wet and above normal years during April (37%
23 and 7% lower, respectively).

24 Oroville Reservoir storage volume at the end of September and end of May influences flows
25 downstream of the dam during the steelhead spawning and egg incubation period. Oroville
26 Reservoir storage volume at the end of September would be 7% to 36% lower under A5_LLT
27 relative to Existing Conditions depending on water year type (Table 11-5-21). May Oroville storage
28 volume under A5_LLT would be lower than Existing Conditions by 1% to 18% depending on water
29 year type (Table 11-5-22).

30 Water temperatures in the Feather River under Alternative 5 would be the same as those under
31 Alternative 1A, Impact AQUA-94, which indicates there would be substantial increases in
32 temperatures under Alternative 1A during the periods examined relative to Existing Conditions.

33 Overall in the Feather River, effects of Alternative 5 on mean monthly flow would be negligible (no
34 difference) in the low-flow channel and negligible (<5% difference) or beneficial (increases to 84%)
35 at Thermalito Afterbay. Small (-8%) to substantial (to -48%) flow reductions at Thermalito Afterbay
36 would occur for some months and water year types but would occur infrequently enough to not
37 have biologically meaningful effects. There would be negative effects of Alternative 5 on water
38 temperatures in the Feather River.

39 **American River**

40 Flows in the American River at the confluence with the Sacramento River were examined for the
41 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
42 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or

1 greater than flows under Existing Conditions in January through April except that they would be
2 substantially lower in below normal, dry and critical years in January, critical years in February and
3 March and in below normal, wet, and above normal years during April. Overall, these results
4 indicate that the effects of Alternative 5 on flow in the American River would be minor.

5 Water temperatures in the American River under Alternative 5 would be the same as those under
6 Alternative 1A, which indicates that there would be substantial increases in temperatures under
7 Alternative 1A during the periods evaluated relative to Existing Conditions.

8 ***Stanislaus River***

9 Flows in the Stanislaus River for Alternative 5 are substantially below those under Existing
10 Conditions in all months and for most water months in the January through April period.

11 Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under
12 Alternative 1A, Impact AQUA-94, which indicates that temperatures under Alternative 1A would be
13 greater during the entire period evaluated relative to Existing Conditions.

14 ***San Joaquin River***

15 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

16 ***Mokelumne River***

17 Flows in the Mokelumne River for Alternative 5 are generally similar to or higher than Existing
18 Conditions in January and February (up to 18% higher) and lower than Existing Conditions in March
19 and April (up to 14% lower).

20 Water temperature modeling was not conducted in the Mokelumne River.

21 **Summary of CEQA Conclusion**

22 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between
23 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
24 alternative could substantially reduce suitable spawning habitat and substantially reduce the
25 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Effects
26 to flow would generally be negligible in the Sacramento, Feather, and American Rivers, and in Clear
27 Creek. However, flows would be substantially lower in in the Stanislaus River and water
28 temperatures would be substantially lower in the Feather, American, and Stanislaus Rivers.

29 These results are primarily caused by four factors: differences in sea level rise, differences in climate
30 change, future water demands, and implementation of the alternative. The analysis described above
31 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
32 alternative from those of sea level rise, climate change and future water demands using the model
33 simulation results presented in this chapter. However, the increment of change attributable to the
34 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
35 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
36 implementation period, which does include future sea level rise, climate change, and water
37 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
38 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
39 effect of the alternative from those of sea level rise, climate change, and water demands.

1 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
2 term implementation period and Alternative 5 indicates that flows in the locations and during the
3 months analyzed above would generally be similar between Existing Conditions during the LLT and
4 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
5 found above would generally be due to climate change, sea level rise, and future demand, and not
6 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
7 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
8 result in a significant impact on spawning habitat for steelhead. This impact is found to be less than
9 significant and no mitigation is required.

10 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

11 In general, Alternative 5 would reduce the quantity and quality of steelhead rearing habitat relative
12 to NAA.

13 ***Sacramento River***

14 Juvenile steelhead rear in the Sacramento River for 1 to 2 years before migrating downstream to the
15 ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in flow
16 can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the reach
17 where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to upstream of
18 RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows
19 during May would be generally greater (up to 11%), flows in November would be lower (up to
20 20%), flows in the other months of the year would be similar or greater than under NAA except for
21 August, September, October, and December which have single water years above and single water
22 years below NAA.

23 SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions
24 under A5_LLTT would be 16% lower than that under NAA (Table 11-5-36). Also, the percentage of
25 years with good (lower) juvenile stranding risk conditions under A5_LLTT would be the same as
26 under NAA. These results indicate that Alternative 5 would cause a small decrease in rearing habitat
27 conditions and no increase in juvenile mortality risk resulting from stranding in the Sacramento
28 River.

29 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
30 Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A are that the predicted magnitude
31 and frequency of water temperatures potentially affecting the quantity and quality of rearing habitat
32 under NAA and Alternative 1A would be comparable.

33 Overall in the Sacramento River, Alternative 5 would have negligible effects on juvenile steelhead
34 rearing conditions based on negligible effects (<5%) on mean monthly flows with the exception of a
35 moderate reduction (-15%) in wet years, a relatively small decrease (-16%) in the number of years
36 classified as “good” rearing habitat, and no effect on juvenile stranding risk, which collectively are
37 not expected to contribute to biologically meaningful effects in the Sacramento River.

38 ***Clear Creek***

39 Water temperatures were not modeled in Clear Creek.

40 Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under
41 A5_LLTT would generally be similar to or sometimes greater than flows under NAA, except for below

1 normal years in March in which flows would be 6% lower (Appendix 11C, *CALSIM II Model Results*
2 *utilized in the Fish Analysis*). Water temperatures were not modeled in Clear Creek.

3 It was assumed that habitat for juvenile steelhead rearing would be constrained by the month
4 having the lowest instream flows. Juvenile rearing habitat is assumed to increase as instream flows
5 increase, and therefore the lowest monthly instream flow was used as an index of habitat
6 constraints for juvenile rearing. Results of the analysis indicate that juvenile steelhead rearing
7 habitat, based on minimum instream flows, is comparable for Alternative 5 relative to NAA in wet,
8 above normal, and critical water year types (Table 11-5-38). Minimum flows would be the same as
9 NAA in all water years except it would be 8% lower in critical water years.

10 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-
11 1A-4). The current Clear Creek management regime uses flows slightly lower than those
12 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being
13 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We
14 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.
15 No change in effect on steelhead in Clear Creek is anticipated.

16 Overall, these results indicate that Alternative 5 would not affect juvenile rearing conditions in Clear
17 Creek.

18 **Table 11-5-38. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during**
19 **the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	0 (0%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	-7 (-8%)	-7 (-8%)

Note: Minimum flows occurred between October and March.

20

21 ***Feather River***

22 Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay
23 (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing
24 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is
25 the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al.
26 2003). Relatively constant flows in the low flow channel throughout the year under A5_LLT would
27 not differ from those under NAA. In the high flow channel, flows under A5_LLT would be mostly
28 lower (up to 61%) during July, August, and September and mostly greater (up to 47%) than flows
29 under NAA in other months.

30 May Oroville storage under A5_LLT would be similar to storage under NAA (Table 11-5-22).
31 September Oroville storage volume would be similar to or up to 17% greater than under NAA
32 depending on water year type (Table 11-5-21).

33 Water temperatures in the Feather River low-flow and high-flow channel under Alternative 5 would
34 be the same as those under Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A are that

1 the predicted magnitude and frequency of water temperatures potentially affecting the quantity and
2 quality of rearing habitat under NAA and Alternative 1A would be comparable.

3 Overall in the Feather River, Alternative 5 would have negligible effects in the low-flow channel and
4 would not have biologically meaningful effects on juvenile rearing conditions at that location.

5 **American River**

6 Water temperatures in the American River under Alternative 5 would be the same as those under
7 Alternative 1A, Impact AQUA-94, which indicates that water temperatures under A1A_LLT would be
8 similar to those under NAA.

9 Flows in the American River at the confluence with the Sacramento River were examined for the
10 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
11 *Analysis*). Flows under A5_LLT would generally be similar to flows under NAA during January
12 through April and December, greater than flows under NAA during May and June, lower than flows
13 under NAA during July through September (up to 43% lower), and with both higher and lower flows
14 in October and November.

15 **Stanislaus River**

16 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
17 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
18 *Analysis*). Flows under A5_LLT would be similar to flows under NAA for the entire year with few
19 exceptions.

20 Water temperatures in the American River under Alternative 5 would be the same as those under
21 Alternative 1A, Impact AQUA-95, which indicates that there would be no effect of Alternative 1A on
22 temperatures during the period evaluated relative to NAA.

23 **San Joaquin River**

24 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing
25 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A5_LLT
26 would be similar to flows under NAA throughout the period.

27 Water temperature modeling was not conducted in the San Joaquin River.

28 **Mokelumne River**

29 Flows in the Mokelumne River for Alternative 5 were examined for the year-round steelhead rearing
30 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) and the flows are not
31 different from those under NAA.

32 Water temperature modeling was not conducted in the Mokelumne River.

33 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
34 potential to substantially reduce rearing habitat and substantially reduce the number of fish as a
35 result of fry and juvenile mortality. There would be substantial reductions in flows in the Feather
36 River (up to 61% lower) and the American River (up to 43% lower). Reduced flows would increase
37 the potential for degradation and loss of juvenile rearing habitat. There would be no other effects on
38 flows or water temperatures in the rivers evaluated.

1 This effect is a result of the specific reservoir operations and resulting flows associated with this
2 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
3 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change
4 the alternative, thereby making it a different alternative than that which has been modeled and
5 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
6 mitigation available. While the implementation of mitigation measures listed below (AQUA-95a
7 through AQUA-95c) would be expected to reduce the severity of effects on steelhead rearing habitat,
8 these would not necessarily result in a not adverse determination.

9 **CEQA Conclusion:** In general, Alternative 5 would reduce the quantity and quality of steelhead
10 rearing habitat relative Existing Conditions.

11 **Sacramento River**

12 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and
13 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM*
14 *II Model Results utilized in the Fish Analysis*). Flows during October and between December and July
15 under A5_LLT would generally be similar to or greater than those under Existing Conditions. Flows
16 during January, February March, May, July and September would be mixed with some water years
17 below and some water years above Existing Conditions. Flows during April, August, November and
18 December would generally be lower under A5_LLT than under Existing Conditions.

19 SacEFT predicts that there would be a 7% decrease in the percentage of years with good rearing
20 availability, measured as weighted usable area, under A5_LLT relative to Existing Conditions (Table
21 11-5-11). SacEFT predicts that there would be a more substantial reduction (-41%) in the number of
22 years with good (lower) juvenile stranding risk under A5_LLT relative to Existing Conditions.

23 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
24 Alternative 1A, Impact AQUA-95, which indicates that temperatures would generally not be affected
25 by Alternative 1A relative to Existing Conditions.

26 Overall in the Sacramento River, Alternative 5 would have negligible effects on water temperature,
27 but would result in substantial increased risk of juvenile stranding (-41%) and moderate reductions
28 in minimum flows in drier water years (to -25%) when effects of flow reductions have the greatest
29 potential to affect rearing conditions.

30 **Clear Creek**

31 Flows in Clear Creek during the year-round rearing period under A5_LLT would generally be similar
32 to or greater than flows under Existing Conditions, except for critical years in August through
33 October in which flows would be 7% to 28% lower and in below normal years in October when
34 flows would be 6% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 No water temperature modeling was conducted in Clear Creek.

36 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and
37 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile
38 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream
39 flows affecting juvenile rearing habitat are shown in Table 11-5-38. Results indicate that Alternative
40 5 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to
41 Existing Conditions in all water years except for that they would be 8% lower in critical water years.

1 These results indicate that the effects of Alternative 5 on flows consist primarily of negligible or
2 beneficial effects (increases in mean monthly flow to 54%) with only infrequent, small to moderate
3 flow reductions (-6% to -28%) that would not have biologically meaningful effects on juvenile
4 rearing habitat in Clear Creek.

5 ***Feather River***

6 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and
7 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 5 relative to Existing
8 Conditions in the low-flow channel during the year-round steelhead juvenile rearing period
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at
10 Thermalito Afterbay), flows under A5_LLTP would be mostly lower (up to 45% lower) during
11 January, May, November and December, mostly similar to or higher (up to 86% higher) in February,
12 March, April, June, July, and October, and mixed with some water years higher and some lower in
13 August and September.

14 Water temperatures in the Feather River under Alternative 5 would be the same as those under
15 Alternative 1A, Impact AQUA-95, which indicate that temperatures would increase under
16 Alternative 1A during the year-round period relative to Existing Conditions.

17 Overall in the Feather River, Alternative 5 would have negligible effects on juvenile rearing
18 conditions in the low-flow channel based on results of effects on water temperatures and mean
19 monthly flows. In the high-flow channel, Alternative 5 would have beneficial effects on rearing
20 conditions through increases in flow for March through July and October (ranging from 5% to
21 141%). However, Alternative 5 would cause substantial decreases in mean monthly flow (to -59%),
22 in January, February, August, September, November, and December, and particularly in drier water
23 years for July through December when effects of flow reductions would be most critical for rearing
24 conditions. Alternative 5 would cause an increase water temperatures in the high-flow channel
25 Feather River.

26 ***American River***

27 Flows in the American River at the confluence with the Sacramento River were examined for the
28 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
29 Analysis*). Flows under A5_LLTP would be generally lower than flows under Existing Conditions (up to
30 61% lower) in May through December (although there are individual water years with high flows in
31 May and June), generally higher flows in February and March (up to 27% higher), and mixed higher
32 and lower flows depending on water year in January and April

33 Water temperatures in the American River under Alternative 5 would be the same as those under
34 Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under
35 Alternative 1A during the year-round period relative to Existing Conditions.

36 Overall in the American River, Alternative 5 would cause substantial flow reductions (to -61%) for
37 much of the year (depending on water year type), including various months throughout the year in
38 drier water years and the warmer summer months in all water years. Increases in flow (to 27%)
39 during January to March in wetter years would have a small beneficial effect but would not offset the
40 prevalence of reductions in flow predicted for other months and water year types. It is also
41 predicted that Alternative 5 would result in flows less than 1,500 cfs for occurrences (June in critical

1 years, August in dry years, September in below normal and dry years) which has been identified as a
2 critical threshold for availability of riffle habitat.

3 **Stanislaus River**

4 Flows in the Stanislaus River for Alternative 5 are generally lower than Existing Conditions in most
5 water years in all months except that they are higher in above normal years in January, in wet years
6 in March and June and in below normal years in December.

7 Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under
8 Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under
9 Alternative 1A during most of the year-round period relative to Existing Conditions.

10 **San Joaquin River**

11 Flows in the San Joaquin River for Alternative 5 are generally lower than Existing Conditions in most
12 water years in all months except that they are higher in above normal years in January and in wet
13 years in January, February and March (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
14 *Analysis*).

15 Water temperature modeling was not conducted in the San Joaquin River.

16 **Mokelumne River**

17 Flows in the Mokelumne River for Alternative 5 are generally lower than Existing Conditions in all
18 months and all water years except that they are similar in March, and generally higher in January
19 and February (up to 18% higher depending on water year) (Appendix 11C, *CALSIM II Model Results*
20 *utilized in the Fish Analysis*).

21 Water temperature modeling was not conducted in the Mokelumne River.

22 **Summary of CEQA Conclusion**

23 Collectively, these results indicate the impact would be significant because it has the potential to
24 substantially reduce rearing habitat and substantially reduce the number of fish as a result of fry
25 and juvenile mortality. Effects of Alternative 5 on flow would have biologically meaningful effects on
26 fry and juvenile steelhead rearing habitats in the Sacramento, Feather American, Stanislaus, San
27 Joaquin, and Mokelumne Rivers through flow reductions prevalent for much of the rearing period
28 and particularly during drier water year types and in the warmer summer and early fall months.
29 Effects of Alternative 5 on flows in Clear Creek would not be as negative. Alternative 5 would also
30 have substantial effects on stranding risk based on SacEFT metrics (decrease in years classified as
31 "good" in terms of stranding risk of -41%).

32 This impact is a result of the specific reservoir operations and resulting flows associated with this
33 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
34 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
35 change the alternative, thereby making it a different alternative than that which has been modeled
36 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
37 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
38 severity of impact though not necessarily to a less-than-significant level.

1 **Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional**
2 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**
3 **Reduce Impacts to Rearing Habitat**

4 Although analysis conducted as part of the EIR/EIS determined that Alternative 5 would have
5 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the
6 best available scientific information at the time and may prove to have been overstated. Upon
7 the commencement of operations of CM1 and continuing through the life of the permit, the
8 BDCP proponents will monitor effects on rearing habitat in order to determine whether such
9 effects would be as extensive as concluded at the time of preparation of this document and to
10 determine any potentially feasible means of reducing the severity of such effects. This mitigation
11 measure requires a series of actions to accomplish these purposes, consistent with the
12 operational framework for Alternative 5.

13 The development and implementation of any mitigation actions shall be focused on those
14 incremental effects attributable to implementation of Alternative 5 operations only.
15 Development of mitigation actions for the incremental impact on spawning habitat attributable
16 to climate change/sea level rise are not required because these changed conditions would occur
17 with or without implementation of Alternative 5.

18 **Mitigation Measure AQUA-95b: Conduct Additional Evaluation and Modeling of Impacts**
19 **on Steelhead Rearing Habitat Following Initial Operations of CM1**

20 Following commencement of initial operations of CM1 and continuing through the life of the
21 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
22 modified operations could reduce impacts to rearing habitat under Alternative 5. The analysis
23 required under this measure may be conducted as a part of the Adaptive Management and
24 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

25 **Mitigation Measure AQUA-95c: Consult with NMFS, USFWS, and CDFW to Identify and**
26 **Implement Potentially Feasible Means to Minimize Effects on Steelhead Rearing Habitat**
27 **Consistent with CM1**

28 In order to determine the feasibility of reducing the effects of CM1 operations on steelhead
29 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
30 Wildlife to identify and implement any feasible operational means to minimize effects on rearing
31 habitat. Any such action will be developed in conjunction with the ongoing monitoring and
32 evaluation of habitat conditions required by Mitigation Measure AQUA-95a.

33 If feasible means are identified to reduce impacts on spawning habitat consistent with the
34 overall operational framework of Alternative 5 without causing new significant adverse impacts
35 on other covered species, such means shall be implemented. If sufficient operational flexibility
36 to reduce effects on steelhead habitat is not feasible under Alternative 5 operations, achieving
37 further impact reduction pursuant to this mitigation measure would not be feasible under this
38 Alternative, and the impact on steelhead would remain significant and unavoidable.

1 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

2 **Upstream of the Delta**

3 In general, the effects of Alternative 5 on steelhead migration conditions relative to the NAA are
4 uncertain.

5 ***Sacramento River***

6 *Juveniles*

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
8 May juvenile steelhead migration period. Flows under A5_LLTP would be higher than NAA in some
9 water years in October (up to 13% higher), 8% to 21% lower than flows under NAA during
10 November depending on water year type, lower and higher in individual water years in December
11 and January, higher in most water years (up to 11% higher) in May and generally similar in
12 February, March and April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
14 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
15 during the periods evaluated relative to NAA.

16 *Adults*

17 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
18 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in
19 the Fish Analysis*). Flows under A5_LLTP would be higher than NAA in wet and critical water years
20 (6% and 23%, respectively) and lower in below normal water years (15% lower) in September,
21 higher than NAA in some water years in October (up to 13% higher), 8% to 21% lower than flows
22 under NAA during November depending on water year type, lower and higher in individual water
23 years in December and January, and generally similar in February and March.

24 *Kelts*

25 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
26 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the
27 Fish Analysis*). Flows during these two months would be minimally different between NAA and
28 A5_LLTP with lower flows in dry years (5% lower) and higher flows in critical years (6% higher) in
29 March and somewhat higher flows in above normal (5%) and below normal (6%) years in April.

30 Overall in the Sacramento River, Alternative 5 would not have biologically meaningful effects on
31 juvenile, adult, or kelt steelhead migration based on mean monthly flows and water temperatures.

32 ***Clear Creek***

33 Water temperatures were not modeled in Clear Creek.

34 *Juveniles*

35 Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period
36 under A5_LLTP would generally be similar to or greater than flows under NAA except in below

1 normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
2 *Analysis*).

3 **Adults**

4 Flows in Clear Creek during the September through March adult steelhead migration period under
5 A5_LLT would generally be similar to or greater than flows under NAA except in below normal years
6 in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 **Kelts**

8 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
9 under A5_LLT would generally be similar to flows under NAA except in below normal years in
10 March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 Overall, these results indicate that juvenile, adult, or kelt steelhead migration conditions in Clear
12 Creek would not be affected by Alternative 5.

13 **Feather River**

14 Water temperatures in the Feather River under Alternative 5 would be the same as those under
15 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
16 during the periods evaluated relative to NAA.

17 **Juveniles**

18 Flows in the Feather River at the confluence with the Sacramento River were examined during the
19 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
20 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be similar to or greater than flows
21 under NAA in all months and water years except during November in above normal years (6%
22 lower).

23 **Adults**

24 Flows in the Feather River at the confluence with the Sacramento River were examined during the
25 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
26 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be up to 47% lower than
27 flows under NAA during September, up to 39% higher than flows under NAA during October, and
28 generally similar to flows under NAA in the remaining five months of the period.

29 **Kelts**

30 Flows in the Feather River at the confluence with the Sacramento River were examined during the
31 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
32 *Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to those under NAA in
33 March and up to 12% greater than flows under NAA in April.

34 Overall, these results indicate that there would be negligible effects of Alternative 5 on steelhead
35 juvenile, adult, and kelt migration conditions. There would be some flow-based beneficial effects in
36 some months.

1 **American River**

2 Water temperatures in the American River under Alternative 5 would be the same as those under
3 Alternative 1A, which indicates that temperatures would not be different between NAA and
4 Alternative 1A during the periods evaluated.

5 *Juveniles*

6 Flows in the American River at the confluence with the Sacramento River were evaluated during the
7 October through May juvenile steelhead migration period. Flows under A5_LLTP would generally be
8 similar to flows under NAA except in wet, above normal and critical water years during October
9 (10%, 15% and 12% lower, respectively), above normal and below normal water years during
10 November (9% lower for each), and dry water years during January (8% lower) (Appendix 11C,
11 *CALSIM II Model Results utilized in the Fish Analysis*).

12 *Adults*

13 Flows in the American River at the confluence with the Sacramento River were evaluated during the
14 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*). Flows under A5_LLTP would generally be similar to flows
16 under NAA except in wet and below normal years during September (8% and 16% lower,
17 respectively), in wet, above normal and critical water years during October (10%, 15% and 12%
18 lower, respectively), above normal and below normal water years during November (9% lower for
19 each), and dry water years during January (8% lower).

20 *Kelts*

21 Flows in the American River at the confluence with the Sacramento River were evaluated for the
22 March and April kelt migration period. Flows under A5_LLTP would generally be similar to flows
23 under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

24 Overall in the American River, Alternative 5 would have negligible effects on water temperatures
25 and effects on flow consist of negligible effects (<5%), increases in flow (to 33%) that would have a
26 beneficial effect on migration conditions, or infrequent and small-magnitude decreases in flow that
27 would not have biologically meaningful effects on juvenile, adult, or kelt steelhead migration in the
28 American River.

29 **Stanislaus River**

30 Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under
31 Alternative 1A, which indicates that temperatures would not be different between NAA and
32 Alternative 1A during the periods evaluated.

33 *Juveniles*

34 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the
35 October through May juvenile steelhead migration period. Flows under A5_LLTP would be similar to
36 flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
37 *Analysis*).

1 **Adults**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the
3 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
4 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar flows under NAA
5 during the entire period.

6 **Kelts**

7 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
8 March and April kelt migration period. Flows under A5_LLT would be similar to under NAA for both
9 months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 **San Joaquin River**

11 Water temperature modeling was not conducted in the San Joaquin River.

12 **Juveniles**

13 Flows in the San Joaquin River at Vernalis were evaluated during the October through May juvenile
14 steelhead migration period. Flows under A5_LLT would be similar to flows under NAA during the
15 entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16 **Adults**

17 Flows in the San Joaquin River at Vernalis were evaluated during the September through March
18 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
19 *Fish Analysis*). Flows under A5_LLT would be similar flows under NAA during the entire period.

20 **Kelts**

21 Flows in the San Joaquin River at Vernalis were evaluated for the March and April kelt migration
22 period. Flows under A5_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM*
23 *II Model Results utilized in the Fish Analysis*).

24 **Mokelumne River**

25 Water temperature modeling was not conducted in the Mokelumne River.

26 **Juveniles**

27 Flows in the Mokelumne River were evaluated during the October through May juvenile steelhead
28 migration period. Flows under A5_LLT would be similar to flows under NAA during the entire period
29 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

30 **Adults**

31 Flows in the Mokelumne River were evaluated during the September through March steelhead adult
32 upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
33 Flows under A5_LLT would be similar flows under NAA during the entire period.

1 *Kelts*

2 Flows in the Mokelumne River were evaluated for the March and April kelt migration period. Flows
3 under A5_LLTT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model*
4 *Results utilized in the Fish Analysis*).

5 **Through-Delta**

6 ***Sacramento River***

7 *Juveniles*

8 Based on DPM results for winter-run Chinook salmon (migration period November to May) (Impact
9 AQUA-42), survival of migrating juvenile steelhead under Alternative 5 would be expected to be
10 similar to baseline (Table 11-5-14).

11 The new north Delta intake structure of Alternative 5 would increase potential predation loss of
12 migrating juvenile salmonids and would displace 3.8 acres of aquatic habitat. Losses of juvenile
13 winter-run Chinook salmon were estimated ranging from 2% to 4% of juveniles reaching the Delta
14 (Impact AQUA-42 for Alternative 5). However, juvenile steelhead would be less vulnerable than
15 winter-run Chinook salmon to predation associated with the intake facilities because of their greater
16 size and strong swimming ability.

17 *Adults*

18 As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin
19 water at Collinsville under Alternative 5 was within 6% of proportions for NAA during the
20 September-March steelhead upstream migration period (Table 11-5-15). For a discussion of the
21 topic see the analysis for Alternative 1A.

22 Alternative 5 would not have an adverse effect on adult and kelt steelhead migration through the
23 Delta.

24 ***San Joaquin River***

25 *Juveniles*

26 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of
27 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.
28 There no flow changes associated with the Alternatives. Alternative 5 would have no effect on
29 steelhead migration success through the Delta.

30 *Adults*

31 The percentage of water at Collinsville that originated from the San Joaquin River during the fall-run
32 migration period (September to December) is small, typically 0.1% to less than 3% under NAA.
33 Alternative 1A operations conditions would incrementally increase olfactory cues associated with
34 the San Joaquin River, which would benefit adult steelhead migrating to the San Joaquin River. For a
35 discussion of the topic see the analysis for Alternative 1A.

1 **NEPA Effects:** Upstream of the Delta, these results indicate the effect of Alternative 5 would not be
2 adverse, because it would not substantially reduce the amount of suitable habitat or substantially
3 interfere with the movement of steelhead. The upstream effects would range from negligible effects
4 on water temperature, and negligible effects (<5%) on flow, substantial increases in flow (to 47%)
5 that would have beneficial effects on migration conditions, isolated occurrences of small to modest
6 decreases (to -17%) that would not have biologically meaningful effects on migration conditions,
7 and more substantial decreases in mean monthly flow in the Feather River (to -61%) that would
8 only occur during September (the start of the adult migration period) in some water years and
9 would not be prevalent enough to have biologically meaningful effects on adult migration
10 conditions. There would be no effects of Alternative 5 on water temperatures in any river evaluate.

11 Near-field effects of Alternative 5 NDD on Sacramento River steelhead related to impingement and
12 predation associated with three new intake structures could result in negative effects on juvenile
13 migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected
14 that the level of near-field impacts would be directly correlated to the number of new intake
15 structures in the river and thus the level of impacts associated with 1 new intake would be
16 considerably lower than those expected from having 5 new intakes in the river. Estimates within the
17 effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~
18 4% mortality above current baseline levels). CM15 would be implemented with the intent of
19 providing localized and temporary reductions in predation pressure at the NDD. Additionally,
20 several pre-construction surveys to better understand how to minimize losses associated with the 1
21 new intake structure will be implemented as part of the final NDD screen design effort. Alternative 5
22 also includes an Adaptive Management Program and Real-Time Operational Decision-Making
23 Process to evaluate and make limited adjustments intended to provide adequate migration
24 conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere
25 in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the
26 NDD remains highly uncertain.

27 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
28 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
29 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 5
30 predict improvements in smolt condition and survival associated with increased access to the Yolo
31 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
32 of each of these factors and how they might interact and/or offset each other in affecting salmonid
33 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

34 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
35 all of these elements of BDCP operations and conservation measures to predict smolt migration
36 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
37 migration survival under Alternative 5 would be similar to those estimated for NAA. Further
38 refinement and testing of the DPM, along with several ongoing and planned studies related to
39 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
40 future. These efforts are expected to improve our understanding of the relationships and
41 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
42 around the potential effects of BDCP implementation on migration conditions for steelhead.
43 However, until these efforts are completed and their results are fully analyzed, the overall
44 cumulative effect of Alternative 5 on steelhead migration remains uncertain.

1 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of
2 migration habitat for steelhead would not be affected relative to the CEQA baseline.

3 **Upstream of the Delta**

4 ***Sacramento River***

5 Water temperatures in the Sacramento River under Alternative 5 would be the same as those under
6 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A from
7 Existing Conditions during the periods evaluated.

8 *Juveniles*

9 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
10 May juvenile steelhead migration period. Flows under A5_LLT would be up to 10%, 9% and 18%
11 lower than flows under Existing Conditions during individual water years during November,
12 December and May, respectively, but would not differ between model scenarios for the remaining
13 seven months of the migration period except for somewhat higher flows in individual water years in
14 October, January, February and March (up to 22% higher) (Appendix 11C, *CALSIM II Model Results*
15 *utilized in the Fish Analysis*).

16 *Adults*

17 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
18 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*
19 *the Fish Analysis*). Flows under A5_LLT would be variable compared to Existing Conditions in
20 September with higher flows in wet and above normal water years (43% and 64%, respectively)
21 and lower flows in below normal and dry water years (12% and 24%, respectively). Flows under
22 A5_LLT would be up to 10%, 9% and 18% lower than flows under Existing Conditions during
23 individual water years during November, December and May, respectively, but would not differ
24 between model scenarios for the remaining seven months of the migration period except for
25 somewhat higher flows in individual water years in October, January, February and March (up to
26 22% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

27 *Kelts*

28 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
29 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
30 *Fish Analysis*). Flows under A5_LLT would generally be similar to those under Existing Conditions
31 except in below normal water years during March (10% lower). Overall in the Sacramento River,
32 these results indicate that there would be no biologically meaningful impacts of Alternative 5 on
33 juvenile, adult, and kelt migration.

34 ***Clear Creek***

35 Water temperatures were not modeled in Clear Creek.

36 *Juveniles*

37 Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period
38 under A5_LLT would generally be similar to or greater than flows under Existing Conditions (up to

1 54% greater) except in below normal and critical years during October (6% and 7% lower,
2 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 **Adults**

4 Flows in Clear Creek during the September through March adult steelhead migration period under
5 A5_LLT would generally be similar to flows under Existing Conditions (up to 54% greater) except in
6 critical years during September (28% lower) and October (6% lower) (Appendix 11C, *CALSIM II*
7 *Model Results utilized in the Fish Analysis*).

8 **Kelt**

9 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
10 under A5_LLT would generally be similar to or greater than flows under Existing Conditions (up to
11 29% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Overall in Clear Creek, Alternative 5 would have primarily negligible effects (<5%) on flows or
13 would cause increases in mean monthly flow that would be beneficial for migration conditions (to
14 54%).

15 **Feather River**

16 Water temperatures in the Feather River under Alternative 5 would be the same as those under
17 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
18 during the periods evaluated relative to Existing Conditions.

19 **Juveniles**

20 Flows in the Feather River at the confluence with the Sacramento River were examined during the
21 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
22 *utilized in the Fish Analysis*). Flows under A5_LLT would be generally lower than flows under
23 Existing Conditions during November and May (up to 28% lower), higher flows during October (up
24 to 39% higher), similar or greater flows in January, February, March, and April and mixed flows
25 during December with lower flows in wet and critical water years (11% and 14%, respectively) and
26 greater in above normal, below normal and dry water years (8%, 11% and 6%, respectively).

27 **Adults**

28 Flows in the Feather River at the confluence with the Sacramento River were examined during the
29 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
30 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would be generally lower than flows
31 under Existing Conditions during November May (up to 21% lower), higher flows during October
32 (up to 39% higher), similar or greater flows in January, February, and March, and mixed flows
33 during December with lower flows in wet and critical water years (11% and 14%, respectively) and
34 greater in above normal, below normal and dry water years (8%, 11% and 6%, respectively).

35 **Kelt**

36 Flows in the Feather River at the confluence with the Sacramento River were examined during the
37 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
38 *Results utilized in the Fish Analysis*). Flows under A5_LLT would be similar to or up to 15% greater

1 than flows under Existing Conditions except in below normal water years during March (18%
2 lower).

3 Overall, these results indicate that migration conditions for steelhead in the Feather River would be
4 degraded by Alternative 5. Although flows would be mostly similar between Existing Conditions and
5 Alternative 5, water temperatures would be greater under Alternative 5 that would have biologically
6 meaningful effects on steelhead migration conditions.

7 ***American River***

8 Water temperatures in the Feather River under Alternative 5 would be the same as those under
9 Alternative 1A, which indicates that temperatures would higher under Alternative 1A during
10 substantial portions of the juvenile and adult migration periods relative to Existing Conditions.

11 *Juveniles*

12 Flows in the American River at the confluence with the Sacramento River were evaluated during the
13 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
14 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be up to 27% greater than flows
15 under Existing Conditions during February and March. Flows under A5_LLT would generally be up
16 to 34% lower than flows under Existing Conditions during October through December, April and
17 May. Flows would generally be higher than those under Existing Conditions during February and
18 March.

19 *Adults*

20 Flows in the American River at the confluence with the Sacramento River were evaluated during the
21 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
22 *Model Results utilized in the Fish Analysis*). Flows under A5_LLT would generally be up to 27%
23 greater than flows under Existing Conditions during February and March. Flows under A5_LLT
24 would generally be up to 48% lower than flows under Existing Conditions during September
25 through December. Flows would generally be higher than those under Existing Conditions during
26 February and March.

27 *Kelt*

28 Flows in the American River at the confluence with the Sacramento River were evaluated for the
29 March and April kelt migration period. Flows under A5_LLT would generally be up to 14% greater
30 than flows under Existing Conditions during March and lower than flows under Existing Conditions
31 in above normal and below normal water year during April and higher than Existing Conditions in
32 critical water years in April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 Overall, these results indicate that Alternative 5 would reduce juvenile and adult migration
34 conditions during a portion of their respective migration periods, but not kelt migration.

35 ***Stanislaus River***

36 Water temperatures in the Stanislaus River under Alternative 5 would be the same as those under
37 Alternative 1A, which indicates that temperatures would be higher under Alternative 1A during
38 substantial portions of the periods evaluated relative to Existing Conditions.

1 Flows in the Stanislaus River for Alternative 5 are substantially below those under Existing
2 Conditions for juveniles, adults or kelts (e.g., 29% lower in wet water years during September).

3 ***San Joaquin River***

4 Flows in the San Joaquin River for Alternative 5 are substantially below those under Existing
5 Conditions for juveniles, adults or kelts (e.g., 16% lower in below normal years during March and
6 38% lower in wet years during May) except for similar flow conditions in November and December
7 and somewhat higher flow conditions in some water years for January (up to 10% higher).

8 Water temperature modeling was not conducted in the San Joaquin River.

9 ***Mokelumne River***

10 Flows in the Mokelumne River for Alternative 5 are substantially below those under Existing
11 Conditions for juveniles, adults or kelts (e.g., 14% lower in below normal years during April) except
12 for somewhat higher flow conditions in some water years for January and February (up to 18%
13 higher) and generally higher flows for all water years in December (up to 15% higher).

14 Water temperature modeling was not conducted in the Mokelumne River.

15 **Through-Delta**

16 ***Sacramento River***

17 *Juveniles*

18 During the juvenile steelhead emigration period (October through May), mean monthly flows in the
19 Sacramento River below the north Delta intake would be reduced (6% to 20% lower) under
20 Alternative 5 compared to Existing Conditions. Based on DPM results for winter-run Chinook
21 salmon (migration period November to May) (Impact AQUA-42), survival of migrating juvenile
22 steelhead under Alternative 5 would be expected to be similar to baseline (Table 11-5-14). As
23 discussed above in Impact AQUA-42, potential predation loss at the new north Delta intake would be
24 2% to 4% for migrating juvenile winter-run Chinook salmon, but this would be even lower for
25 juvenile steelhead because of their greater size and strong swimming ability. The impact to juvenile
26 steelhead migration through the Delta would be less than significant, and no mitigation would be
27 required.

28 *Adults*

29 As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River-origin
30 water at Collinsville under Alternative 5 was within 6% of proportions for Existing Conditions
31 during the September-March steelhead upstream migration period (Table 11-5-15).

32 ***San Joaquin River***

33 The percentage of water at Collinsville that originated from the San Joaquin River during the
34 fall-run migration period (September to December) is small, typically 0.1% to less than 3%
35 under NAA. Alternative 1A operations conditions would incrementally increase olfactory cues
36 associated with the San Joaquin River, which would benefit adult steelhead migrating to the San
37 Joaquin River. For a discussion of the topic see the analysis for Alternative 1A.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-96 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce migration conditions, contrary to the NEPA conclusion set
5 forth above. Alternative 5 would have biologically meaningful effects on juvenile and adult steelhead
6 migration conditions in the Feather, American, Stanislaus, San Joaquin, and Mokelumne Rivers).
7 Alternative 5 would not have biologically meaningful effects on migration conditions in the
8 Sacramento and Feather Rivers or in Clear Creek. There would be no effects of Alternative 5 on in-
9 Delta migration conditions, including through-Delta juvenile survival and adult olfactory cues.

10 These results are primarily caused by four factors: differences in sea level rise, differences in climate
11 change, future water demands, and implementation of the alternative. The analysis described above
12 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
13 alternative from those of sea level rise, climate change and future water demands using the model
14 simulation results presented in this chapter. However, the increment of change attributable to the
15 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
16 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
17 implementation period, which does include future sea level rise, climate change, and water
18 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
19 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
20 effect of the alternative from those of sea level rise, climate change, and water demands.

21 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
22 term implementation period and Alternative 5 indicates that flows in the locations and during the
23 months analyzed above would generally be similar between Existing Conditions during the LLT and
24 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
25 found above would generally be due to climate change, sea level rise, and future demand, and not
26 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
27 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
28 result in a significant impact on migration habitat for steelhead. This impact is found to be less than
29 significant and no mitigation is required.

30 **Restoration Measures (CM2, CM4–CM7, and CM10)**

31 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

32 **NEPA Effects:** The potential effects of restoration construction activities under Alternative 5 would
33 be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that
34 would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-97). This would
35 include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of
36 contaminated sediments, construction-related disturbance, and predation. However, as concluded in
37 Impact AQUA-97, restoration construction activities are not expected to adversely affect steelhead.

38 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-97 for steelhead, the potential
39 impact of restoration construction activities is considered less than significant, and no mitigation
40 would be required.

1 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

2 *NEPA Effects:* The potential effects of contaminants associated with restoration measures under
3 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-98). This
4 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
5 organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be
6 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but
7 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As
8 concluded in Alternative 1A, Impact AQUA-98, contaminants associated with restoration measures
9 are not expected to adversely affect steelhead with respect to selenium, copper, ammonia and
10 pesticides. The effects of methylmercury on steelhead are uncertain.

11 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-98 for steelhead, the potential
12 impact of contaminants associated with restoration measures is considered less than significant, and
13 no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat
14 restoration (25,000 acres rather than 65,000 acres).

15 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

16 *NEPA Effects:* The effects of restored habitat conditions on steelhead would be the same as
17 described for winter-run Chinook salmon, please refer to the discussion under Alternative 5, Impact
18 AQUA-45 above. However, steelhead are assumed and/or known to occur within the Plan Area for
19 relatively short periods of time as both juveniles and adults. As noted for other salmonids, the
20 benefits of the restoration in the Plan Area include a substantial increase in tidal, floodplain, channel
21 margin, and riparian habitat, which is anticipated to provide improved habitat for occupancy and
22 appreciably greater food production for juvenile steelhead; however, because most juvenile
23 steelhead are typically migrants passing quite quickly through the Plan Area, the effect of food
24 benefits and habitat change would be limited for rearing. Additionally, steelhead also occur in the
25 Cosumnes/Mokelumne ROA and would receive the benefits of increased habitat acreage and food
26 production in this location.

27 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-99, the potential impact of restored
28 habitat conditions on steelhead is considered to be beneficial although the reduced tidal habitat
29 would proportionally reduce the benefit by approximately 60%. No mitigation would be required.

30 **Other Conservation Measures (CM12–CM19 and CM21)**

31 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

32 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

33 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

34 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

35 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

36 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

37 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

1 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

2 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**
3 **(CM21)**

4 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms
5 on steelhead are the same as those described under Alternative 1A (Impacts AQUA-100 through
6 AQUA-108). The effects would range from no effect, to not adverse, to beneficial.

7 *CEQA Conclusion:* The impacts of the nine impact mechanisms listed above would range from no
8 impact, to less than significant, to beneficial, and no mitigation is required.

9 **Sacramento Splittail**

10 **Construction and Maintenance of CM1**

11 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**
12 **Splittail**

13 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on Sacramento
14 splittail would be similar to those described for Alternative 1A (Impact AQUA-109) except that
15 Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects
16 would be proportionally less under this alternative. This would convert about 2,050 lineal feet of
17 existing shoreline habitat into intake facility structures and would require about 4.7 acres of dredge
18 and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
19 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-109,
20 environmental commitments and mitigation measures would be available to avoid and minimize
21 potential effects, and the effect would not be adverse for Sacramento splittail.

22 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-109 for Sacramento splittail, the
23 impact of the construction of water conveyance facilities on Sacramento splittail would be less than
24 significant except for construction noise associated with pile driving. Potential pile driving impacts
25 would be less than under Alternative 1A because only one intake would be constructed rather than
26 five. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
27 reduce that noise impact to less than significant.

28 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
29 **of Pile Driving and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
31 Alternative 1A.

32 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
33 **and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
35 Alternative 1A.

1 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**
2 **Splittail**

3 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
4 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-110)
5 except that only one intake would need to be maintained under Alternative 5 rather than five under
6 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-110, the effect would not be adverse
7 for Sacramento splittail.

8 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance
9 of water conveyance facilities on Sacramento splittail would be less than significant and no
10 mitigation would be required.

11 **Water Operations of CM1**

12 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

13 **Water Exports from SWP/CVP South Delta Facilities**

14 Total entrainment of juvenile splittail at the south Delta facilities (estimated from Yolo Bypass
15 inundation) averaged across all water years would be 877% greater under Alternative 5 compared
16 NAA) (Table 11-5-39). The greatest increase in total entrainment would be in above normal water
17 years (1,732%). However, this effect is related to the expected increase in overall juvenile splittail
18 abundance resulting from additional floodplain habitat in wetter years. The per capita juvenile
19 splittail entrainment averaged across all years would be relative unchanged (3% decrease) under
20 Alternative 5 compared to NAA (Table 11-5-40). Average adult entrainment would be reduced 9%
21 across all water years (Table 11-5-41). The relative impact of entrainment on the splittail population
22 would be similar or reduced under Alternative 5 relative to NAA because the per capita entrainment
23 risk would be similar to NAA. The decrease in per capita entrainment of splittail is due to reductions
24 in south Delta water exports during the main May–June entrainment period.

25 **Table 11-5-39. Juvenile Sacramento Splittail Entrainment Index^a (Yolo Bypass Days of Inundation**
26 **Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for**
27 **Alternative 5**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	8,044,574 (838%)	7,857,888 (685%)
Above Normal	635,108 (1,388%)	643,713 (1,732%)
Below Normal	20,311 (595%)	20,743 (695%)
Dry	2,912 (101%)	3,257 (128%)
Critical	1 (0%)	452 (42%)
All Years	2,647,760 (874%)	2,590,050 (700%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost, based on normalized data, estimated from Yolo Bypass Inundation Method.

1 **Table 11-5-40. Juvenile Sacramento Splittail Entrainment Index^a (per Capita Method) at the**
 2 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 5**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-351,540 (-18%)	-27,221 (-2%)
Above Normal	-19,920 (-15%)	-2,088 (-2%)
Below Normal	448 (4%)	765 (8%)
Dry	-630 (-31%)	-139 (-9%)
Critical	-515 (-39%)	-257 (-24%)
All Years	-116,454 (-21%)	-14,906 (-3%)
Shading indicates entrainment increased by 10% or more.		

^a Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

3
 4 **Table 11-5-41. Adult Sacramento Splittail Entrainment Index^a (Salvage Density Method) at the**
 5 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 5**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-370 (-9%)	-505 (-12%)
Above Normal	-548 (-11%)	-564 (-12%)
Below Normal	-441 (-13%)	-176 (-6%)
Dry	262 (-11%)	-97 (-4%)
Critical	-212 (-6%)	10 (0%)
All Years	-401 (-11%)	-323 (-9%)
Shading indicates entrainment increased by 10% or more.		

^a Estimated annual number of fish lost, based on normalized data. Average (December–March).

6
 7 ***Water Exports from SWP/CVP North Delta Intake Facilities***

8 The impact would be similar in type to Alternative 1A (with five intakes), but the degree would be
 9 less because Alternative 5 would only have one north Delta intake. Therefore, under Alternative 5
 10 there would be about an 80% reduction in impingement and predation risk associated with the
 11 north Delta facilities relative to Alternative 1A (Impact AQUA-111).

12 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

13 The effect of implementing dual conveyance for the NBA with an alternative Sacramento River
 14 intake would be the same as described under Alternative 1A (Impact AQUA-111). Screens on the
 15 Barker Slough pumping plant currently exclude fish greater than 25 mm, and the alternate intake on
 16 the Sacramento River would be screened to effectively exclude splittail greater than 10 mm in length
 17 (detailed in *BDCP Effects Analysis – Appendix 5.8, Entrainment, Section 6.2.4.2*).

1 **Predation Associated with Entrainment**

2 Under Alternative 5, per capita juvenile splittail entrainment and associated predation losses at the
3 south Delta would be fairly similar (3% decreased) to NAA.

4 Predation at the north Delta would increase due to the construction of the proposed water export
5 facilities on the Sacramento River, as described for Alternative 1A (Impact AQUA-111). Potential
6 predation at the north Delta would be partially offset by reduced predation loss at the SWP/CVP
7 south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions
8 (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that predation was
9 not a factor currently limiting splittail abundance.

10 **NEPA Effects:** In conclusion, under Alternative 5 the effect of entrainment risk on the splittail
11 population would not be adverse, because per capita entrainment would be similar for juveniles and
12 reduced for adults compared to NAA. Additionally, the effect of predation loss, particularly at the
13 north Delta intake, would have no effect on the splittail population since it is relatively minor
14 compared to the magnitude of south Delta entrainment loss and would be offset by increased
15 production of juveniles due to *CM2 Yolo Bypass Fisheries Enhancement*.

16 **CEQA Conclusion:** Under Alternative 5 total juvenile entrainment (based on Yolo Bypass
17 inundation) would be 838% greater averaged across all years compared to Existing Conditions.
18 However, operational activities associated with reduced south Delta water exports would result in
19 an overall decrease in the proportion of splittail population entrained for all water year types. At the
20 south Delta facilities, estimated per capita juvenile entrainment would be reduced by 21% (116,000
21 juveniles) and adult entrainment would be reduced 11% (400 adults) relative to Existing
22 Conditions. Entrainment and hence pre-screen predation loss at the south Delta facilities would be
23 reduced. Entrainment of splittail would also be reduced at the NBA. The impact and conclusion for
24 predation associated with entrainment would be the same as described above.

25 In conclusion, the impact from entrainment and associated predation loss under Alternative 5 would
26 be less than significant, because of improvements in overall entrainment and the increased
27 production of juvenile splittail from CM2 actions. No mitigation would be required.

28 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
29 **Sacramento Splittail**

30 In general, Alternative 5 would have beneficial effects on splittail spawning habitat relative to NAA
31 due to substantial increases in the quantity and quality of suitable spawning habitat in the Yolo
32 Bypass. There would also be beneficial effects on channel margin and side-channel spawning habitat
33 due to small to moderate increases in mean monthly flow in the Sacramento River and the Feather
34 River for a portion of the spawning period.

35 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream
36 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning
37 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not
38 inundated, spawning in side channels and channel margins would be much more critical.

39 **Floodplain Habitat**

40 Effects of Alternative 5 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased
41 flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the

1 Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects
 2 in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m
 3 threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored
 4 because flow velocity was generally very low throughout the modeled area for most conditions, with
 5 generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a
 6 reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

7 The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo
 8 Bypass inundation events compared to NAA; the changes are attributable to the influence of the
 9 Fremont Weir notch at lower flows. Only the inundation events lasting more than 30 days are
 10 considered biologically beneficial to splittail, so are the focus of the analyses provided here. For the
 11 drier type years (below normal, dry, and critical), Alternative 5 results in an increase in frequency of
 12 inundation events greater than 30 days compared to NAA (Table 11-5-42). For below normal years,
 13 Alternative 5 would result in occurrence of one inundation event ≥ 70 days, compared to zero such
 14 events for NAA; and one inundation event of 30–49 days, compared to zero such events for NAA in
 15 critical years. For dry and critical years, project-related increases are for 30–49 day duration events
 16 only as there are no events of longer duration for either scenario. These results indicate that overall
 17 project-related effects on occurrence of various duration inundation events would be beneficial for
 18 splittail spawning by creating better spawning habitat conditions.

19 **Table 11-5-42. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**
 20 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**
 21 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
30–49 Days		
Wet	-4	-2
Above Normal	-1	-1
Below Normal	4	4
Dry	1	1
Critical	1	1
50–69 Days		
Wet	-5	-5
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0
≥ 70 Days		
Wet	8	7
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0

22

1 There would be increases in area of acreage of suitable splittail habitat in Yolo Bypass under A5_LLT
 2 ranging from 5 to 832 acres relative to NAA (Table 11-5-43). Areas under A5_LLT would be 49%,
 3 56%, and 192% greater than areas under NAA in wet, above normal, and below normal water years,
 4 respectively. There would be increases in area under A5_LLT in dry and critical years relative to
 5 NAA, but they would be minimal (7 and 5 acres, respectively). These results indicate that increases
 6 in inundated acreage in each water year type would result in increased habitat and have a beneficial
 7 effect on splittail spawning.

8 **Table 11-5-43. Change in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass under**
 9 **Alternative 5 by Water Year Type from 15 2-D and Daily CALSIM II Modeling Runs**

Water Year Type	A5_LLT	
	vs. EXISTING CONDITIONS	vs. NAA
Wet	971 (63%)	832 (49%)
Above Normal	652 (57%)	644 (56%)
Below Normal	240 (183%)	244 (192%)
Dry	7 (NA)	7 (NA)
Critical	5 (NA)	5 (NA)

NA = could not be calculated because the denominator was 0.

10

11 A potential negative effect of Alternative 5 that is not included in the modeling is reduced inundation
 12 of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. Potential effects on
 13 habitat and uncertainties in predicting the magnitude of such effects would be the same as described
 14 for Alternative 1A. These results indicate that Alternative 5 has the potential to reduce some of the
 15 habitat benefits of Yolo Bypass inundation on splittail production due to effects on Sutter Bypass
 16 inundation, but these effects have not been quantified.

17 ***Channel Margin and Side-Channel Habitat***

18 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel
 19 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,
 20 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are
 21 affected by changes in flow because greater flows cause more flooding, thereby increasing
 22 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially
 23 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are
 24 expected to be most important to the splittail population because in years of high-flows, when most
 25 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively
 26 little production.

27 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions
 28 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the
 29 Sacramento River for the time-frame February through June. These are the most important months
 30 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from
 31 the side-channel habitats during May and June if conditions become unfavorable.

32 Differences between model scenarios for monthly average flows during February through June by
 33 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather
 34 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 For the Sacramento River at Wilkins Slough, flows during February through March under A5_LLT
2 would be similar to flows under NAA. During April flows would be similar to NAA except higher in
3 critical years. May flows would be higher in critical, dry and above normal years and lower in below
4 normal and wet water years. June flows would be higher in all water years than under NAA.
5 Generally these flows result in a beneficial effect on rearing conditions. These results indicate that
6 there would be some increases in flow (up to 15%) that would have beneficial effects on splittail
7 rearing conditions in the Sacramento River.

8 Modeling indicated no differences in project-related effects on water temperature for Alternative 5
9 relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for
10 Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be
11 exceeded in the Sacramento River and would rarely be exceeded in the Feather River. Therefore,
12 effects of Alternative 5 on water temperature would not affect spawning habitat conditions for
13 Sacramento splittail.

14 ***Stranding Potential***

15 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,
16 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and
17 historical data to evaluate possible stranding effects, potential effects have been evaluated with a
18 narrative summary. Effects for Alternative 5 would be as described for Alternative 1A, which
19 concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of
20 stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits,
21 while keeping water away from other areas to reduce stranding in isolated ponds.

22 ***NEPA Effects:*** Collectively, these results indicate the effect would not be adverse because it would
23 not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a
24 result of egg mortality. Alternative 5 would result in increased spawning habitat in Yolo Bypass,
25 would have negligible effects (<5% difference), small effects that would not be biologically
26 meaningful (-10% change in mean monthly flow), and small to moderate beneficial effects
27 (increases in mean monthly flow to 15% in the Sacramento River and to 34% in the Feather River)
28 on channel margin and side-channel rearing habitats, and would have negligible effects on spawning
29 conditions based on stranding potential (flow reductions) and changes in water temperature.

30 ***CEQA Conclusion:*** In general, Alternative 5 would have beneficial effects on splittail spawning
31 habitat relative to Existing Conditions due to substantial increases in the quantity and quality of
32 suitable spawning habitat in the Yolo Bypass. There would also be beneficial effects on channel
33 margin and side-channel spawning habitat due to small to moderate increases in mean monthly flow
34 in the Sacramento River and the Feather River for a portion of the spawning period.

35 ***Floodplain Habitat***

36 Alternative 5 would result in increased acreage of suitable spawning habitat compared to Existing
37 Conditions in all water years (Table 11-5-43), with increases of between 5 and 971 acres of suitable
38 spawning habitat depending on water year type. Increased areas for wet, above normal, and below
39 normal water years are predicted to be 63%, 57%, and 183%, respectively, for Alternative 5.
40 Comparisons for dry and critical water years indicate project-related increases of 7 and 5 acres of
41 suitable spawning habitat, respectively, compared to 0 acres for Existing Conditions. These results
42 indicate that Alternative 5 would have beneficial effects on splittail habitat through increasing
43 spawning habitats by up to 183%.

Channel Margin and Side-Channel Habitat

Modeled flows were in the Sacramento River at Wilkins Slough (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for February through June splittail spawning and early life stage rearing (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Results indicate Alternative 5 would have negligible effects (<5%) during February through April, with the exception of a flow decrease (-6% during March in below normal years) and a flow increase (8% during April in critical years). Effects of Alternative 5 on flow during May and June consist primarily of increase in mean monthly flow (to 26%), except for decreases during May in below normal years (-7%), and in wet years (-17%). These results indicate that effects of Alternative 5 on flows would not have biologically meaningful effects on splittail spawning rearing conditions in the upper Sacramento River.

Flows in the Feather River at the confluence with the Sacramento River were evaluated during February through June. Flows during this period would show variable effects of Alternative 5 (A5_LL1 compared to Existing Conditions) depending on month and water year type, with primarily negligible effects (<5%) or increases in flow (to 30%) that would have beneficial effects on rearing conditions. There would be (to -18%) decreases in mean monthly flow during February and March in below normal years, decreases to -28% during May in wet and above normal years when the effects of flow reductions on rearing conditions would be less critical, and decreases during June in wet (-17%) and critical years (-9%). Flow reductions in drier water years when they would be most critical for rearing conditions would be infrequent and of small magnitude. These results indicate that effects of Alternative 5 on flow would not have biologically meaningful effects on splittail rearing conditions in the Feather River. Modeling results indicate no differences in project-related effects on water temperature for Alternative 5 relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be exceeded in the Sacramento River and rarely exceeded in the Sacramento and Feather Rivers. Therefore, impacts on spawning habitat for Sacramento splittail would not be biologically meaningful.

Stranding Potential

As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects have been evaluated with a narrative summary. Effects for Alternative 5 would be as described for Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to maximize biological benefits, while keeping water away from other areas to reduce stranding in isolated ponds.

Summary of CEQA Conclusion

Collectively, these results indicate the impact would be less than significant because it would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. No mitigation would be necessary. Alternative 5 would result in increased spawning habitat in Yolo Bypass, and would have negligible effects on spawning conditions based on stranding potential (flow reductions) and changes in water temperature. Effects of Alternative 5 on mean monthly flows would consist of negligible effects (<5% difference), beneficial effects based on increases in mean monthly flow to 30%, and infrequent small (-9%) to moderate (-28%) decreases in flow that would not have biologically meaningful effects (based on infrequent occurrence and/or

1 on the timing in wetter years when effects of flow reductions on habitat conditions would be less
2 critical) on channel margin and side-channel rearing habitats.

3 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

4 **NEPA Effects:** In general, Alternative 5 would have beneficial effects on splittail rearing habitat
5 relative to NAA based on the beneficial effects on floodplain habitat in the Yolo Bypass and channel
6 margin and side-channel habitats in the Sacramento River and the Feather River described in the
7 previous impact discussion, AQUA-112.

8 Sacramento splittail rear in floodplain and main-channel environments; the analyses of splittail
9 weighted habitat area and effects of flow conditions on channel margin and side-channel habitats
10 provided in the previous impact, Impact AQUA-112, apply to rearing as well as spawning habitat for
11 splittail. There would be increases in mean monthly flow for portions of the rearing period that
12 would be beneficial for rearing conditions in channel margin and side-channel habitat in the
13 Sacramento River (to 15%) and the Feather River (increases to 34%). Therefore, effects of
14 Alternative 5 on flow would not have adverse effects on availability of channel margin and side-
15 channel habitat for rearing in the Sacramento River and the Feather River at the confluence with the
16 Sacramento River. Increased flows into Yolo Bypass may reduce flooding and flooded rearing habitat
17 to some extent in the Sutter Bypass but would create habitat in the Yolo Bypass.

18 **CEQA Conclusion:** In general, Alternative 5 would have beneficial effects on splittail rearing habitat
19 relative to Existing Conditions, based on the beneficial effects on floodplain habitat in the Yolo
20 Bypass and channel margin and side-channel habitats in the Sacramento River and the Feather River
21 described in the previous impact discussion, AQUA-112.

22 Project effects on splittail rearing habitat are the same as described for spawning habitat in the
23 previous impact discussion, Impact AQUA-112. Effects of Alternative 5 on flow would not negatively
24 affect the availability of channel margin and side-channel habitat in the Sacramento River and the
25 Feather River at the confluence with the Sacramento River. There would be increases in mean
26 monthly flow for portions of the rearing period that would be beneficial for rearing conditions in
27 channel margin and side-channel habitat in the Sacramento River (to 26%) and the Feather River (to
28 30%). Increased flows into Yolo Bypass may reduce flooding and flooded rearing habitat to some
29 extent in the Sutter Bypass but would create habitat in the Yolo Bypass. These results indicate that
30 impact would be less than significant and no mitigation would be required.

31 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento** 32 **Splittail**

33 ***Upstream of Delta***

34 Effects of Alternative 5 on migration conditions for Sacramento splittail would be the same as
35 described above for channel margin and side-channel environments (Impact AQUA-112). As
36 concluded above, the effect would not be adverse. Effects of Alternative 5 on flow would not have
37 meaningful negative effects on the availability of channel margin and main-channel habitat, and
38 would have beneficial effects on migration conditions from increases in mean monthly flow for a
39 portion of the migration period.

1 **Through-Delta**

2 Alternative 5 would reduce OMR reverse flows during the months of juvenile splittail migration
3 through the Delta compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Therefore the effect on juvenile migration survival would be beneficial, because of the
5 improvement in OMR flow conditions under Alternative 5.

6 **NEPA Effects:** In general, effects of Alternative 5 on upstream splittail migration conditions would be
7 beneficial relative to NAA, based on occurrence of increases in mean monthly flow in the
8 Sacramento River and the Feather River for portions of the migration period, and reduced OMR
9 flows compared to NAA.

10 **CEQA Conclusion:**

11 **Upstream of Delta**

12 Effects of Alternative 5 on migration conditions for Sacramento splittail would be the same as
13 described above for channel margin and side-channel environments (Impact AQUA-112). As
14 concluded above, the impact would be less than significant and no mitigation would be necessary.
15 Effects of Alternative 5 on flow would not have meaningful negative effects on the availability of
16 channel margin and main-channel habitat, and would have beneficial effects on migration conditions
17 from increases in mean monthly flow for a portion of the migration period.

18 **Through-Delta**

19 Average OMR flows would be slightly reduced in May, particularly in below normal and dry water
20 year types, but increased relative to Existing Conditions during the other months of the juvenile
21 splittail migration through the Delta. Periods of increased reverse flows in May would remain within
22 the NMFS and USFWS BiOp requirements, thus the changes are not expected to have a significant
23 impact. Therefore the impact on splittail migration survival would be less than significant, because
24 of the overall improvement in OMR flows under Alternative 5.

25 **Summary of CEQA Conclusion**

26 In general, effects of Alternative 5 on upstream splittail migration conditions would be beneficial
27 relative to Existing Conditions, due to increased mean monthly flows in the Sacramento and Feather
28 Rivers. Although average OMR flows would be slightly reduced relative to Existing Conditions in
29 May, but increased during the other juvenile splittail migration months, through the Delta, the
30 impact on splittail migration survival would be less than significant, and no mitigation is required.

31 **Restoration Measures (CM2, CM4–CM7, and CM10)**

32 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

33 **NEPA Effects:** The potential effects of restoration construction activities under Alternative 5 would
34 be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that
35 would be restored (25,000 acres rather than 65,000 acres) (see Alternative 1A, Impact AQUA-115).
36 This would include potential effects of turbidity, exposure to methyl mercury, accidental spills,
37 disturbance of contaminated sediments, construction-related disturbance, and predation. However,
38 as concluded in Alternative 1A, Impact AQUA-115, restoration construction activities are not
39 expected to adversely affect Sacramento splittail.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-115 for Sacramento splittail, the
2 potential impact of restoration construction activities is considered less than significant, and no
3 mitigation would be required.

4 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**
5 **Sacramento Splittail**

6 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
7 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-116). This
8 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
9 organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be
10 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but
11 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As
12 concluded in Alternative 1A, Impact AQUA-116, contaminants associated with restoration measures
13 are not expected to adversely affect Sacramento splittail with respect to selenium, copper, ammonia
14 and pesticides. The effects of methylmercury on Sacramento splittail are uncertain.

15 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-116 for Sacramento splittail, the
16 potential impact of contaminants associated with restoration measures is considered less than
17 significant, and no mitigation would be required. The same conclusion applies to the reduced acres
18 of tidal habitat restoration (25,000 acres rather than 65,000 acres).

19 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

20 **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 5 would be the
21 same as those described for Alternative 1A (see Impact AQUA-117). These would include CM2 Yolo
22 Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally
23 Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural
24 Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be
25 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As
26 concluded in Impact AQUA-117 under Alternative 1A, restored tidal habitat is expected to be
27 beneficial for Sacramento splittail although the reduced acreage would reduce the benefit. The
28 present discussion considers the restored tidal habitat to be proportionally distributed across the
29 five ROAs and to provide proportionally less benefit based on the reduced acreage compared to
30 Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

31 The restored tidal habitat will provide benefits to Sacramento splittail through increased habitat
32 and improved food production especially those migrating to and from the San Joaquin River.
33 Increased food production from all ROAs that is exported into the Delta will also benefit Sacramento
34 splittail. The overall improved habitat connectivity will benefit all species including Sacramento
35 splittail.

36 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-117 for Sacramento splittail, the
37 potential impact of restored habitat conditions on Sacramento splittail is considered to be beneficial
38 although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%.
39 No mitigation would be required.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

3 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**
4 **Splittail (CM13)**

5 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**
6 **(CM14)**

7 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**
8 **(CM15)**

9 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

10 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

11 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

12 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

13 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**
14 **Splittail (CM21)**

15 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms
16 on Sacramento splittail are the same as those described under Alternative 1A (Impacts AQUA-118
17 through AQUA-126). The effects would range from no effect, to not adverse, to beneficial.

18 **CEQA Conclusion:** The impacts of the nine impact mechanisms listed above would range from no
19 impact, to less than significant, to beneficial, and no mitigation is required.

20 **Green Sturgeon**

21 **Construction and Maintenance of CM1**

22 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

23 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on green
24 sturgeon would be similar to those described for Alternative 1A (Impact AQUA-127) except that
25 Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects
26 would be proportionally less under this alternative. This would convert about 2,050 lineal feet of
27 existing shoreline habitat into intake facility structures and would require about 4.7 acres of dredge
28 and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
29 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-127,
30 environmental commitments and mitigation measures would be available to avoid and minimize
31 potential effects, and the effect would not be adverse for green sturgeon.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-127, the impact of the construction
33 of water conveyance facilities on green sturgeon would be less than significant except for
34 construction noise associated with pile driving. Potential pile driving impacts would be less than
35 Alternative 1A because only one intake would be constructed rather than five. Implementation of

1 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
2 less than significant.

3 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
4 **of Pile Driving and Other Construction-Related Underwater Noise**

5 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
6 Alternative 1A.

7 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
8 **and Other Construction-Related Underwater Noise**

9 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
10 Alternative 1A.

11 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

12 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
13 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-128)
14 except that only one intake would need to be maintained under Alternative 5 rather than five under
15 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-128, the effect would not be adverse
16 for green sturgeon.

17 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-128, the impact of the maintenance
18 of water conveyance facilities on green sturgeon would be less than significant and no mitigation
19 would be required.

20 **Water Operations of CM1**

21 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

22 **Water Exports**

23 Alternative 5 is expected to reduce overall entrainment of juvenile green sturgeon at the south Delta
24 export facilities, estimated as salvage density, by about 23–30% (34–49 fish) as compared to NAA
25 (Table 11-5-44). Like Alternative 1A (Impact AQUA-129), entrainment reductions would be greater
26 in wet and above normal years (25–31% decrease, 26–35 fish) than in below normal, dry, and critical
27 years (20–29% decrease, 8–14 fish) compared to NAA. Alternative 5 would be beneficial for juvenile
28 green sturgeon.

29 **Predation Associated with Entrainment**

30 Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to
31 entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation
32 loss, would change minimally between Alternative 5 and NAA (34 fish). The impact and conclusion
33 for predation risk associated with NPB structures and the north Delta intake would be the same as
34 described for Alternative 1A, Impact AQUA-129.

35 **NEPA Effects:** The effect on entrainment and predation losses under Alternative 5 would not be
36 adverse.

1 **CEQA Conclusion:** As described above, annual entrainment losses of juvenile green sturgeon across
 2 all water year types would decrease 33% (54 fish) under Alternative 5 (A5_LLT) relative to Existing
 3 Conditions (Table 11-5-44). Impacts of water operations on entrainment of green sturgeon would be
 4 beneficial and no mitigation would be required.

5 **Table 11-5-44. Juvenile Green Sturgeon Entrainment Index^a at the SWP and CVP Salvage**
 6 **Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 5**

Water Year Type ^b	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet and Above Normal	-38 (-33%)	-26 (-25%)
Below Normal, Dry, and Critical	-16 (-33%)	-8 (-20%)
All Years	-54 (-33%)	-34 (-23%)
Shading indicates entrainment increased by 10% or more.		

^a Estimated annual number of fish lost, based on non-normalized data.
^b Sacramento Valley water year-types.

7
 8 The impact and conclusion for predation associated with entrainment would be the same as
 9 described above. Since few juvenile green sturgeon are entrained at the south Delta, reductions in
 10 entrainment (33% reduction compared to Existing Conditions, representing 54 fish) under
 11 Alternative 5 would have little effect in affecting entrainment related predation loss. Overall, the
 12 impact would be less than significant, because there would be little change in predation loss under
 13 Alternative 5.

14 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
 15 **Green Sturgeon**

16 In general, Alternative 5 would not reduce spawning and egg incubation habitat for green sturgeon
 17 relative to NAA.

18 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
 19 Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under
 20 A5_LLT would almost always be similar to or greater than flows under NAA, except during dry years
 21 in March at Keswick (5% lower) although flows can be lower or higher in individual months of
 22 individual years. These results indicate that there would be very few reductions in flows in the
 23 Sacramento River under Alternative 5 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 24 *Analysis*).

25 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
 26 the Sacramento River during the February through June green sturgeon spawning and egg
 27 incubation period. Flows under A5_LLT would be similar to or greater than flows under NAA at both
 28 Thermalito Afterbay and the confluence with the Sacramento River except in below normal years
 29 during March at Thermalito Afterbay (11% lower). These results indicate that there would be very
 30 few reductions in flows in the Feather River under Alternative 5 independent of climate change
 31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as
2 those under Alternative 1A, Impact AQUA-130, which indicates that there would be no effect of
3 Alternative 1A on temperatures during the period evaluated relative to NAA.

4 Flows in the San Joaquin River under Alternative 5 would be the same as those under NAA
5 throughout the March through June period (Appendix 11C, *CALSIM II Model Results utilized in the*
6 *Fish Analysis*).

7 No water temperatures modeling was conducted in the San Joaquin River.

8 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
9 not have the potential to substantially reduce the amount of suitable habitat. There would be limited
10 effects of Alternative 5 on flows and water temperatures in the Sacramento and Feather rivers that
11 would not affect spawning and egg incubation conditions for green sturgeon. Further, there would
12 be no effects of Alternative 5 on flows in the San Joaquin River.

13 **CEQA Conclusion:** In general, Alternative 5 would not reduce spawning and egg incubation habitat
14 for green sturgeon relative to Existing Conditions.

15 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
16 Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows at
17 Keswick under A5_LLT would generally be similar to or greater than those under Existing
18 Conditions, except in below normal and dry years during March (18% and 7% lower, respectively),
19 above normal years during April (6% lower), wet and below normal years during May (23% and 7%
20 lower, respectively), and critical years during July (11% lower). Flows upstream of Red Bluff under
21 A5_LLT would generally be similar to or greater than those under Existing Conditions, except in
22 below normal water years during March in wet and below normal years during May, and in critical
23 years during July. Also, flows can be lower or higher in individual months of individual years. These
24 results indicate that there would be few reductions in flows in the Sacramento River under
25 Alternative 5 relative to Existing Conditions.

26 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
27 the Sacramento River during the February through June green sturgeon spawning and egg
28 incubation period. At Thermalito, flows under A5_LLT would generally be similar to or greater than
29 those under Existing Conditions, except in above normal and below normal years during February
30 (8% and 46% lower, respectively), below normal years during March (48% lower) and in wet and
31 above normal years during May (37% and 7% lower, respectively). (Appendix 11C, *CALSIM II Model*
32 *Results utilized in the Fish Analysis*). At the confluence with the Sacramento River, flows under
33 A5_LLT would generally be similar to or greater than flows under Existing Conditions, except in
34 below normal years during February and March (12% and 18% lower, respectively), in wet and
35 above normal years during May (28% and 14% lower, respectively), and in wet and critical years
36 during June (17% and 9% lower, respectively). These results indicate that there would be
37 reductions in flows in the Feather River under Alternative 5 relative to Existing Conditions.

38 Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as
39 those under Alternative 1A, Impact AQUA-130, which indicates that temperatures would be higher
40 in both rivers under Alternative 1A during the periods evaluated.

41 Flows in the San Joaquin River at Vernalis under Alternative 5 would be similar to those under
42 Existing Conditions throughout the March through June spawning and egg incubation period for

1 green sturgeon, except during June, in which there would be a 30% flow reduction under Alternative
2 5 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 **Summary of CEQA Conclusion**

4 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between
5 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
6 alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the
7 NEPA conclusion set forth above. Flows in the Feather River at the confluence with the Sacramento
8 River would be moderately lower under Alternative 5 relative to Existing Conditions. Further, water
9 temperature-related impacts would be greater in the Sacramento and Feather Rivers, which could
10 lead to reduced hatching success and egg mortality.

11 These results are primarily caused by four factors: differences in sea level rise, differences in climate
12 change, future water demands, and implementation of the alternative. The analysis described above
13 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
14 alternative from those of sea level rise, climate change and future water demands using the model
15 simulation results presented in this chapter. However, the increment of change attributable to the
16 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
17 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
18 implementation period, which does include future sea level rise, climate change, and water
19 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
20 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
21 effect of the alternative from those of sea level rise, climate change, and water demands.

22 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
23 term implementation period and Alternative 5 indicates that flows in the locations and during the
24 months analyzed above would generally be similar between Existing Conditions during the LLT and
25 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
26 found above would generally be due to climate change, sea level rise, and future demand, and not
27 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
28 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
29 result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is
30 found to be less than significant and no mitigation is required.

31 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

32 In general, Alternative 5 would not reduce the quantity and quality of green sturgeon larval and
33 juvenile rearing habitat relative to NAA.

34 Water temperature was used to determine the potential effects of Alternative 5 on green sturgeon
35 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
36 their habitat is more likely to be limited by changes in water temperature than flow rates.

37 Water temperatures in the Sacramento River and Feather River for Alternative 5 are not different
38 from those for Alternative 1A, Impact AQUA-131, which indicates that Alternative 1A would not
39 affect temperatures relative to NAA in either river. Water temperature modeling was not conducted
40 in the San Joaquin River.

1 **NEPA Effects:** Collectively, these results indicate that this effect would not be adverse because it
2 does not have the potential to substantially reduce the amount of suitable rearing habitat relative to
3 NAA.

4 **CEQA Conclusion:** In general, Alternative 5 would not reduce the quantity and quality of green
5 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

6 Water temperature was used to determine the potential effects of Alternative 5 on green sturgeon
7 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
8 their habitat is more likely to be limited by changes in water temperature than flow rates.

9 Water temperatures in the Sacramento River and Feather River for Alternative 5 are not different
10 from those for Alternative 1A, Impact AQUA-131, which indicates that there would be an increase in
11 temperatures in both rivers under Alternative 1A relative to Existing Conditions.

12 Water temperature modeling was not conducted in the San Joaquin River.

13 **Summary of CEQA Conclusion**

14 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between
15 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
16 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set
17 forth above. Temperatures under Alternative 5 would increase in both the Sacramento and Feather
18 Rivers relative to the CEQA baseline.

19 These results are primarily caused by four factors: differences in sea level rise, differences in climate
20 change, future water demands, and implementation of the alternative. The analysis described above
21 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
22 alternative from those of sea level rise, climate change and future water demands using the model
23 simulation results presented in this chapter. However, the increment of change attributable to the
24 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
25 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
26 implementation period, which does include future sea level rise, climate change, and water
27 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
28 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
29 effect of the alternative from those of sea level rise, climate change, and water demands.

30 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
31 term implementation period and Alternative 5 indicates that flows in the locations and during the
32 months analyzed above would generally be similar between Existing Conditions during the LLT and
33 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
34 found above would generally be due to climate change, sea level rise, and future demand, and not
35 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
36 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
37 result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than
38 significant and no mitigation is required.

1 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

2 In general, the effects of Alternative 5 on green sturgeon migration conditions relative to NAA are
3 uncertain.

4 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
5 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
6 the Sacramento River during the April through October larval migration period, the August through
7 March juvenile migration period, and the November through June adult migration period (Appendix
8 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
9 entire year, flows during all months were compared. Reduced flows could slow or inhibit
10 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
11 cues and pass impediments by adults.

12 Sacramento River flows under A5_LLT would generally be similar to or greater than flows under
13 NAA in all months except September, during which flows would be up to 21% lower depending on
14 location and water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 Larval transport flows were also examined by utilizing the positive correlation between white
16 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the
17 assumption that the mechanism responsible for the relationship is that Delta outflow provides
18 improved green sturgeon larval transport that results in improved year class strength. Results for
19 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation
20 between Delta outflow and year class strength, green sturgeon year class strength would be lower
21 under Alternative 5.

22 Feather River flows under A5_LLT would generally be lower by up to 61% than those under NAA
23 during August and September. Flows during other months under A5_LLT would generally be similar
24 to or greater than flows under NAA with some exceptions (Appendix 11C, *CALSIM II Model Results*
25 *utilized in the Fish Analysis*).

26 **NEPA Effects:** Upstream flows (above the north Delta intake) are similar between Alternative 5 and
27 NAA. However, due to the removal of water at the north Delta intake, there are substantial
28 differences in through-Delta flows between Alternative 5 and NAA (see Table 11-5-47 below).
29 Analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green
30 sturgeon, found a positive correlation between year class strength and Delta outflow during April
31 and May. However, this conclusion was reached in the absence of the north Delta intake, and the
32 exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that
33 the correlation is caused by high flows in the upper river resulting in improved migration, spawning,
34 and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation
35 is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river
36 to spawn. It is also possible that some combination of these factors are working together to produce
37 the positive correlation between high flows and sturgeon year-class strength.

38 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation
39 between year class strength and river/Delta flow will be addressed through targeted research and
40 monitoring to be conducted in the years leading up to the initiation of north Delta facilities
41 operations. If these targeted investigations determine that the primary mechanisms behind the
42 positive correlation between high flows and sturgeon year-class strength are related to upstream
43 conditions, then Alternative 5 would be deemed not adverse due to the similarities in upstream flow

1 conditions between Alternative 5 and NAA. However, if the targeted investigations lead to a
2 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and
3 through-Delta flow conditions, then Alternative 5 would be deemed adverse due to the magnitude of
4 reductions in through-Delta flow conditions in Alternative 5 as compared to NAA.

5 **CEQA Conclusion:** In general, Alternative 5 would not affect green sturgeon migration conditions
6 relative to Existing Conditions.

7 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
8 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
9 the Sacramento River during the April through October larval migration period, the August through
10 March juvenile migration period, and the November through June adult migration period (Appendix
11 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
12 entire year, flows during all months were compared. Reduced flows could slow or inhibit
13 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
14 cues and pass impediments by adults.

15 Sacramento River flows between Keswick and Wilkins Slough under A5_LLT would generally be
16 similar to or greater than flows under Existing Conditions in all months except February and
17 November. In February and November, flows under A5_LLT would be up to 14% lower than under
18 Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19 For Delta outflow, the percent of months exceeding flow thresholds under A5_LLT would be similar
20 to or up to 50% lower (relative scale) than those under Existing Conditions depending on flow
21 threshold, water year type, and month (Table 11-5-47).

22 Feather River flows between Thermalito and the confluence with the Sacramento River under
23 A5_LLT would generally be similar to or greater than flows under Existing Conditions during all
24 months except January and November. During January and November, flows under A5_LLT would
25 be up to 45% lower than under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized
26 in the Fish Analysis*).

27 **Summary of CEQA Conclusion**

28 Collectively, the results of the Impact AQUA-132 CEQA analysis indicate that the difference between
29 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
30 alternative could substantially interfere with the movement of fish, contrary to the NEPA conclusion
31 set forth above. Although there are reductions in flows in the Sacramento and Feather rivers during
32 summer and fall months under the Alternative 5 relative to the Existing Conditions, these reductions
33 are not frequent enough (two of 12 months) to have substantial effects on green sturgeon migration.
34 Exceedance of Delta outflow thresholds would be lower under Alternative 5 than under Existing
35 Conditions, although there is high uncertainty that year class strength is due to Delta outflow or if
36 both year class strength and Delta outflows are co-variable with another unknown factor.

37 These results are primarily caused by four factors: differences in sea level rise, differences in climate
38 change, future water demands, and implementation of the alternative. The analysis described above
39 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
40 alternative from those of sea level rise, climate change and future water demands using the model
41 simulation results presented in this chapter. However, the increment of change attributable to the
42 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
43 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT

1 implementation period, which does include future sea level rise, climate change, and water
2 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
3 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
4 effect of the alternative from those of sea level rise, climate change, and water demands.

5 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
6 term implementation period and Alternative 5 indicates that flows in the locations and during the
7 months analyzed above would generally be similar between Existing Conditions during the LLT and
8 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
9 found above would generally be due to climate change, sea level rise, and future demand, and not
10 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
11 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
12 result in a significant impact on migration conditions for green sturgeon. This impact is found to be
13 less than significant and no mitigation is required.

14 **Restoration Measures (CM2, CM4–CM7, and CM10)**

15 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

16 **NEPA Effects:** The potential effects of restoration construction activities under Alternative 5 would
17 be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that
18 would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-133). This would
19 include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of
20 contaminated sediments, construction-related disturbance, and predation. However, as concluded in
21 Alternative 1A, Impact AQUA-133, restoration construction activities are not expected to adversely
22 affect green sturgeon.

23 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-133 for green sturgeon, the
24 potential impact of restoration construction activities is considered less than significant, and no
25 mitigation would be required.

26 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green 27 Sturgeon**

28 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
29 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-134). This
30 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
31 organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be
32 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but
33 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As
34 concluded in Alternative 1A, Impact AQUA-134, contaminants associated with restoration measures
35 are not expected to adversely affect green sturgeon with respect to copper, ammonia and pesticides.
36 The effects of methylmercury and selenium on green sturgeon are uncertain.

37 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-134 for green sturgeon, the
38 potential impact of contaminants associated with restoration measures is considered less than
39 significant, and no mitigation would be required. The same conclusion applies to the reduced acres
40 of tidal habitat restoration (25,000 acres rather than 65,000 acres).

1 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

2 **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 5 would be the
3 same as those described for Alternative 1A (see Impact AQUA-135). These would include *CM2 Yolo*
4 *Bypass Fisheries Enhancements*, *CM4 Tidal Natural Communities Restoration*, *CM5 Seasonally*
5 *Inundated Floodplain Restoration*, *CM6, Channel Margin Enhancement*, *CM7 Riparian Natural*
6 *Community Restoration*, and *CM10 Nontidal Marsh Restoration*. Under Alternative 5 there would be
7 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As
8 concluded in Alternative 1A, Impact AQUA-135 under Alternative 1A, restored tidal habitat is
9 expected to be beneficial for delta smelt although the reduced acreage would reduce the benefit. The
10 present discussion considers the restored tidal habitat to be proportionally distributed across the
11 five ROAs and to provide proportionally less benefit based on the reduced acreage compared to
12 Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

13 The restored tidal habitat will provide benefits to green sturgeon in all ROAs except the south Delta.
14 Sturgeon foraging on marsh mudflats will benefit from the increased transfer of increased
15 production to mudflat fauna. Increased food production from all ROAs that is exported into the Delta
16 will also benefit sturgeon. The overall improved habitat connectivity will benefit all species
17 including sturgeon.

18 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-135 for green sturgeon, the
19 potential impact of restored habitat conditions on green sturgeon is considered to be beneficial
20 although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%.
21 No mitigation would be required.

22 **Other Conservation Measures (CM12–CM19 and CM21)**

23 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

24 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**
25 **(CM13)**

26 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

27 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**
28 **(CM15)**

29 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

30 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

31 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

32 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

33 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**
34 **Sturgeon (CM21)**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms
2 on green sturgeon are the same as those described under Alternative 1A (Impacts AQUA-136
3 through AQUA-144). The effects would range from no effect, to not adverse, to beneficial.

4 **CEQA Conclusion:** The impacts of the nine impact mechanisms listed above would range from no
5 impact, to less than significant, to beneficial, and no mitigation is required.

6 **White Sturgeon**

7 **Construction and Maintenance of CM1**

8 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

9 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on white
10 sturgeon would be similar to those described for Alternative 1A (Impact AQUA-145) except that
11 Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects
12 would be proportionally less under this alternative. This would convert about 2,050 lineal feet of
13 existing shoreline habitat into intake facility structures and would require about 4.7 acres of dredge
14 and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
15 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-145,
16 environmental commitments and mitigation measures would be available to avoid and minimize
17 potential effects, and the effect would not be adverse for white sturgeon.

18 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-145, the impact of the construction
19 of water conveyance facilities on white sturgeon would be less than significant except for
20 construction noise associated with pile driving. Potential pile driving impacts would be less than
21 Alternative 1A because only one intake would be constructed rather than five. Implementation of
22 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
23 less than significant.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
27 Alternative 1A.

28 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 29 **and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
31 Alternative 1A.

32 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

33 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
34 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-146)
35 except that only one intake would need to be maintained under Alternative 5 rather than five under
36 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse
37 for white sturgeon.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance
2 of water conveyance facilities on white sturgeon would be less than significant and no mitigation
3 would be required.

4 **Water Operations of CM1**

5 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

6 **Water Exports**

7 Alternative 5 is expected to reduce overall entrainment of juvenile white sturgeon at the south Delta
8 export facilities, estimated as salvage density, by 23–30% (62–91 fish) across all water year types as
9 compared to NAA (Table 11-5-45). As discussed for Alternative 1A (Impact AQUA-147), entrainment
10 is highest in wet and above normal water years. Under Alternative 5, entrainment in wet and above
11 normal water years would be reduced 24–31% (59–83 fish), compared to NAA. Therefore,
12 Alternative 5 would have beneficial effects on juvenile white sturgeon.

13 **Predation Associated with Entrainment**

14 Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to
15 entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation
16 loss, would change minimally between Alternative 5 and NAA (62 fish). The effect on predation loss
17 under Alternative 5 would not be adverse.

18 **CEQA Conclusion:** As described above, operational activities associated with water exports from
19 SWP/CVP south Delta facilities would decrease entrainment for juvenile white sturgeon by 35%
20 (117 fish) under Alternative 5 (A5_LL1) relative to Existing Conditions (Table 11-5-45). Impacts of
21 water operations on entrainment of white sturgeon would be beneficial and no mitigation would be
22 required.

23 **Table 11-5-45. Juvenile White Sturgeon Entrainment Index^a at the SWP and CVP Salvage Facilities**
24 **for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between**
25 **Model Scenarios for Alternative 5**

Water Year Type ^b	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
Wet and Above Normal	-105 (-36%)	-59 (-24%)
Below Normal, Dry, and Critical	-12 (-28%)	-4 (-13%)
All Years	-117 (-35%)	-62 (-23%)

Shading indicates entrainment increase of 10% or more.

^a Estimated annual number of fish lost, based on non-normalized data.

^b Sacramento Valley water year-types.

26
27 The impact and conclusion for predation associated with entrainment would be the same as
28 described immediately. Since few juvenile white sturgeon are entrained at the south Delta,
29 reductions in entrainment (35% reduction compared to Existing Conditions, representing 117 fish)
30 under Alternative 5 would have little effect in affecting entrainment related predation loss. Overall,

1 the impact would be less than significant, because there would be little change in predation loss
2 under Alternative 5.

3 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
4 **White Sturgeon**

5 In general, Alternative 5 would not affect spawning and egg incubation habitat for white sturgeon
6 relative to NAA.

7 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
8 May spawning and egg incubation period for white sturgeon. Flows under A5_LLT from February to
9 May would be similar to or greater than those under NAA, except at Verona in below normal years
10 during February (7% lower), below normal and dry years in March (8% and 6% lower,
11 respectively), and wet and above normal years during April (7% and 5% lower, respectively)
12 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate that
13 there would be mostly small (<10%) reductions in flows in the Sacramento River under Alternative
14 5.

15 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
16 River were examined during the February to May spawning and egg incubation period for white
17 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito
18 Afterbay under A5_LLT would be similar to or greater than flows under NAA during February to
19 May, except in below normal years during March (11%). Flows under A5_LLT at the confluence with
20 the Sacramento River would always be similar to or greater than flows under NAA. These results
21 indicate that there would be few low magnitude reductions in flows in the Feather River during the
22 white sturgeon spawning and egg incubation period under Alternative 5.

23 Flows in the San Joaquin River under Alternative 5 would not be different from those under
24 Alternative 1A, Impact AQUA-148, which indicates that flows under Alternative 1A would not differ
25 from those under NAA throughout the period evaluated.

26 Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as
27 those under Alternative 1A, Impact AQUA-148, which indicates that flows under Alternative 1A
28 would not differ from those under NAA throughout the period evaluated.

29 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
30 not have the potential to substantially reduce the amount of suitable habitat. Reductions in flows
31 under Alternative 5 are small and infrequent relative to NAA and, therefore, would not have a
32 substantial effect on the species. There would be no increases in temperatures in the Sacramento or
33 Feather rivers.

34 **CEQA Conclusion:** In general, Alternative 5 would not affect spawning and egg incubation habitat for
35 white sturgeon relative to Existing Conditions.

36 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
37 May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results*
38 *utilized in the Fish Analysis*). At Wilkins Slough, flows under A5_LLT would be similar to or greater
39 than those under Existing Conditions, except in below normal years during March (6% lower) and
40 wet and below normal years during May (17% and 7% lower, respectively). At Verona, flows under
41 A5_LLT from February to May would be generally similar to or up to 22% lower than Existing
42 Conditions, depending on month and water year type. These results indicate that there would be

1 mostly small (<12%) reductions in flows in the Sacramento River under Alternative 5 relative to
2 Existing Conditions.

3 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
4 River were examined during the February to May spawning and egg incubation period for white
5 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito
6 Afterbay from February to May under A5_LL1T would generally be similar to or greater than those
7 under Existing Conditions, except in above normal and below normal years during February (8%
8 and 46% lower, respectively), below normal years during March (48% lower), and wet and above
9 normal years during May (37% to 7% lower, respectively). Flows at the confluence with the
10 Sacramento River under A5_LL1T would generally be similar to or greater than flows under Existing
11 Conditions, except in below normal years during February and March (12% and 18% lower,
12 respectively) and wet and above normal years during May (28% and 14% lower, respectively).
13 These results indicate that there would be few reductions in flows in the Feather River under
14 Alternative 5 relative to Existing Conditions.

15 Flows in the San Joaquin River under Alternative 5 would not be different from those under
16 Alternative 1A, Impact AQUA-148, which indicates that flows would not differ between Existing
17 Conditions and Alternative 1A.

18 Water temperatures in the Sacramento and Feather rivers under Alternative 5 would be the same as
19 those under Alternative 1A, Impact AQUA-148, which indicates that there would be no effect of
20 Alternative 1A on temperatures relative to Existing Conditions.

21 **Summary of CEQA Conclusion**

22 Collectively, these results indicate that the impact would be less than significant and no mitigation is
23 necessary because Alternative 5 does not have the potential to substantially reduce the amount of
24 suitable habitat. Reductions in flows under Alternative 5 relative to Existing Conditions are small
25 and infrequent and, therefore, would not have a substantial effect on the species. There would be no
26 increases in temperatures in the Sacramento or Feather rivers.

27 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

28 In general, Alternative 5 would not affect the quantity and quality of white sturgeon larval and
29 juvenile rearing habitat relative to NAA.

30 Water temperature was used to determine the potential effects of Alternative 5 on white sturgeon
31 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
32 their habitat is more likely to be limited by changes in water temperature than flow rates.

33 Water temperatures in the Sacramento and Feather rivers under Alternative 5 would not be
34 different from those under Alternative 1A, Impact AQUA-149, which indicates that there would be
35 no effect of Alternative 1A on temperatures in either river relative to NAA.

36 Water temperatures were not modeled in the San Joaquin River.

37 **NEPA Effects:** These results indicate that the effect would not be adverse because it does not have
38 the potential to substantially reduce the amount of suitable habitat.

39 **CEQA Conclusion:** In general, Alternative 5 would not affect the quantity and quality of white
40 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

1 Water temperature was used to determine the potential effects of Alternative 5 on white sturgeon
2 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
3 their habitat is more likely to be limited by changes in water temperature than flow rates. Water
4 temperatures in the Sacramento and Feather rivers under Alternative 5 would not be different from
5 those under Alternative 1A, which indicates that there would be no effect of Alternative 1A on
6 temperatures in the Sacramento River relative to Existing Conditions, but temperatures would be
7 higher under the majority of months under Alternative 1A in the Feather River.

8 **Summary of CEQA Conclusion**

9 Collectively, the results of the Impact AQUA-149 CEQA analysis indicate that the difference between
10 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
11 alternative could substantially reduce the quality of suitable rearing habitat, contrary to the NEPA
12 conclusion set forth above. Water temperatures would be higher in the Feather River during the
13 majority of the white sturgeon rearing period.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate
15 change, future water demands, and implementation of the alternative. The analysis described above
16 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
17 alternative from those of sea level rise, climate change and future water demands using the model
18 simulation results presented in this chapter. However, the increment of change attributable to the
19 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
20 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
21 implementation period, which does include future sea level rise, climate change, and water
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
26 term implementation period and Alternative 5 indicates that flows in the locations and during the
27 months analyzed above would generally be similar between Existing Conditions during the LLT and
28 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
29 found above would generally be due to climate change, sea level rise, and future demand, and not
30 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
31 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
32 result in a significant impact on rearing habitat of white sturgeon. This impact is found to be less
33 than significant and no mitigation is required.

34 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

35 In general, the effects of Alternative 5 on white sturgeon migration conditions relative to NAA are
36 uncertain.

37 Analyses for white sturgeon focused on the Sacramento River (north Delta to RM 143—i.e., Wilkins
38 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number
39 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)
40 (Table 11-5-19). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A5_LL1T were
41 generally similar to those under NAA (Table 11-5-46). The number of months per year above 31,000
42 cfs at Verona would range from small increases to a reduction of 0.5 months (21% lower in wet

1 years) relative to NAA. Overall, there is no consistent difference between Alternative 5 and the NAA.
2 On an absolute scale, none of these values would be biologically meaningful (up to 0.2 months).

3 **Table 11-5-46. Difference and Percent Difference in Number of Months in Which Flow Rates**
4 **Exceed 17,700 and 5,300 Cubic Feet per Second (cfs) in the Sacramento River at Wilkins Slough,**
5 **and 31,000 cfs at Verona**

Water Year Types	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wilkins Slough, 17,700 cfs^a		
Wet	-0.04 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (5%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs^b		
Wet	-0.2 (-2%)	0 (1%)
Above Normal	-0.1 (-1%)	0.3 (4%)
Below Normal	0.2 (4%)	0.5 (10%)
Dry	0.6 (11%)	0.3 (5%)
Critical	0.3 (10%)	0.3 (7%)
Verona, 31,000 cfs^a		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.2 (-10%)	0 (0%)
Below Normal	-0.2 (-43%)	-0.1 (-33%)
Dry	-0.2 (-60%)	-0.1 (-50%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Months analyzed: February through May.

^b Months analyzed: November through May.

6

7 Larval transport flows were also examined by utilizing the positive correlation between year class
8 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the
9 mechanism responsible for the relationship is that Delta outflow provides improved larval transport
10 that results in improved year class strength. The percent of months exceeding flow thresholds under
11 A5_LLT would generally be lower than those under NAA (up to 33% lower) (Table 11-5-47). These
12 results indicate that, using the positive correlation between Delta outflow and year class strength,
13 year class strength would be lower under Alternative 5.

1 **Table 11-5-47. Difference and Percent Difference in the Percentage of Months in Which Average**
 2 **Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in**
 3 **April and in May of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
April			
15,000 cfs	Wet	-4 (-4%)	-4 (-4%)
	Above Normal	-8 (-9%)	-8 (-9%)
20,000 cfs	Wet	-4 (-5%)	-4 (-5%)
	Above Normal	-17 (-22%)	-8 (-13%)
25,000 cfs	Wet	-8 (-10%)	-4 (-5%)
	Above Normal	-17 (-29%)	-8 (-17%)
May			
15,000 cfs	Wet	-12 (-13%)	-4 (-5%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-27 (-32%)	-4 (-6%)
	Above Normal	-8 (-20%)	0 (0%)
25,000 cfs	Wet	-19 (-28%)	-8 (-13%)
	Above Normal	-17 (-50%)	-8 (-33%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-25 (-25%)	-17 (-18%)
20,000 cfs	Wet	-8 (-9%)	-4 (-5%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	0 (0%)	0 (0%)

4
 5 For juveniles, year-round migration flows at Verona would be up to 30% under A5_LLT relative to
 6 NAA throughout much of the year and under almost all water year types (Appendix 11C, *CALSIM II*
 7 *Model Results utilized in the Fish Analysis*). Although the differences would be generally small, they
 8 would occur throughout the year (in all but two months).

9 For adults, the average number of months per year during the November through May adult
 10 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was
 11 determined (Table 11-5-19). The average number of months exceeding 5,300 cfs under A5_LLT
 12 would always be similar to or up to 10% greater than the number of months under NAA.

13 **NEPA Effects:** Upstream flows (above the north Delta intake) are similar between Alternative 5 and
 14 NAA (Table 11-5-46). However, due to the removal of water at the north Delta intake, there are
 15 substantial differences in through-Delta flows between Alternative 5 and NAA (Table 11-5-47).
 16 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between
 17 year class strength and Delta outflow during April and May. However, this conclusion was reached in
 18 the absence of the north Delta intake, and the exact mechanism that causes this correlation is not
 19 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper
 20 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another
 21 hypothesis suggests that the positive correlation is a result of higher flows through the Delta

1 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some
2 combination of these factors are working together to produce the positive correlation between high
3 flows and sturgeon year-class strength.

4 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation
5 between year class strength and river/Delta flow will be addressed through targeted research and
6 monitoring to be conducted in the years leading up to the initiation of north Delta facilities
7 operations. If these targeted investigations determine that the primary mechanisms behind the
8 positive correlation between high flows and sturgeon year-class strength are related to upstream
9 conditions, then Alternative 5 would be deemed not adverse due to the similarities in upstream flow
10 conditions between Alternative 5 and NAA. However, if the targeted investigations lead to a
11 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and
12 through-Delta flow conditions, then Alternative 5 would be deemed adverse due to the magnitude of
13 reductions in through-Delta flow conditions in Alternative 5 as compared to NAA.

14 **CEQA Conclusion:** In general, migration conditions for white sturgeon under Alternative 5 would be
15 similar to those under the CEQA baseline.

16 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough
17 under A5_LLT would generally be similar to or greater than those under Existing Conditions, except
18 in below normal years (25% lower) (Table 11-5-19). The number of months per year above 31,000
19 cfs at Verona would be mostly lower than under Existing Conditions, except in critical water years
20 (0% difference).

21 For Delta outflow, the percent of months exceeding flow thresholds under A5_LLT would be similar
22 to or up to 50% lower (relative scale) than those under Existing Conditions depending on flow
23 threshold, water year type, and month (Table 11-5-47).

24 For juveniles, year-round migration flows at Verona would be up to 34% under A5_LLT relative to
25 Existing Conditions throughout much of the year under and almost all water year types (Appendix
26 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Although the differences would be
27 generally small, they would occur throughout the year (every month but October).

28 For adult migration, the average number of months exceeding 5,300 cfs under A5_LLT would
29 generally be similar or up to 11% greater than the number of months under Existing Conditions
30 (Table 11-5-46).

31 **Summary of CEQA Conclusion**

32 Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between
33 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
34 alternative could substantially reduce the quality of suitable rearing habitat, contrary to the NEPA
35 conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for Delta
36 outflow would be lower under Alternative 5 than under the CEQA Existing Conditions although
37 there is high uncertainty that year class strength is due to Delta outflow or if both year class strength
38 and Delta outflows co-vary with another unknown factor. Juvenile migration flows in the
39 Sacramento River at Verona would be up to 34% lower during most months relative to Existing
40 Conditions. These reduced flows would have a substantial effect on the ability to migrate
41 downstream, delaying or slowing rates of successful migration downstream and increasing the risk
42 of mortality.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate
 2 change, future water demands, and implementation of the alternative. The analysis described above
 3 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
 4 alternative from those of sea level rise, climate change and future water demands using the model
 5 simulation results presented in this chapter. However, the increment of change attributable to the
 6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
 7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
 8 implementation period, which does include future sea level rise, climate change, and water
 9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
 10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
 11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
 13 term implementation period and Alternative 5 indicates that flows in the locations and during the
 14 months analyzed above would generally be similar between Existing Conditions during the LLT and
 15 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
 16 found above would generally be due to climate change, sea level rise, and future demand, and not
 17 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
 18 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would
 19 not in itself result in a significant impact on migration habitat of white sturgeon. Additionally, as
 20 described above in the NEPA Effects statement, further investigation is needed to better understand
 21 the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management
 22 would be used to make adjustments to meet the biological goals and objectives. This impact is found
 23 to be less than significant and no mitigation is required.

24 **Restoration Measures (CM2, CM4–CM7, and CM10)**

25 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

26 **NEPA Effects:** The potential effects of restoration construction activities under Alternative 5 would
 27 be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that
 28 would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-151). This would
 29 include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of
 30 contaminated sediments, construction-related disturbance, and predation. However, as concluded in
 31 Alternative 1A, Impact AQUA-7, restoration construction activities are not expected to adversely
 32 affect white sturgeon.

33 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-151 for white sturgeon, the
 34 potential impact of restoration construction activities is considered less than significant, and no
 35 mitigation would be required.

36 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White**
 37 **Sturgeon**

38 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
 39 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-152). This
 40 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
 41 organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be
 42 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but
 43 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As

1 concluded in Alternative 1A, Impact AQUA-152, contaminants associated with restoration measures
2 are not expected to adversely affect white sturgeon with respect to copper, ammonia and pesticides.
3 The effects of methylmercury and selenium on white sturgeon are uncertain.

4 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-152 for white sturgeon, the
5 potential impact of contaminants associated with restoration measures is considered less than
6 significant, and no mitigation would be required. The same conclusion applies to the reduced acres
7 of tidal habitat restoration (25,000 acres rather than 65,000 acres).

8 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

9 **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 5 would be the
10 same as those described for Alternative 1A (see Impact AQUA-153). These would include CM2 Yolo
11 Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally
12 Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural
13 Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be
14 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As
15 concluded in Impact AQUA-153 under Alternative 1A, restored tidal habitat is expected to be
16 beneficial for white sturgeon although the reduced acreage would reduce the benefit. The present
17 discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs
18 and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A.
19 The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

20 The restored tidal habitat will provide benefits to white sturgeon in all ROAs except the South Delta.
21 Sturgeon foraging on marsh mudflats will benefit from the increased transfer of increased
22 production to mudflat fauna. Increased food production from all ROAs that is exported into the Delta
23 will also benefit sturgeon. The overall improved habitat connectivity will benefit all species
24 including sturgeon.

25 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-153 for white sturgeon, the
26 potential impact of restored habitat conditions on white sturgeon is considered to be beneficial
27 although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%.
28 No mitigation would be required.

29 **Other Conservation Measures (CM12–CM19 and CM21)**

30 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

31 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon** 32 **(CM13)**

33 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

34 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon** 35 **(CM15)**

36 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

37 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

1 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

2 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

3 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**
4 **Sturgeon (CM21)**

5 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms
6 on white sturgeon are the same as those described under Alternative 1A (Impacts AQUA-154
7 through AQUA-162). The effects would range from no effect, to not adverse, to beneficial.

8 *CEQA Conclusion:* The impacts of the nine impact mechanisms listed above would range from no
9 impact, to less than significant, to beneficial, and no mitigation is required.

10 **Pacific Lamprey**

11 **Construction and Maintenance of CM1**

12 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

13 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on Pacific
14 lamprey would be similar to those described for Alternative 1A (Impact AQUA-163) except that
15 Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects
16 would be proportionally less under this alternative. This would convert about 2,050 lineal feet of
17 existing shoreline habitat into intake facility structures and would require about 4.7 acres of dredge
18 and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
19 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-163,
20 environmental commitments and mitigation measures would be available to avoid and minimize
21 potential effects, and the effect would not be adverse for Pacific lamprey.

22 *CEQA Conclusion:* As described in Impact AQUA-163, the impact of the construction of water
23 conveyance facilities on Pacific lamprey would be less than significant except for construction noise
24 associated with pile driving. Potential pile driving impacts would be less than Alternative 1A
25 because only one intake would be constructed rather than five. Implementation of Mitigation
26 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
27 significant.

28 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
29 **of Pile Driving and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
31 Alternative 1A.

32 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
33 **and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
35 Alternative 1A.

1 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

2 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
3 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-164)
4 except that only one intake would need to be maintained under Alternative 5 rather than five under
5 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-164, the effect would not be adverse
6 for Pacific lamprey.

7 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance
8 of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation
9 would be required.

10 **Water Operations of CM1**

11 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

12 **Water Exports**

13 The potential entrainment impacts of Alternative 5 on Pacific lamprey would be the same as
14 described above for Alternative 1A for operating new SWP/CVP north Delta intakes (Impacts AQUA-
15 165), non-physical barriers at the entrances to CCF and the DMC (Impacts AQUA-165), and
16 decommissioning agricultural diversions in ROAs (Impacts AQUA-165). These actions would avoid
17 or reduce potential entrainment and the effect would not be adverse.

18 The analysis of Pacific lamprey and river lamprey entrainment at the SWP/CVP south Delta facilities
19 is combined because the salvage facilities do not distinguish between the two lamprey species.
20 Under Alternative 5, average annual entrainment of lamprey at the south Delta export facilities, as
21 estimated by salvage density, would be reduced by about 10% (312 fish) (Table 11-5-48) across all
22 water year types compared to NAA. Therefore, Alternative 5 would not have adverse effects on
23 lamprey.

24 **Predation Associated with Entrainment**

25 Lamprey predation loss at the south Delta facilities is assumed to be proportional to entrainment
26 loss. Average pre-screen predation loss for fish entrained at the south Delta is 75% at Clifton Court
27 Forebay and 15% at the CVP. Lamprey entrainment to the south Delta would be reduced by 10%
28 compared to NAA and predation losses would be expected to be reduced at a similar proportion. The
29 impact and conclusion for predation risk associated with NPB structures would be the same as
30 described for Alternative 1A.

31 Predation at the north Delta would be increased due to the construction of the proposed water
32 export facilities on the Sacramento River. The effect on lamprey from predation loss at the north
33 Delta is unknown because of the lack of knowledge about their distribution and population
34 abundances in the Delta. The overall effect of predation loss on lamprey is considered not adverse.

35 **CEQA Conclusion:** As described above, annual entrainment losses of lamprey would be decreased by
36 12% (418 fish) under Alternative 5 (A5_LL1) relative to Existing Conditions. Impacts on Pacific
37 lamprey are expected to be considered less than significant due to expected reductions in
38 entrainment, and no mitigation would be required.

1 **Table 11-5-48. Lamprey Annual Entrainment Index^a at the SWP and CVP Salvage Facilities for**
2 **Alternative 5**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
All Years	-418 (-12%)	-312 (-10%)
Shading indicates entrainment increase of 10% or more.		
^a Number of fish lost, based on non-normalized data, for all months.		

3
4 The impact and conclusion for predation associated with entrainment would be the same as
5 described immediately above because the additional predation losses associated with the proposed
6 north Delta intake would be partially offset by the reduction in predation loss at the south Delta. The
7 relative impact of predation loss on the lamprey population is unknown since there is little available
8 knowledge on their distribution and abundance in the Delta. The impact is considered to be less
9 than significant. No mitigation would be required.

10 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
11 **Pacific Lamprey**

12 In general, Alternative 5 would reduce the quantity and quality of Pacific lamprey spawning habitat
13 relative to the NAA.

14 Flow-related effects on Pacific lamprey spawning habitat were evaluated by estimating effects of
15 flow alterations on redd dewatering risk and effects on water temperature. Rapid reductions in flow
16 can dewater redds leading to mortality. Dewatering risk was analyzed for the Sacramento River at
17 Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at
18 Thermalito Afterbay, and American River at Nimbus Dam and at the confluence with the Sacramento
19 River. Pacific lamprey spawn in these rivers between January and August. Dewatering risk to redd
20 cohorts was characterized by the number of cohorts experiencing a month-over-month reduction in
21 flows (using CALSIM II outputs) of greater than 50%.

22 For evaluation of dewatering risk, comparisons for Alternative 5 to NAA indicate increases would
23 occur in the Feather River (49% increase in dewatering risk) that would have negative effects on
24 spawning success, and smaller increases would occur in the American River (to 7%) that would not
25 have biologically meaningful effects (Table 11-5-49). Alternative 5 effects in all other locations
26 analyzed consist of negligible effects (<5%) or decreases in dewatering risk (to -15% in the
27 Sacramento River) that would constitute a beneficial effect.

1 **Table 11-5-49. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**
2 **Cohorts^a**

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A5_LL1	NAA vs. A5_LL1
Sacramento River at Keswick	Difference	12	-10
	Percent Difference	22%	-13%
Sacramento River at Red Bluff	Difference	7	-11
	Percent Difference	13%	-15%
Trinity River downstream of Lewiston	Difference	-1	-1
	Percent Difference	-1%	-1%
Feather River at Thermalito Afterbay	Difference	0	42
	Percent Difference	0%	39%
American River at Nimbus Dam	Difference	45	8
	Percent Difference	54%	7%
American River at Sacramento River confluence	Difference	46	6
	Percent Difference	48%	4%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 5 than under the baseline (Existing Conditions or NAA).

3

4 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
5 results of the analysis on Pacific lamprey egg exposure to elevated temperatures for Alternative 5
6 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate
7 that egg exposure would be similar to NAA at most locations, although egg exposure would
8 substantially increase in the Feather River below Thermalito Afterbay.

9 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
10 potential to substantially reduce suitable spawning habitat and substantially reduce the number of
11 fish as a result of egg mortality. There would be a 39% increase in the number of Pacific lamprey
12 redd cohorts predicted to experience a month-over-month change in flow of greater than 50% in the
13 Feather River, which would affect lamprey spawning and egg incubation habitat in the Feather
14 River. Also, there would be a 91% increase in the risk of egg exposure to temperatures greater than
15 71.6°F. This effect is a result of the specific reservoir operations and resulting flows associated with
16 this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows)
17 to the extent necessary to reduce this effect to a level that is not adverse would fundamentally
18 change the alternative, thereby making it a different alternative than that which has been modeled
19 and analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
20 mitigation available. While the implementation of the mitigation measures listed below (Mitigation
21 Measures AQUA-166a through Aqua-166c) would reduce the severity of effects, this would not
22 necessarily result in a not adverse determination.

23 **CEQA Conclusion:** In general, Alternative 5 would reduce the quantity and quality of Pacific lamprey
24 spawning habitat relative to Existing Conditions due to moderate to substantial increases in
25 exposure to month-over-month flow reductions in the Sacramento River and the American River.

1 Rapid reductions in flow can dewater redds leading to mortality. Predicted effects of Alternative 5 in
2 the Sacramento River and American River are for increases in the number of redd cohorts predicted
3 to experience a month-over-month change in flow of greater than 50% relative to Existing
4 Conditions (Table 11-5-49). Changes would be most substantial for the American River, with
5 increased risk of dewatering exposure to 45 cohorts or 54% at Nimbus Dam, and 46 cohorts or 48%
6 at the confluence. Effects of Alternative 5 would be negligible (<5%) for the Trinity River and
7 Feather River.

8 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
9 results of the analysis on egg exposure to elevated temperatures for Alternative 5 would be similar
10 to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate that egg exposure
11 would be greater than under Existing Conditions at the Sacramento, Feather, and American Rivers.

12 **Summary of CEQA Conclusion**

13 Collectively, these results indicate that the impact would be significant because it has the potential
14 to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a
15 result of egg mortality. Effects of Alternative 5 on flow would affect Pacific lamprey redd dewatering
16 risk in Sacramento River (22% increase in exposure risk) and the American River (maximum of 54%
17 increase in exposure risk), but would not have a biologically meaningful effect in the Feather River
18 and Trinity River. Further, there would be an increase in egg exposure to elevated temperatures in
19 the Sacramento, Feather, and American Rivers. This impact is a result of the specific reservoir
20 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
21 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
22 less-than-significant level would fundamentally change the alternative, thereby making it a different
23 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
24 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation
25 that has the potential to reduce the severity of impact though not necessarily to a less-than-
26 significant level.

27 **Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional** 28 **Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of** 29 **Mitigation to Reduce Impacts to Spawning Habitat**

30 Although analysis conducted as part of the EIR/EIS determined that Alternative 5 would have
31 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on
32 the best available scientific information at the time and may prove to have been overstated.
33 Upon the commencement of operations of CM1 and continuing through the life of the permit, the
34 BDCP proponents will monitor effects on spawning habitat in order to determine whether such
35 effects would be as extensive as concluded at the time of preparation of this document and to
36 determine any potentially feasible means of reducing the severity of such effects. This mitigation
37 measure requires a series of actions to accomplish these purposes, consistent with the
38 operational framework for Alternative 5.

39 The development and implementation of any mitigation actions shall be focused on those
40 incremental effects attributable to implementation of Alternative 5 operations only.
41 Development of mitigation actions for the incremental impact on spawning habitat attributable
42 to climate change/sea level rise are not required because these changed conditions would occur
43 with or without implementation of Alternative 5.

1 **Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts**
2 **on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1**

3 Following commencement of initial operations of CM1 and continuing through the life of the
4 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
5 modified operations could reduce impacts to spawning habitat under Alternative 5. The analysis
6 required under this measure may be conducted as a part of the Adaptive Management and
7 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

8 **Mitigation Measure AQUA-166c: Consult with NMFS, USFWS, and CDFW to Identify and**
9 **Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning**
10 **Habitat Consistent with CM1**

11 In order to determine the feasibility of reducing the effects of CM1 operations on Pacific lamprey
12 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
13 Wildlife to identify and implement any feasible operational means to minimize effects on
14 spawning habitat. Any such action will be developed in conjunction with the ongoing monitoring
15 and evaluation of habitat conditions required by Mitigation Measure AQUA-166a.

16 If feasible means are identified to reduce impacts on spawning habitat consistent with the
17 overall operational framework of Alternative 5 without causing new significant adverse impacts
18 on other covered species, such means shall be implemented. If sufficient operational flexibility
19 to reduce effects on Pacific lamprey habitat is not feasible under Alternative 5 operations,
20 achieving further impact reduction pursuant to this mitigation measure would not be feasible
21 under this Alternative, and the impact on Pacific lamprey would remain significant and
22 unavoidable.

23 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

24 In general, effects of Alternative 5 on Pacific lamprey rearing habitat would be negligible relative to
25 NAA.

26 Flow-related effects on Pacific lamprey rearing habitat were evaluated by estimating effects of flow
27 alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the
28 Trinity River, Feather River, and the American River at Nimbus Dam and at the confluence with the
29 Sacramento River. Lower flows can reduce the instream area available for rearing and rapid
30 reductions in flow can strand ammocoetes leading to mortality. The analysis of ammocoete
31 stranding was conducted by analyzing a range of month-over-month flow reductions from CALSIM II
32 outputs, using the range of 50%–90% in 5% increments. A cohort was considered stranded if at
33 least one month-over-month flow reduction was greater than the flow reduction at any time during
34 the period.

35 Additionally, as described for operations-related effects of Alternative 5 on spawning habitat for
36 Pacific lamprey above, it was determined that the effects of Alternative 5 on water temperatures for
37 the Sacramento River, Trinity River, Feather River, and the American River were the same as those
38 described in Impact AQUA-167 for Alternative 1A. Conclusions for Alternative 1A are that effects of
39 water temperature during Pacific lamprey ammocoete rearing are not adverse relative to NAA.

40 Effects of Alternative 5 on Pacific lamprey ammocoete stranding were analyzed by calculating
41 month-over-month flow reductions for the Sacramento River at Keswick for January through August
42 (Table 11-5-50). Results indicate no effect (0%) or negligible effects (<5%) to ammocoete cohort

1 exposures to all flow reduction categories. These results indicate that project-related effects of
2 Alternative 5 on flow would not affect Pacific lamprey ammocoete stranding conditions in the
3 Sacramento River at Keswick.

4 **Table 11-5-50. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
5 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
6 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	-1	-1
-70%	-1	-1
-75%	-3	0
-80%	7	0
-85%	47	0
-90%	NA	NA

NA = all values were 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

7
8 Results of comparisons for the Sacramento River at Red Bluff (Table 11-5-51) indicate no change
9 (0%) or negligible effects (<5%) on ammocoete cohort exposures to all flow reductions. These
10 results indicate that Alternative 5 would not affect Pacific lamprey ammocoete stranding conditions
11 in the Sacramento River at Red Bluff.

12 **Table 11-5-51. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
13 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
14 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	3	-1
-60%	1	-1
-65%	-2	-3
-70%	9	-2
-75%	9	0
-80%	13	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

15

1 Comparisons for the Trinity River indicate no effect (0%) or negligible changes (<5%) attributable
2 to the project (Table 11-5-52). These results indicate that Alternative 5 would not affect Pacific
3 lamprey ammocoete stranding conditions in the Trinity River.

4 **Table 11-5-52. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
5 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	21	-3
-80%	27	0
-85%	18	0
-90%	41	3

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

6
7 Comparisons for the Feather River indicate no difference (0%) or negligible effects (<5%) for flow
8 reductions up to 80%, and decreases in the percentage of cohorts exposed to 85% flow reductions
9 (-10%) and 90% flow reductions (-56%) that would have a beneficial effect on spawning success
10 (Table 11-5-53). These results indicate that Alternative 5 would not have biologically meaningful
11 negative effects on Pacific lamprey ammocoete stranding conditions in the Feather River.

12 **Table 11-5-53. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
13 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
14 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	0	2
-85%	18	-10
-90%	-22	-56

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

15
16 Comparisons for the American River at Nimbus Dam (Table 11-5-54) indicate negligible effects
17 (<5%) for most flow reduction categories, small increases (to 11%) in cohorts exposed to 75% and

1 80% flow reductions, and a moderate decrease (-25%) in cohorts exposed to 90% flow reductions
 2 which would have a beneficial effect on spawning success. These results indicate that Alternative 5
 3 would not have biologically meaningful negative effects on Pacific lamprey ammocoete stranding
 4 conditions in the American River at Nimbus Dam.

5 **Table 11-5-54. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 7 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	2	0
-70%	40	1
-75%	113	11
-80%	314	9
-85%	400	-1
-90%	125	-25

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

8
 9 Comparisons for the American River at the confluence with the Sacramento River (Table 11-5-55)
 10 indicate no effect (0% difference) on cohort exposure for all flow reduction categories with the
 11 exception of small (10%) to moderate (28%) increases in exposure to 80, 85, and 90% flow
 12 reductions. These results indicate that project-related effects of Alternative 5 would cause small to
 13 moderate increases in ammocoete cohort exposures to flow reductions but not of a magnitude that
 14 would contribute to biologically meaningful negative effects on spawning success in the American
 15 River at the confluence with the Sacramento River.

16 **Table 11-5-55. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 17 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 18 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	8	0
-75%	37	0
-80%	279	28
-85%	300	14
-90%	364	10

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

19

1 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
2 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be
3 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there
4 would be small to moderate increases and decreases in exposure relative to NAA will balance out
5 within rivers such that there would be no overall effect on Pacific lamprey ammocoetes.

6 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
7 would not substantially reduce rearing habitat or substantially reduce the number of fish as a result
8 of ammocoete mortality in any of the locations analyzed. While the effects of climate change would
9 increase stranding risk during A5_LL1 for some locations, project-related effects would primarily
10 consist of no effect (0%), negligible effects (<5%), isolated categories of flow reductions that would
11 experience a small increase in cohort exposure, or small decreases in stranding risk that would have
12 beneficial effects on rearing success. There would also be small, beneficial effects in the Feather
13 River and the American River at Nimbus Dam from decreased exposures to month-over-month flow
14 reductions in the higher flow reduction categories. There would be small to moderate increases and
15 decreases in ammocoete exposure to elevated temperatures that will balance out within rivers such
16 that there would be no overall effect on Pacific lamprey ammocoetes

17 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of
18 rearing habitat for Pacific lamprey would not be affected relative to the CEQA baseline.

19 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can
20 strand ammocoetes leading to mortality. Comparisons of month-over-month flow reductions under
21 Alternative 5 relative to Existing Conditions for the Sacramento River at Keswick indicate negligible
22 changes (<5%) in occurrence of cohort exposure for all flow reduction categories with the exception
23 of a small increase in exposure (7%) in the 80% flow reduction category and a more substantial
24 increase in exposure (47%) to 85% flow reductions (Table 11-5-50). With primarily negligible to
25 small effects and a moderate effect on a single flow reduction category, these results indicate that
26 effects of Alternative 5 on flow would not result in biologically meaningful effects on Pacific lamprey
27 ammocoete stranding risk in the Sacramento River at Keswick.

28 Comparisons of Alternative 5 to Existing Conditions for the Sacramento River at Red Bluff indicate
29 negligible changes (<5%) in occurrence of cohort exposure for flow reduction categories from 50%
30 to 65%, small increases (to 13%) in exposure to 70, 75, and 80% flow reductions, and a more
31 substantial increase in exposure (56 to 112 cohorts or 100%) to 85% flow reductions (Table 11-5-
32 51). These results indicate that effects of Alternative 5 on flow would cause increase risk of Pacific
33 lamprey ammocoete stranding in the Sacramento River at Red Bluff but not to the extent that would
34 be considered a biologically meaningful effect on rearing success.

35 Comparisons of Alternative 5 to Existing Conditions for the Trinity River indicate no effect (0%
36 difference) in ammocoete cohort exposure for the lower flow reduction categories, and moderate
37 increases in cohort exposure (to 41%) for flow reductions from 75% to 90% (Table 11-5-52). The
38 effects of Alternative 5 on flow reduction exposures are consistent for the higher flow reduction
39 categories which would contribute incrementally to increased stranding risk and therefore would
40 have a negative effect on rearing conditions.

41 Comparisons of Alternative 5 to Existing Conditions for Feather River indicate no effect (0%
42 difference) on ammocoete cohort exposures for the lower flow reduction categories, a moderate
43 increase in cohort exposure (18%) to flow reductions of 85%, and a moderate decrease (22%) in
44 exposures to flow reductions of 90% (Table 11-5-53). Based on the fact that moderate effects on

1 cohort exposure would only occur for the two highest flow reduction categories, with one adverse
2 and one beneficial in terms of stranding risk, these results indicate that effects of Alternative 5 on
3 flow would not cause biologically meaningful effects on rearing success.

4 Comparisons for the American River at Nimbus Dam (Table 11-5-54) and at the confluence with the
5 Sacramento River (Table 11-5-55) indicate negligible effects (<5%) on ammocoete cohort exposures
6 under A5_LL1T relative to Existing Conditions for 50% through 65% flow reduction events, and
7 moderate (40%) to substantial increases (to 400%) in exposures for the larger flow reduction
8 categories. These are substantial increases in cohort stranding exposure and would have negative
9 effects on spawning success at both locations.

10 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
11 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be
12 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that there
13 would be substantial increases in ammocoete exposure in all rivers evaluated relative to Existing
14 Conditions.

15 **Summary of CEQA Conclusion**

16 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between
17 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
18 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
19 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of
20 Alternative 5 on flow would affect ammocoete stranding risk in the Trinity River and the American
21 River at Nimbus Dam and at the confluence with the Sacramento River (based on substantial
22 increases in the number of cohorts exposed to stranding risk in the larger flow reduction categories,
23 to 41% in the Trinity River and between 40% and 400% in the American River), and would not have
24 biologically meaningful effects in the Sacramento River and the Feather River. Also, there would be
25 substantial increases in ammocoete exposure to elevated temperatures in all rivers evaluated.

26 These results are primarily caused by four factors: differences in sea level rise, differences in climate
27 change, future water demands, and implementation of the alternative. The analysis described above
28 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
29 alternative from those of sea level rise, climate change and future water demands using the model
30 simulation results presented in this chapter. However, the increment of change attributable to the
31 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
32 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
33 implementation period, which does include future sea level rise, climate change, and water
34 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
35 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
36 effect of the alternative from those of sea level rise, climate change, and water demands.

37 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
38 term implementation period and Alternative 5 indicates that flows in the locations and during the
39 months analyzed above would generally be similar between Existing Conditions during the LLT and
40 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
41 found above would generally be due to climate change, sea level rise, and future demand, and not
42 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
43 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

1 result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less
2 than significant and no mitigation is required.

3 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

4 In general, effects of Alternative 5 on Pacific lamprey migration conditions would be negligible
5 relative to NAA.

6 ***Macrophthalmia***

7 After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macrophthalmia once
8 they reach the Delta. Migration generally is associated with large flow pulses in winter months
9 (December through March) (USFWS unpublished data) meaning alterations in flow have the
10 potential to affect downstream migration conditions. The effects of Alternative 5 on seasonal
11 migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow output. Flow
12 rates along the migration pathways of Pacific lamprey during the likely migration period (December
13 through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River
14 at the confluence with the Sacramento River, and the American River at the confluence with the
15 Sacramento River.

16 *Sacramento River*

17 Analysis of Alternative 5 on mean monthly flow rates for the Sacramento River at Rio Vista
18 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate
19 negligible effects (<5%) or small decreases in mean monthly flow (to -11%) for all months during
20 the migration period. These results indicate that effects of Alternative 5 on flow would not cause
21 biologically meaningful effects on macrophthalmia migration conditions in the Sacramento River at
22 Rio Vista.

23 For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
24 *Analysis*), the difference in mean monthly flow rate for Alternative 5 indicates negligible effects on
25 flow (<5%) or small increases or decreases (to 5%) that would not affect migration conditions, and
26 increases in mean monthly flow (to 9%) for some water years during May which would have a
27 beneficial effect on migration conditions. These results indicate that effects of Alternative 5 on flow
28 would not have biologically meaningful effects on outmigrating macrophthalmia in the Sacramento
29 River at Red Bluff.

30 *Feather River*

31 Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C,
32 *CALSIM II Model Results utilized in the Fish Analysis*) indicate negligible project-related effects (<5%)
33 or increases in flow to 24% that would have beneficial effects on migration, with the exception of a
34 single, small project-related decrease in flow during December in above normal years (-6%). These
35 results indicate that effects project-related effects of Alternative 5 on flow would not have
36 biologically meaningful effects on macrophthalmia migration in the Feather River at the confluence.

37 *American River*

38 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
39 *CALSIM II Model Results utilized in the Fish Analysis*) indicate project-related effects consist primarily
40 of negligible effects (<5%), with small to moderate increases in flow (to 18%) during some

1 months/water years that would be beneficial for migration, and a small decrease in flow (-9%)
2 during January in dry years that would be isolated and of small magnitude and therefore not have
3 biologically meaningful negative effects. These results indicate that project-related effects of
4 Alternative 5 on flow would not have biologically meaningful effects on macrophthalmia migration in
5 the American River.

6 Overall, effects of Alternative 5 on outmigrating macrophthalmia for all locations analyzed consist of
7 negligible effects on flow (<5% difference), small to moderate increases in flow that would have a
8 beneficial effect on migration conditions, or infrequent and relatively small decreases in flow (to -
9 11%) which would not have biologically meaningful effects on Pacific lamprey macrophthalmia
10 migration.

11 **Adults**

12 *Sacramento River*

13 For the Sacramento River at Red Bluff project-related effects consist primarily of negligible effects
14 (<5%), with increases in mean monthly flow (to 9%) during May and June for some water years and
15 a single occurrence of a small decrease in flow (-5%) during January in dry years. These results
16 indicate that project-related effects of Alternative 5 on flow would not have biologically meaningful
17 effects on adult migration in the Sacramento River.

18 *Feather River*

19 For the Feather River at the confluence with the Sacramento River (*Appendix 11C, CALSIM II Model*
20 *Results utilized in the Fish Analysis*) project-related effects consist primarily of negligible changes
21 (<5%) throughout the migration period, with occasional, small increases in flow (to 12%) for some
22 months/water years and more substantial increases (to 34%) during June in all but critical water
23 years. Increases in drier years during April and June would have a beneficial effect on migration
24 conditions. These results indicate that project-related effects of Alternative 5 on flow would not
25 affect adult migration conditions in the Feather River.

26 *American River*

27 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
28 River for January to June (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*)
29 indicate predominantly negligible effects (<5%) or small increases in flow (to 12%) attributable to
30 the project with more substantial increases for some water years during May (to 18%) and June (to
31 56%) that would have beneficial effects on migration conditions. These results indicate that effects
32 of Alternative 5 on flow would not affect adult migration conditions in the American River.

33 Overall, project-related effects of Alternative 5 on flow for all locations analyzed consist of negligible
34 effects on flow (<5% difference), small to substantial increases in flow (to 56%) that would have a
35 beneficial effect on migration conditions, or infrequent, small decreases in flow (-5%) that would not
36 have biologically meaningful effects on Pacific lamprey adult migration conditions.

37 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
38 would not substantially reduce the amount of suitable habitat or substantially interfere with the
39 movement of fish. Effects of Alternative 5 on mean monthly flows during the Pacific lamprey
40 macrophthalmia outmigration period and the adult migration period consist of negligible effects
41 (<5%) or increases in flow (to 56%) that would have beneficial effects on migration conditions, with

1 highly infrequent, small reductions in flow (to -11%) that would not have biologically meaningful
2 effects on migration conditions.

3 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of
4 Pacific lamprey migration habitat would not be affected relative to the CEQA baseline.

5 **Macrophthalmia**

6 *Sacramento River*

7 Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista (Appendix 11C,
8 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 5 relative
9 to Existing Conditions indicate primarily negligible effects (<5%) with occasional small increases (to
10 10%) or decreases (to -12%) in mean monthly flow, with a moderate decrease (-17%) during March
11 in below normal years and more substantial decreases (to -33%) during May in wetter water years.
12 Effects in drier water year types when flow reductions would be most critical for migration
13 conditions consist of negligible effects or small decreases (to -9%) in all months during the
14 migration period with the exception of slightly greater reductions during March and May in below
15 normal years (-17%). Flow reductions in drier water years would contribute incrementally to effects
16 on migration but would not be of the frequency or magnitude to biologically meaningful effects on
17 Pacific lamprey macrophthalmia migration conditions.

18 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*
19 *in the Fish Analysis*) for December to May for Alternative 5 relative to Existing Conditions indicate
20 negligible (<5%) effects, or small decreases (to -9%) or increases in flow (to 13%) for all months
21 and water years, which would have beneficial effects on migration conditions, with the exception of
22 a moderate decrease in flow (-18%) during May in wet years when effects of flow reductions on
23 migration conditions would be less critical. These results indicate that effects of Alternative 5 on
24 flow would not have biologically meaningful effects on outmigrating macrophthalmia at this location.

25 *Feather River*

26 Comparisons for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized*
27 *in the Fish Analysis*) for December to May indicate effects of Alternative 5 compared to Existing
28 Conditions consist of negligible effects (<5%) or small increases (to 11%) or decreases in flow (-
29 14%), with a few occurrences of larger increases in mean monthly flow (to 20%) that would have a
30 beneficial effect on migration conditions, moderate decreases in flow predicted during January
31 through March in below normal years (to -18%) and during May in wetter years (to -28%) when
32 effects of flow reductions would be less critical for migration. Reductions for three months in below
33 normal years would contribute to incremental effects on migration conditions; however, overall
34 effects of Alternative 5 on flow for the entire migration period and all water years consists
35 predominantly of negligible effects, increases in flow, and smaller decreases in flow. These results
36 indicate that the effects of Alternative 5 on flow would not have biologically meaningful effects on
37 outmigrating macrophthalmia in the Feather River.

38 *American River*

39 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
40 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable results
41 depending on the specific month and water year, with negligible effects (<5%) or decreases in flow
42 (to -23%) during December (including in drier water years), increases in wetter water years (to

1 27%) and decreases in drier water years (to -21%) during January through March, negligible effects
2 (<5%) and small-scale increases (11%) or decreases (to -9%) during April, and reductions in flow
3 (to -34%) during May in all but dry years (increase of 7%). Based on small to moderate reductions
4 in flow in drier water years during most of the migration period (December through March and
5 May), these results indicate that effects of Alternative 5 on flow would have negative effects on
6 outmigrating macrophthalmia in the American River at the confluence.

7 Overall, these results indicate that the effects of Alternative 5 on mean monthly flows during the
8 Pacific lamprey macrophthalmia migration period consist primarily of negligible effects (<5%),
9 increases in flow that would be beneficial for migration conditions, and infrequent and/or small
10 decreases in flow (to -17%), and occasional, more substantial decreases in wetter water years (to -
11 33%) that would not affect migration conditions in the Sacramento River and the Feather River.
12 Impacts would consist of more persistent and increased magnitude flow reductions throughout the
13 migration period (flow reductions to -34% in December through March and May) in the American
14 River.

15 **Adults**

16 *Sacramento River*

17 Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II*
18 *Model Results utilized in the Fish Analysis*) during the Pacific lamprey adult migration period from
19 January through June indicate primarily negligible effects (<5%), with small increases (to 11%) or
20 decreases (to -10%) in flow that would not have biologically meaningful effects on migration
21 conditions, and a moderate decrease in flow during May in wet years (-18%) when effects of flow
22 reductions on migration conditions would be less critical. These results indicate that effects of
23 Alternative 5 on flow would not have biologically meaningful effects on adult migration conditions
24 in the Sacramento River.

25 *Feather River*

26 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento
27 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
28 indicate effects of Alternative 5 consist primarily of negligible effects (<5%) or increases in flow (to
29 30%) that would have beneficial effects on migration, with the exception of small to moderate
30 decreases (to -18%) during January, February, and March in below normal years that would not
31 have biologically meaningful effects on migration conditions, moderate reductions during May in
32 wet (-28%) and above normal (-14%) years when effects of flow reductions would be less critical
33 for migration, and a reduction during June in wet years (-17%) and a small reduction in critical
34 years (-9%) that would not have biologically meaningful effects. While flow reductions in drier
35 water years would contribute incrementally to effects on migration, based on the prevalence of
36 negligible effects and increases in flow, and isolated and/or small reductions in flow, effects would
37 not be biologically meaningful for adult migration conditions in the Feather River.

38 *American River*

39 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
40 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
41 indicate variable effects of Alternative 5 depending on the month and water year type, with
42 negligible effects (<5%) or increases in flow (to 27%) in wetter water years and decreases (to -21%)

1 in drier water years for January through March, negligible effects or small decreases in flow (to -9%)
2 during April, reductions in flow (to -34%) in all but dry years (increase of 7%) during May and
3 decreases in wet (-32%) and critical years (-24%) in June with increases (to 19%) in below normal
4 and dry years. The prevalence of moderate flow reductions in some of the drier water year types for
5 January and May, with moderate decreases during February and June in critical years, would
6 contribute incrementally to effects on migration conditions that would have negative effects on
7 adult migration in the American River.

8 Overall, these results indicate that effects of Alternative 5 on flow during the January to June adult
9 Pacific lamprey migration period in the Sacramento River and Feather River consist predominantly
10 of negligible effects (<5% difference), increases in flow that would have beneficial effects, or small,
11 isolated occurrences of decreases in flow (to -18%) for some water year types, or infrequent, more
12 substantial decreases in wetter water years (to -28%) that would not have biologically meaningful
13 effects. There would be greater prevalence of moderate flow reductions (to -34%) during some
14 water year types from January through March, May, and June in the American River that would have
15 negative effects on migration conditions.

16 **Summary of CEQA Conclusion**

17 Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between
18 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
19 alternative could substantially reduce migration conditions for Pacific lamprey, contrary to the
20 NEPA conclusion set forth above. Effects of Alternative 5 on flow would affect Pacific lamprey
21 macrophthalmia and adult migration conditions in the American River (based on flow reductions to -
22 34% for a substantial portion of the migration periods) and would not affect macrophthalmia and
23 adult migration in the Sacramento River and the Feather River (based on primarily negligible effects
24 on flow, small increases that would have beneficial effects, and isolated occurrences of flow
25 decreases to -18% in drier water years and to -33% in wetter water years that would not have
26 biologically meaningful effects on migration conditions).

27 These results are primarily caused by four factors: differences in sea level rise, differences in climate
28 change, future water demands, and implementation of the alternative. The analysis described above
29 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
30 alternative from those of sea level rise, climate change and future water demands using the model
31 simulation results presented in this chapter. However, the increment of change attributable to the
32 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
33 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
34 implementation period, which does include future sea level rise, climate change, and water
35 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
36 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
37 effect of the alternative from those of sea level rise, climate change, and water demands.

38 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
39 term implementation period and Alternative 5 indicates that flows in the locations and during the
40 months analyzed above would generally be similar between Existing Conditions during the LLT and
41 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
42 found above would generally be due to climate change, sea level rise, and future demand, and not
43 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
44 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

1 result in a significant impact on migration habitat for Pacific lamprey. This impact is found to be less
2 than significant and no mitigation is required.

3 **Restoration Measures (CM2, CM4–CM7, and CM10)**

4 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

5 **NEPA Effects:** The potential effects of restoration construction activities under Alternative 5 would
6 be less than that described for Alternative 1A because of the reduced acreage of tidal habitat that
7 would be restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-169). This would
8 include potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of
9 contaminated sediments, construction-related disturbance, and predation. However, as concluded in
10 Alternative 1A, Impact AQUA-169, restoration construction activities are not expected to adversely
11 affect Pacific lamprey.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-169 for Pacific lamprey, the
13 potential impact of restoration construction activities is considered less than significant, and no
14 mitigation would be required.

15 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific 16 Lamprey**

17 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
18 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-170). This
19 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
20 organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be
21 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but
22 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As
23 concluded in Alternative 1A, Impact AQUA-170, contaminants associated with restoration measures
24 are not expected to adversely affect Pacific lamprey.

25 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-170 for Pacific lamprey, the
26 potential impact of contaminants associated with restoration measures is considered less than
27 significant, and no mitigation would be required. The same conclusion applies to the reduced acres
28 of tidal habitat restoration (25,000 acres rather than 65,000 acres).

29 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

30 **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 5 would be the
31 same as those described for Alternative 1A (see Impact AQUA-171). These would include CM2 Yolo
32 Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally
33 Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural
34 Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be
35 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As
36 concluded in Impact AQUA-171 under Alternative 1A, restored tidal habitat is expected to be
37 beneficial for Pacific lamprey although the reduced acreage would reduce the benefit. The present
38 discussion considers the restored tidal habitat to be proportionally distributed across the five ROAs
39 and to provide proportionally less benefit based on the reduced acreage compared to Alternative 1A.
40 The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

1 The restored tidal habitat will provide benefits to Pacific lamprey primarily through increased food
2 production from all ROAs that is exported to the Delta. The overall improved habitat connectivity
3 will benefit all species including Pacific lamprey.

4 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-171 for Pacific lamprey, the
5 potential impact of restored habitat conditions on Pacific lamprey is considered to be beneficial
6 although the reduced tidal habitat would proportionally reduce the benefit by approximately 60%.
7 No mitigation would be required.

8 **Other Conservation Measures (CM12–CM19 and CM21)**

9 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

10 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey** 11 **(CM13)**

12 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

13 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey** 14 **(CM15)**

15 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

16 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

17 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

18 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

19 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific** 20 **Lamprey (CM21)**

21 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms
22 on Pacific lamprey are the same as those described under Alternative 1A (Impacts AQUA-172
23 through AQUA-180). The effects would range from no effect, to not adverse, to beneficial.

24 **CEQA Conclusion:** The impacts of the nine impact mechanisms listed above would range from no
25 impact, to less than significant, to beneficial, and no mitigation is required.

26 **River Lamprey**

27 **Construction and Maintenance of CM1**

28 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

29 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on river
30 lamprey would be similar to those described for Alternative 1A (Impact AQUA-181) except that
31 Alternative 5 would include one intake compared to five intakes under Alternative 1A, so the effects
32 would be proportionally less under this alternative. This would convert about 2,050 lineal feet of
33 existing shoreline habitat into intake facility structures and would require about 4.7 acres of dredge
34 and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and

1 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-181,
2 environmental commitments and mitigation measures would be available to avoid and minimize
3 potential effects, and the effect would not be adverse for river lamprey.

4 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-181, the impact of the construction
5 of water conveyance facilities on river lamprey would be less than significant except for
6 construction noise associated with pile driving. Potential pile driving impacts would be less than
7 Alternative 1A because only one intake would be constructed rather than five. Implementation of
8 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
9 less than significant.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
13 Alternative 1A.

14 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
15 **and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
17 Alternative 1A.

18 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

19 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
20 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-182)
21 except that only one intake would need to be maintained under Alternative 5 rather than five under
22 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-182, the effect would not be adverse
23 for river lamprey.

24 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-182, the impact of the maintenance
25 of water conveyance facilities on river lamprey would be less than significant and no mitigation
26 would be required.

27 **Water Operations of CM1**

28 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

29 **Water Exports**

30 The potential entrainment impacts of Alternative 5 on river lamprey would be the same as described
31 above for Alternative 1A for operating new SWP/CVP north Delta intakes (Impacts AQUA-183), non-
32 physical barriers at the entrances to CCF and the DMC (Impacts AQUA-183), and decommissioning
33 agricultural diversions in ROAs (Impacts AQUA-183). These actions would avoid or reduce potential
34 entrainment and the effect would not be adverse.

35 The analysis of river lamprey entrainment at the SWP/CVP south Delta facilities is combined with
36 the analysis of Pacific lamprey because the salvage facilities do not distinguish between the two
37 lamprey species. Under Alternative 5, average annual entrainment of lamprey at the south Delta
38 export facilities, as estimated by salvage density, would be reduced by about 10% (312 fish) (Table

1 11-5-56) across all water year types compared to NAA. Therefore, Alternative 5 would not have
2 adverse effects on lamprey.

3 **CEQA Conclusion:** As described above, annual entrainment losses of lamprey would be decreased by
4 12% (418 fish) under Alternative 5 (A5_LLT) relative to Existing Conditions. Impacts of water
5 operations on entrainment of river lamprey would be considered less than significant due to
6 expected reductions in entrainment and no mitigation would be required.

7 **Table 11-5-56. Lamprey Annual Entrainment Index^a at the SWP and CVP Salvage Facilities for**
8 **Alternative 5**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
All Years	-418 (-12%)	-312 (-10%)

Shading indicates entrainment increased by 10% or more.

^a Number of fish lost, based on non-normalized data, for all months.

9

10 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
11 **River Lamprey**

12 In general, effects of Alternative 5 on river lamprey spawning habitat would be negligible relative to
13 NAA.

14 Flow-related effects on river lamprey spawning habitat were evaluated by estimating effects of flow
15 alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames
16 for river lamprey incorporated into the analysis. The same locations were analyzed as for Pacific
17 lamprey: the Sacramento River at Keswick and Red Bluff, Trinity River downstream of Lewiston,
18 Feather River at Thermalito Afterbay, and American River at Nimbus Dam and at the confluence
19 with the Sacramento River. River lamprey spawn in these rivers between February and June so flow
20 reductions during those months have the potential to dewater redds, which could result in
21 incomplete development of the eggs to ammocoetes (the larval stage).

22 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-
23 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Results were
24 expressed as the number of cohorts exposed to dewatering risk and as a percentage of the total
25 number of cohorts anticipated in the river based on the applicable time-frame, February to June.

26 Results for the Sacramento River at Keswick indicate project-related increases would only occur in
27 the Feather River, with a small increase of 12% that would not have biologically meaningful
28 negative effects (Table 11-5-57). All other locations would experience negligible changes (<5%)
29 attributable to the project or decreases in dewatering risk (to -12%) that would be beneficial for
30 spawning success.

1 **Table 11-5-57. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**
2 **Cohorts^a**

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A5_LL1	NAA vs. A5_LL1
Sacramento River at Keswick	Difference	1	-2
	Percent Difference	3%	-6%
Sacramento River at Red Bluff	Difference	-2	-4
	Percent Difference	-5%	-10%
Trinity River downstream of Lewiston	Difference	-3	-1
	Percent Difference	-4%	-1%
Feather River at Thermalito Afterbay	Difference	-3	7
	Percent Difference	-4%	12%
American River at Nimbus Dam	Difference	10	1
	Percent Difference	18%	2%
American River at Sacramento River confluence	Difference	14	-3
	Percent Difference	24%	-4%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 5 than under the baseline (Existing Conditions or NAA).

3
4 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
5 results of the analysis on river lamprey egg exposure to elevated temperatures for Alternative 5
6 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate
7 that egg exposure would be similar to NAA at most locations, although egg exposure would
8 moderately increase in the Feather River below Thermalito Afterbay.

9 **NEPA Effects:** These results indicate that the effect would not be adverse because it would not
10 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result
11 of egg mortality. Effects of Alternative 5 on water temperature would be negligible, and effects on
12 flow reductions that could negatively affect spawning and egg incubation conditions consists of
13 negligible effects (<5%), a small increase in dewatering risk (12% for the Feather River) that would
14 not have biologically meaningful effects, or decreases in dewatering risk (to -12%) that would be
15 beneficial for spawning conditions. Egg exposure to elevated water temperatures under Alternative
16 5 would not increase in the majority of location evaluated.

17 **CEQA Conclusion:** In general, effects of Alternative 5 on river lamprey spawning habitat would be
18 negligible relative to Existing Conditions based on primarily negligible effects on water
19 temperatures and month-over-month flow reductions. Effects of Alternative 5 on flow reductions
20 during the river lamprey spawning period from February to June in the Sacramento River, Trinity
21 River, and Feather River consist of negligible (<5%) or small effects (-5%) on dewatering risk (Table
22 11-5-57). There would be increases in river lamprey redd cohort dewatering risk relative to Existing
23 Conditions for the American River at Nimbus Dam (18%) and at the confluence (24%).

24 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
25 results of the analysis on egg exposure to elevated temperatures for Alternative 5 would be similar
26 to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate that egg exposure

1 would be greater than under Existing Conditions at the Sacramento, Feather, American, and
2 Stanislaus Rivers.

3 **Summary of CEQA Conclusion**

4 Collectively, the results of the Impact AQUA-184 CEQA analysis indicate that the difference between
5 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
6 alternative could substantially, contrary to the NEPA conclusion set forth above reduce suitable
7 spawning habitat and substantially reduce the number of fish as a result of egg mortality. The risk of
8 egg exposure to increased temperatures would be higher under Alternative 5 in multiple rivers.
9 There would be negligible effects of Alternative 5 on redd dewatering risk.

10 These results are primarily caused by four factors: differences in sea level rise, differences in climate
11 change, future water demands, and implementation of the alternative. The analysis described above
12 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
13 alternative from those of sea level rise, climate change and future water demands using the model
14 simulation results presented in this chapter. However, the increment of change attributable to the
15 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
16 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
17 implementation period, which does include future sea level rise, climate change, and water
18 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
19 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
20 effect of the alternative from those of sea level rise, climate change, and water demands.

21 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
22 term implementation period and Alternative 5 indicates that flows in the locations and during the
23 months analyzed above would generally be similar between Existing Conditions during the LLT and
24 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
25 found above would generally be due to climate change, sea level rise, and future demand, and not
26 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
27 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
28 result in a significant impact on spawning habitat for river lamprey. This impact is found to be less
29 than significant and no mitigation is required.

30 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

31 In general, effects of Alternative 5 on river lamprey rearing habitat would be negligible relative to
32 NAA.

33 Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow
34 alterations on ammocoete exposure, or stranding risk, as described for Pacific lamprey, and effects
35 of water temperatures. As described for river lamprey spawning effects above, water temperature
36 results from the SRWQM and the Reclamation Temperature Model were used to assess the
37 exceedances of water temperatures under Alternative 5 in the upper Sacramento, Trinity, Feather,
38 American, and Stanislaus Rivers for river lamprey ammocoete rearing. It was determined that the
39 effects of Alternative 5 on water temperatures for all locations were the same as described for
40 Alternative 1A in Impact AQUA-185. Conclusions for Alternative 1A are that effects of water
41 temperature during river lamprey ammocoete rearing relative to NAA are not adverse.

1 For ammocoete stranding risk, the effects of Alternative 5 on flow were evaluated in the Sacramento
 2 River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus
 3 Dam and at the confluence with the Sacramento River. As for Pacific lamprey, the analysis of river
 4 lamprey ammocoete stranding was conducted by analyzing a range of month-over-month flow
 5 reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of
 6 ammocoetes was assumed to be born every month during their spawning period (February through
 7 June) and spend 5 years rearing upstream. Therefore, a cohort was considered stranded if at least
 8 one month-over-month flow reduction was greater than the flow reduction at any time during the
 9 period.

10 Comparisons of Alternative 5 to NAA for the Sacramento River at Keswick (Table 11-5-58) indicate
 11 either no effect (0%) or negligible effects (<5%) for all flow reduction categories attributable to the
 12 project. These results indicate that effects of Alternative 5 on flow would not affect ammocoete
 13 rearing success in the Sacramento River at Keswick.

14 **Table 11-5-58. Percent Difference between Model Scenarios in the Number of River Lamprey**
 15 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
 16 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	1	-1
-60%	4	1
-65%	-1	-2
-70%	-1	-1
-75%	-7	-1
-80%	11	0
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

17
 18 Results of comparisons for the Sacramento River at Red Bluff (Table 11-5-59) indicate no change
 19 (0%) or negligible effects (<5%) attributable to the project for all flow reduction categories. These
 20 results indicate that effects of Alternative 5 on flow reductions would not affect river lamprey
 21 ammocoete stranding in the Sacramento River at Red Bluff.

1 **Table 11-5-59. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
 3 **Bluff**

Percent Flow Reduction	Percent Difference	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
-50%	0	0
-55%	3	-1
-60%	6	-1
-65%	-2	-3
-70%	9	0
-75%	22	0
-80%	10	0
-85%	[25-50] 100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

4

5 Comparisons for the Trinity River indicate negligible effects (<5%) for most flow reduction
 6 categories with a small reduction in ammocoete cohort exposures (-5%) to 75% flow reduction
 7 events and a small increase in exposure (6%) to 90% flow reduction events (Table 11-5-60). These
 8 results indicate Alternative 5 effects on flow would not have biologically meaningful effects on river
 9 lamprey ammocoete stranding in the Trinity River.

10 **Table 11-5-60. Percent Difference between Model Scenarios in the Number of River Lamprey**
 11 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	26	-5
-80%	39	0
-85%	31	0
-90%	62	6

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

12

13 Comparisons for the Feather River no effect (0% difference) in exposures to flow events up to 75%,
 14 a small increase in exposure (7%) to 80% flow reductions, a more substantial increase (51%) for
 15 90% flow reductions, and reduced exposure (-11%) to 85% flow reduction events (Table 11-5-61).
 16 With a substantial increase in ammocoete cohort exposure (51%) to a single flow reduction
 17 category (90%), and no effect, small effects, or a beneficial effect in the remaining categories, these

1 results indicate that project-related effects of Alternative 5 on flow would not have biologically
2 meaningful effects on river lamprey ammocoete stranding in the Feather River.

3 **Table 11-5-61. Percent Difference between Model Scenarios in the Number of River Lamprey**
4 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
5 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LL1	NAA vs. A5_LL1
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	0	7
-85%	18	-11
-90%	-15	51

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

6
7 Comparisons for the American River at Nimbus Dam (Table 11-5-62) and at the confluence with the
8 Sacramento River (Table 11-5-63) indicate no effect (0%), negligible effects (<5%), small increases
9 (to 12%) that would not have biologically meaningful effects on spawning success, or decreases (to -
10 21%) that would have a beneficial effect, with the exception of moderate increases in exposure to
11 80% and 85% flow reduction events at the confluence (41% and 16%, respectively). Small increases
12 in exposures to several larger flow reduction categories at Nimbus Dam would partially offset by a
13 moderate reduction in exposure to 90% flow reduction events. Small to moderate increases in
14 exposures to flow reductions, with a more substantial increase in exposure (31%) to a single flow
15 reduction category (80%) would contribute incrementally to effects on rearing conditions at the
16 confluence but not to the extent that would be considered an adverse effect. These results indicate
17 that project-related effects of Alternative 5 on flow would not have biologically meaningful effects
18 on river lamprey ammocoete stranding in the American River.

1 **Table 11-5-62. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 3 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0.0	0.0
-55%	0.0	0.0
-60%	0.0	0.0
-65%	0.0	0.8
-70%	5.6	0.0
-75%	2.8	12.4
-80%	60.0	10.1
-85%	31.2	3.6
-90%	544.0	-21.3

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

4

5 **Table 11-5-63. Relative Difference between Model Scenarios in the Number of River Lamprey**
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 7 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	5	0
-70%	24	1
-75%	60	4
-80%	345	31
-85%	400	16
-90%	396	7

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 5.

8

9 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
 10 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be
 11 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there
 12 would be small to moderate increases and decreases in exposure will balance out within rivers such
 13 that there would be no overall effect on river lamprey ammocoetes relative to NAA.

14 **NEPA Effects:** Overall, these results indicate that the effect would not be adverse because it would
 15 not substantially reduce rearing habitat or substantially reduce the number of fish as a result of
 16 ammocoete mortality. Results indicate that effects of Alternative 5 on flow would not affect river
 17 lamprey ammocoete stranding in the Sacramento River at Keswick and Red Bluff, Trinity River,

1 Feather River, and the American River at Nimbus Dam and the confluence. This is based on results
2 indicating no change (0%), negligible effects (<5%), or only small effects (to 6%) in flow reduction
3 events attributable to the project for all flow reduction categories in the Sacramento River and
4 Trinity River. Results for the Feather River and the American River are more variable, with small to
5 substantial (51%) increases in exposure to one or two flow reduction categories and small to
6 moderate decreases in exposure (to -21%) to other flow reduction categories, with an overall result
7 of no adverse effects on rearing success. There would be small to moderate increases and decreases
8 in exposure will balance out within rivers such that there would be no overall effect on river
9 lamprey ammocoetes

10 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of
11 rearing habitat for river lamprey would not be reduced relative to the CEQA baseline.

12 Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow
13 alterations on ammocoete exposure, or stranding risk, as described for Pacific lamprey, and effects
14 on water temperatures. As described for river lamprey spawning effects above, water temperature
15 results from the SRWQM and the Reclamation Temperature Model were used to assess the
16 exceedances of water temperatures under Alternative 5 in the upper Sacramento, Trinity, Feather,
17 and American Rivers for river lamprey ammocoete rearing. It was determined that the effects of
18 Alternative 5 on water temperatures for all locations analyzed were the same as described for
19 Alternative 1A. Conclusions for Alternative 1A are that effects of water temperature during river
20 lamprey ammocoete rearing would be less than significant relative to Existing Conditions.

21 Flow reductions were evaluated to determine the effects of Alternative 5 on ammocoete stranding
22 risk. Comparisons of Alternative 5 to Existing Conditions for the Sacramento River at Keswick
23 indicate negligible effects (<5%) or small-scale effects (to $\pm 11\%$) on the number of ammocoete
24 cohorts exposed to flow reductions for all flow reduction categories (Table 11-5-58) with the
25 exception of a larger increase (44%) in exposure to month-over-month flow reductions of 85%.
26 Comparisons for the Sacramento River at Red Bluff indicate slightly more variable results with
27 negligible effects (<5%) for all flow reduction categories except for small increases (5% to 10%) in
28 the 60%, 70%, and 80% flow reduction categories, and more substantial increases in exposure to
29 75% flow reduction events (20%) and 85% flow reduction events (25 to 50 cohorts or 100%)
30 (Table 11-5-59). While there would be fairly substantial increases in the number of cohorts exposed
31 to the 85% reduction category at both locations, effects would be negligible or small in all other flow
32 reduction categories and therefore, results indicate that effects of Alternative 5 on flow reductions
33 would not have biologically meaningful effects on river lamprey ammocoete stranding in the
34 Sacramento River at Keswick and at Red Bluff.

35 Comparisons for the Trinity River indicated no effect (0%) for flow reduction categories from 50%
36 to 70%, and increases ranging from 26% to 62% for the higher flow reduction categories (Table 11-
37 5-60). These consistent and more substantial increases in ammocoete cohort exposures to larger
38 flow reductions would affect ammocoete stranding risk and therefore rearing success in the Trinity
39 River.

40 Comparisons for the Feather River indicated no effect or reductions in frequency of occurrence for
41 all flow reduction categories with the exception of a moderate increase in cohort exposure (18%) to
42 85% flow reductions (Table 11-5-61). Decreased exposure (-15%) to 90% flow reduction events
43 would have a beneficial effect. These results indicate that effects of Alternative 5 on flow would not
44 have biologically meaningful effects on river lamprey ammocoete stranding in the Feather River.

1 Comparisons for the American River at Nimbus Dam (Table 11-5-63) and at the confluence with the
2 Sacramento River (Table 11-5-63) indicate small (5%) to substantial (480%) increased ammocoete
3 cohort exposures to flow reductions between 70 and 90% for Alternative 5 compared to Existing
4 Conditions; substantial increases are from 58 to 480% (increase in cohorts exposed from 25 to 145)
5 for Nimbus Dam and from 24% to 400% (increase in cohorts exposed from 50 to 250) for the
6 confluence. These consistent and substantial increases in ammocoete cohorts exposed to flow
7 reductions would affect ammocoete stranding risk and therefore rearing success in the American
8 River.

9 Because water temperatures under Alternative 5 would be similar to those under Alternative 1A,
10 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 5 would be
11 similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that there
12 would be moderate to large increases in ammocoete exposure under Alternative 1A in all rivers
13 evaluated that would substantially reduce rearing habitat conditions relative to Existing Conditions.

14 **Summary of CEQA Conclusion**

15 Overall, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between the
16 CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
17 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
18 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of
19 Alternative 5 on flow reductions would affect ammocoete stranding risk in the Trinity River (based
20 on increases to 62% for the larger flow reduction categories) and the American River (based on
21 increases to 480% for the larger flow reduction categories), and would not affect rearing conditions
22 in the Sacramento River and the Feather River (based on the occurrence of project-related increases
23 in flow reductions with smaller magnitudes deemed to not contribute to biologically meaningful
24 effects on rearing success). Further, there would be moderate to large increases in ammocoete
25 exposure under Alternative 1A in all rivers evaluated that would substantially reduce rearing
26 habitat conditions

27 These results are primarily caused by four factors: differences in sea level rise, differences in climate
28 change, future water demands, and implementation of the alternative. The analysis described above
29 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the
30 alternative from those of sea level rise, climate change and future water demands using the model
31 simulation results presented in this chapter. However, the increment of change attributable to the
32 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
33 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
34 implementation period, which does include future sea level rise, climate change, and water
35 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
36 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
37 effect of the alternative from those of sea level rise, climate change, and water demands.

38 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
39 term implementation period and Alternative 5 indicates that flows in the locations and during the
40 months analyzed above would generally be similar between Existing Conditions during the LLT and
41 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
42 found above would generally be due to climate change, sea level rise, and future demand, and not
43 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
44 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

1 result in a significant impact on rearing habitat for river lamprey. This impact is found to be less
2 than significant and no mitigation is required.

3 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

4 In general, effects of Alternative 5 on river lamprey migration conditions would be negligible
5 relative to NAA.

6 ***Macrophthalmia***

7 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once
8 they reach the Delta. River lamprey migration generally occurs September through November
9 (USFWS unpublished data). The effects of water operations on seasonal migration flows for river
10 lamprey macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely
11 migration pathways of river lamprey during the likely migration period (September through
12 November) were examined to predict how Alternative 5 may affect migration flows for outmigrating
13 macrophthalmia. Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the
14 confluence with the Sacramento River, and the American River at the confluence with the
15 Sacramento River.

16 *Sacramento River*

17 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*
18 *in the Fish Analysis*) for September through November negligible effects (<5%) for some water years
19 during September and October, with increases (to 20%) that would have a beneficial effect on
20 migration and a small decrease (-14%) during September in below normal years. Project-related
21 effects during November consist of small (-6 to -8%) to moderate (to -17%) decreases in all water
22 years. Effects in drier water years for the migration period consist of negligible effects, increased
23 flow, or relatively small decreases in mean monthly flow that would contribute incrementally to
24 effects on migration conditions but would not be expected to have biologically meaningful effects on
25 migration conditions. These results indicate that while flow reductions would occur, effects on
26 outmigrating macrophthalmia would not be biologically meaningful.

27 *Feather River*

28 Comparisons for the Feather River at the confluence with the Sacramento River indicates decreases
29 in mean monthly flow during September in wetter years (to -47%) when effects on migration would
30 be less critical, negligible effects in dry years, and a small increase (7%) in critical years. Project-
31 related effects during October consist of increases in mean monthly flow (to 39%) which would
32 benefit migration. Effects during November consist of negligible effects (<5%) in all water years
33 except a small decrease (-6%) in above normal years. Fairly substantial reductions in flow during
34 September in wetter water years would contribute incrementally to effects on migration conditions;
35 however, this would be offset by increases during October. Based on this and negligible effects or
36 positive effects in drier water years, these results indicate that effects of Alternative 5 on flow would
37 not cause biologically meaningful negative effects for river lamprey macrophthalmia migration in the
38 Feather River.

39 *American River*

40 Comparisons for the American River at the confluence with the Sacramento River for September
41 through November a prevalence of negligible (<5%) or small-scale effects on mean monthly flow,

1 with decreases (to -16%) during September in wet and below normal years, during October in wet,
2 above normal, and critical years, and during November in above and below normal years. These
3 would be offset by small to moderate increases (to 24%) in some water years in each month. Effects
4 in drier water years consist primarily of negligible effects, increases in flow, or small decreases.
5 These results indicate that project-related effects of Alternative 5 on flows would not have
6 biologically meaningful negative effects on river lamprey macrophthalmia migration in the American
7 River.

8 Overall, these results indicate that, despite some variation in results by location, month, and water
9 year type, effects of Alternative 5 on flow would generally not have biologically meaningful effects
10 on river lamprey macrophthalmia migration in the Sacramento River, Feather River, and American
11 River.

12 **Adults**

13 Effects of Alternative 5 on flow during the adult migration period, September through November,
14 would be the same as described for the macrophthalmia migration period, September through
15 November, above. Results are the same; Alternative 5 would not have biologically meaningful
16 negative effects on adult river lamprey migration in the Sacramento River, Feather River, and
17 American River.

18 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
19 would not substantially reduce the amount of suitable habitat or substantially interfere with the
20 movement of fish. Project-related effects consist primarily of negligible effects (<5%), increases in
21 flow (to 24%) that would have a beneficial effect, infrequent small decreases (to -16%) in drier
22 water years that would not have biologically meaningful effects, and more substantial decreases (to
23 -47%) in wetter years when effects on migration would not be critical.

24 **CEQA Conclusion:** In general, under Alternative 5 water operations, the quantity and quality of
25 migration habitat for river lamprey would not be reduced relative to the CEQA baseline.

26 **Macrophthalmia**

27 *Sacramento River*

28 Comparisons for the Sacramento River at Red Bluff for September through November indicate
29 variable effects of Alternative 5 during September, with increases in mean monthly flow (to 64%) in
30 wetter years and decreases (to -24%) in drier years, primarily negligible effects (<5%) and
31 increases in flow (to 22%) during October, and negligible effects or small decreases (to -10%)
32 during November. Flow reductions during September (-24%) and November (-10%) in dry years,
33 and smaller reductions during November in below normal (-13%) and critical years (-10%), would
34 have incremental effects on migration conditions but would not be substantial enough to cause
35 biologically meaningful negative effects on migration conditions.

36 *Feather River*

37 Comparisons for the Feather River at the confluence with the Sacramento River for September
38 through November indicate variable results by month and water year type, with primarily increases
39 (to 72%) in wetter years and decreases (to -34%) in drier years during September, primarily
40 increases in mean monthly flow during October (to 39%) with the exception of a small decrease
41 (-7%) in wet years, and negligible effects (<5%) or small to moderate (to -21%) decreases during

1 November. There would be a substantial reduction in flow in below normal years during September
2 (-30%) with negligible effects during October and a further decrease (-8%) during November that
3 would contribute incrementally to effects on migration conditions in this water year type. The
4 substantial reduction in flow during September in dry years (-34%) would be offset somewhat with
5 an increase during October (11%). While decreases for some of the drier water years during
6 September and November would contribute incrementally to migration conditions, overall effects of
7 Alternative 5 on flows would not have biologically meaningful effects on river lamprey
8 macrophthalmia migration conditions in the Feather River.

9 *American River*

10 Comparisons for the American River at the confluence with the Sacramento River for September
11 through November indicate reductions in flow during September through November in all water
12 year types, ranging from -12 to -48%, with the exception of an increase during October in below
13 normal years (29%) and negligible effects in critical years. The predominance of moderate to
14 substantial decreases in mean monthly flows under Alternative 5 throughout the migration period
15 would affect river lamprey macrophthalmia migration conditions in the American River.

16 Overall, these results indicate that effects of Alternative 5 on flow from September through
17 November would not have biologically meaningful negative effects on river lamprey macrophthalmia
18 migration in the Sacramento River and the Feather River (based on primarily negligible effects or
19 increases in flow, to 72%, with isolated decreases in drier years to -34%), but would affect
20 conditions in the American River (based on decreases in mean monthly flow from -12% to -48% in
21 all water year types throughout the migration period with only a few isolated exceptions).

22 **Adults**

23 Effects of Alternative 5 on flow during the adult migration period, September through November,
24 would be the same as described for the macrophthalmia migration period, September through
25 November, above. These results indicate that Alternative 5 would affect adult migration conditions
26 in the American River, and would not have biologically meaningful negative effects in the
27 Sacramento River and Feather River.

28 **Summary of CEQA Conclusion**

29 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between
30 the CEQA baseline and Alternative 5 could be significant because, under the CEQA baseline, the
31 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
32 the movement of fish, contrary to the NEPA conclusion set forth above. Effects of Alternative 5 on
33 flow would be biologically meaningful to river lamprey macrophthalmia and adult migration
34 conditions in the American River based on persistent and substantial decreases in mean monthly
35 flow (from -12% to -48% in all water year types throughout the migration period with only a few
36 isolated exceptions), and would not be biologically meaningful in the Sacramento River and Feather
37 River (based on variable results with infrequent and/or small reductions in flow in drier years, to -
38 34%, and otherwise primarily negligible effects, <5%, or increases in flow, to 72% that would have
39 beneficial effects).

40 These results are primarily caused by four factors: differences in sea level rise, differences in climate
41 change, future water demands, and implementation of the alternative. The analysis described above
42 comparing Existing Conditions to Alternative 5 does not partition the effect of implementation of the

1 alternative from those of sea level rise, climate change and future water demands using the model
2 simulation results presented in this chapter. However, the increment of change attributable to the
3 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
4 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
5 implementation period, which does include future sea level rise, climate change, and water
6 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
7 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
8 effect of the alternative from those of sea level rise, climate change, and water demands.

9 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
10 term implementation period and Alternative 5 indicates that flows in the locations and during the
11 months analyzed above would generally be similar between Existing Conditions during the LLT and
12 Alternative 5. This indicates that the differences between Existing Conditions and Alternative 5
13 found above would generally be due to climate change, sea level rise, and future demand, and not
14 the alternative. As a result, the CEQA conclusion regarding Alternative 5, if adjusted to exclude sea
15 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
16 result in a significant impact on migration habitat for river lamprey. This impact is found to be less
17 than significant and no mitigation is required.

18 **Restoration Measures (CM2, CM4–CM7, and CM10)**

19 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

20 The potential effects of restoration construction activities under Alternative 5 would be less than
21 that described for Alternative 1A because of the reduced acreage of tidal habitat that would be
22 restored (25,000 acres rather than 65,000 acres) (see Impact AQUA-187). This would include
23 potential effects of turbidity, exposure to methyl mercury, accidental spills, disturbance of
24 contaminated sediments, construction-related disturbance, and predation. However, as concluded in
25 Alternative 1A, Impact AQUA-187, restoration construction activities are not expected to adversely
26 affect river lamprey.

27 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-187 for river lamprey, the potential
28 impact of restoration construction activities is considered less than significant, and no mitigation
29 would be required.

30 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River 31 Lamprey**

32 **NEPA Effects:** The potential effects of contaminants associated with restoration measures under
33 Alternative 5 would be the same as those described for Alternative 1A (see Impact AQUA-188). This
34 would include potential effects of mercury, selenium, copper, ammonia, pyrethroids,
35 organophosphate pesticides and organochlorine pesticides. Under Alternative 5 there would be
36 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres) but
37 the effects on those acres and elsewhere would be the same as described under Alternative 1A. As
38 concluded in Alternative 1A, Impact AQUA-188, contaminants associated with restoration measures
39 are not expected to adversely affect river lamprey.

40 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-188 for river lamprey, the potential
41 impact of contaminants associated with restoration measures is considered less than significant, and

1 no mitigation would be required. The same conclusion applies to the reduced acres of tidal habitat
2 restoration (25,000 acres rather than 65,000 acres).

3 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

4 **NEPA Effects:** The potential effects of restored habitat conditions under Alternative 5 would be the
5 same as those described for Alternative 1A (see Impact AQUA-189). These would include CM2 Yolo
6 Bypass Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally
7 Inundated Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural
8 Community Restoration, and CM10 Nontidal Marsh Restoration. Under Alternative 5 there would be
9 reduced acreage of tidal habitat that would be restored (25,000 acres rather than 65,000 acres). As
10 concluded in Alternative 1A, Impact AQUA-189 under Alternative 1A, restored tidal habitat is
11 expected to be beneficial for river lamprey although the reduced acreage would reduce the benefit.
12 The present discussion considers the restored tidal habitat to be proportionally distributed across
13 the five ROAs and to provide proportionally less benefit based on the reduced acreage compared to
14 Alternative 1A. The Alternative 5 acreage is slightly over 60% less than the Alternative 1A acreage.

15 The restored tidal habitat will provide benefits to river lamprey primarily through increased food
16 production from all ROAs that is exported to the Delta. The overall improved habitat connectivity
17 will benefit all species including river lamprey.

18 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-189 for river lamprey, the potential
19 impact of restored habitat conditions on river lamprey is considered to be beneficial although the
20 reduced tidal habitat would proportionally reduce the benefit by approximately 60%. No mitigation
21 would be required.

22 **Other Conservation Measures (CM12–CM19 and CM21)**

23 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

24 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**
25 **(CM13)**

26 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

27 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

28 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

29 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

30 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

31 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

32 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**
33 **(CM21)**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these nine impact mechanisms
2 on river lamprey are the same as those described under Alternative 1A (Impacts AQUA-190 through
3 AQUA-198). The effects would range from no effect, to not adverse, to beneficial.

4 **CEQA Conclusion:** The impacts of the nine impact mechanisms listed above would range from no
5 impact, to less than significant, to beneficial, and no mitigation is required.

6 **Non-Covered Aquatic Species of Primary Management Concern**

7 **Construction and Maintenance of CM1**

8 The effects of construction and maintenance of CM1 under Alternative 5 would be similar for all
9 non-covered species; therefore, the analysis below is combined for all non-covered species instead
10 of analyzed by individual species.

11 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered** 12 **Aquatic Species of Primary Management Concern**

13 Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water
14 conveyance facilities on non-covered species of primary management concern. That discussion
15 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
16 to the aquatic environment and aquatic species. The potential effects of the construction of water
17 conveyance facilities under Alternative 5 would be similar to those described for Alternative 1A (see
18 Alternative 1A, Impact AQUA-1) except that Alternative 5 would include one intake compared to five
19 intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This
20 would convert about 2,050 lineal feet of existing shoreline habitat into intake facility structures and
21 would require about 4.7 acres of dredge and channel reshaping. In contrast, Alternative 1A would
22 convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. Additionally,
23 California bay shrimp would not be affected because they do not occur in the vicinity and
24 Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary
25 distributions are upstream. As concluded for Alternative 1A, Impact AQUA-199, environmental
26 commitments and mitigation measures would be available to avoid and minimize potential effects,
27 and the effect would not be adverse for non-covered aquatic species of primary management
28 concern.

29 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact
30 of the construction of water conveyance facilities on non-covered species of primary management
31 concern would not be significant except potentially for construction noise associated with pile
32 driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
33 reduce that noise impact to less than significant.

34 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 35 **of Pile Driving and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

37 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 38 **and Other Construction-Related Underwater Noise**

39 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

1 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**
2 **Aquatic Species of Primary Management Concern**

3 Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water
4 conveyance facilities on non-covered species of primary management concern. That discussion
5 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
6 to the aquatic environment and aquatic species. The potential effects of the construction of water
7 conveyance facilities under Alternative 5 would be similar to those described for Alternative 1A (see
8 Alternative 1A, Impact AQUA-2) except that only one intake would be maintained rather than five
9 intakes. California bay shrimp would not be affected because they do not occur in the vicinity and
10 Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary
11 distributions are upstream. Consequently, the effects would not be adverse.

12 **CEQA Conclusion:** As described above, these impacts would be less than significant.

13 **Water Operations of CM1**

14 The effects of water operations of CM1 under Alternative 5 include a detailed analysis of the
15 following species:

- 16 ● Striped Bass
- 17 ● American Shad
- 18 ● Threadfin Shad
- 19 ● Largemouth Bass
- 20 ● Sacramento tule perch
- 21 ● Sacramento-San Joaquin roach – California species of special concern
- 22 ● Hardhead – California species of special concern
- 23 ● California bay shrimp

24 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**
25 **Species of Primary Management Concern**

26 Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-
27 covered species of primary management concern.

28 ***Striped Bass***

29 Striped bass eggs and larvae would be vulnerable to entrainment at the proposed single north
30 SWP/CVP Delta intake and the alternate NBA intake as these life stages are passively transported
31 downstream to the north Delta. State of the art fish screens on the north Delta intake though would
32 exclude juvenile and adult striped bass.

33 Entrainment losses under Alternative 5 to the SWP/CVP south Delta intakes would be expected to
34 decrease moderately compared to NAA since exports from the south Delta facilities would be
35 moderately reduced in the summer. Agricultural diversions are potential sources of entrainment for
36 small fish such as larval and juvenile striped bass (Nobriga et al. 2004). Reduction or consolidation
37 of diversions from the ROAs (approximately 4–12% of diversions) would not increase entrainment
38 and may provide a minor benefit. Additionally, decommissioning of agricultural diversions may also

1 reduce entrainment of striped bass. Also, restoration activities as part of the conservation measures
2 should increase the amount of habitat for young striped bass (e.g. inshore rearing habitat), and
3 increase their food supply. The expectation is that these habitat changes would result in at least a
4 minor improvement in production of juvenile striped bass. Overall, the effect on striped bass
5 entrainment would not be adverse.

6 Variations in striped bass survival rates during the first few months of life are moderated by a
7 population bottleneck between YOY striped bass and three-year-old individuals (Kimmerer et al.
8 2000). Therefore it would be expected that reductions in entrainment of juveniles and adults at the
9 south Delta intakes would have a greater population impact than increases in entrainment of striped
10 bass larvae and eggs at the proposed SWP/CVP north Delta intake and the NBA intake.

11 **CEQA Conclusion:** The impact of water operations on entrainment of striped bass would be the
12 same as described immediately above. The changes in entrainment under Alternative 5 would not
13 substantially reduce the striped bass population. The impact would be less than significant and no
14 mitigation would be required.

15 **American Shad**

16 American shad eggs and larvae would be vulnerable to entrainment at the proposed single north
17 SWP/CVP Delta intake and the alternate NBA intake as these life stages are passively transported
18 downstream to the north Delta. State of the art fish screens on the north Delta intake though would
19 exclude juvenile and adult American shad.

20 American shad entrainment losses under Alternative 5 would decrease compared to NAA due to
21 moderately reduced south Delta exports in the summer. Reduced south Delta entrainment would
22 also be expected to reduce predation loss associated with these facilities, especially within Clifton
23 Court Forebay. Reduction or consolidation of agricultural diversions in ROAs would not increase
24 entrainment. Overall, the effect on American shad would not be adverse, and would be slightly
25 beneficial.

26 **CEQA Conclusion:** The impact of water operations on entrainment of American shad would be the
27 same as described immediately above. The changes in entrainment under Alternative 5 would not
28 substantially reduce the American shad population. The impact would be less than significant and
29 no mitigation would be required.

30 **Threadfin Shad**

31 The impact and conclusion would be the same as discussed for Alternative 1A (Impact AQUA-201).
32 Entrainment at the south Delta would be reduced due to overall lower exports from south Delta
33 facilities; there would also be a concomitant reduction in predation loss especially within Clifton
34 Court Forebay. There would be entrainment of threadfin shad eggs and larvae at the north Delta
35 intake. Decommissioning agricultural diversions in Delta ROAs would decrease or have no impact on
36 threadfin shad entrainment. Overall, threadfin shad entrainment would be reduced because they are
37 most abundant in the southwestern portion of the Delta and would benefit from reduced south Delta
38 exports. The effect would not be adverse.

39 **CEQA Conclusion:** The impact of water operations on entrainment of threadfin shad would be the
40 same as described immediately above. The changes in entrainment under Alternative 5 would not
41 substantially reduce and may benefit the threadfin shad population. The impact would be less than
42 significant and no mitigation would be required.

1 **Largemouth Bass**

2 Since largemouth bass are predominantly found in the south and central portions of the Delta,
3 largemouth bass would be most vulnerable to entrainment to south Delta facilities. Entrainment to
4 the south Delta would be reduced because of reductions in south Delta exports in the summer. As
5 discussed for Alternative 1A (Impact AQUA-201) few larval largemouth bass would be vulnerable to
6 entrainment to north Delta and alternative NBA intake since they are not expected to readily occur
7 there. Decommissioning agricultural diversions could reduce entrainment of largemouth bass since
8 they hold in shallow water habitats where most agricultural diversions are sited. Overall
9 entrainment would be reduced under Alternative 5 and there could be a small benefit to the species.

10 **CEQA Conclusion:** The impact of water operation on largemouth bass would be as described
11 immediately above. The changes in entrainment under Alternative 5 could benefit the largemouth
12 bass population. The impact would be less than significant and no mitigation would be required.

13 **Sacramento Tule Perch**

14 The effects and conclusion for this impact would be the same as Alternative 1A (Impact AQUA-201).
15 Entrainment of Sacramento tule perch to the SWP/CVP south Delta facilities would decrease
16 because south Delta exports would be less compared to NAA. Entrainment-related predation loss
17 would also be reduced. Because Sacramento tule perch are viviparous, newly born Sacramento tule
18 perch would be large enough to be effectively screened at the proposed north Delta facilities.
19 Reduction or consolidation of these agricultural diversions under the Plan would decrease
20 entrainment of Sacramento tule perch into these agricultural intakes. Overall the reduction in
21 entrainment of Sacramento tule perch under Alternative 5 would not be adverse, and may provide a
22 benefit for the species.

23 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would
24 be the same as described immediately above. The changes in entrainment under Alternative 5 may
25 provide a benefit to the Sacramento tule perch. The impact would be less than significant and no
26 mitigation would be required.

27 **Sacramento-San Joaquin Roach**

28 The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 5
29 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a
30 detailed discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

31 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento-San Joaquin roach
32 would be the same as described immediately above. The impacts would be less than significant.

33 **Hardhead**

34 The effect of water operations on entrainment of hardhead under Alternative 5 would be similar to
35 that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion,
36 please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

37 **CEQA Conclusion:** The impact of water operations on entrainment of hardhead would be the same
38 as described immediately above. The impacts would be less than significant.

1 **California Bay Shrimp**

2 The effect of water operations on entrainment of California bay shrimp under Alternative 5 would
3 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed
4 discussion, please see Alternative 1A, Impact AQUA-201. California bay shrimp do not occur in the
5 vicinity of the intake and there would be effect.

6 **CEQA Conclusion:** The impact of water operations on entrainment of California bay shrimp would
7 be the same as described immediately above. There would be no impact.

8 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
9 **Non-Covered Aquatic Species of Primary Management Concern**

10 Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-
11 covered species of primary management concern.

12 **Striped Bass**

13 In general, Alternative 5 would slightly improve the quality and quantity of upstream habitat
14 conditions for striped bass relative to NAA.

15 **Flows**

16 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
17 Clear Creek were examined during the April through June striped bass spawning, embryo
18 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
19 habitat available for spawning, egg incubation, and rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
21 greater (to 15% greater) than flows under NAA during April through June except in wet years
22 during May relative to NAA (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
23 *Analysis*).

24 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
25 greater (to 28% greater) than flows under NAA during April through June except in above normal
26 years in April relative to NAA (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
27 *Fish Analysis*).

28 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
29 (to 9% greater) than flows under NAA during April through June for each month and water year
30 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 83%
32 greater) than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
33 *utilized in the Fish Analysis*).

34 In the American River at Nimbus Dam, flows under A5_LLT would generally greater (to 44%) than
35 flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in*
36 *the Fish Analysis*).

37 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
38 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
39 flows relative to the NAA.

1 *Water Temperature*

2 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
3 bass spawning, embryo incubation, and initial rearing during April through June was examined in
4 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
5 range could lead to reduced spawning success and increased egg and larval stress and mortality.
6 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
9 there would be no temperature related effects in these rivers during the April through June period.

10 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the
11 range would be similar to or lower (to 36% lower) than the percentage under NAA in all water year
12 types (Table 11-5-64).

13 **Table 11-5-64. Difference and Percent Difference in the Percentage of Months during April–June in**
14 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F**
15 **to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial**
16 **Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (0%)	-5 (-12%)
Above Normal	-6 (-13%)	-3 (-8%)
Below Normal	-10 (-22%)	-12 (-36%)
Dry	-4 (-8%)	0 (0%)
Critical	8 (21%)	-6 (-12%)
All	-2 (-5%)	-5 (-12%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

17
18 Collectively, these results indicate that the effect would not be adverse because Alternative 5 would
19 not cause a substantial reduction in striped bass spawning, incubation, or initial rearing habitat.
20 Flows in all rivers examined during the April through June spawning, incubation, and initial rearing
21 period under Alternative 5 would generally be similar to or greater than flows under NAA. The
22 percentage of months outside the 59°F to 68°F water temperature range would generally be lower
23 under Alternative 5 than under NAA.

24 **CEQA Conclusion:** In general, Alternative 5 would slightly improve the quality and quantity of
25 upstream habitat conditions for striped bass relative to Existing Conditions.

26 *Flows*

27 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
28 Clear Creek were examined during the April through June striped bass spawning, embryo
29 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
30 habitat available for spawning, egg incubation, and rearing.

31 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
32 greater (to 13% greater) than flows under Existing Conditions during April through June, except in

1 wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM*
2 *II Model Results utilized in the Fish Analysis*).

3 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
4 greater (to 28% greater) than flows under Existing Conditions during April through June, except in
5 critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
6 *Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to
8 14% greater) than flows under Existing Conditions during April through June regardless of water
9 year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or
11 greater (to 86% greater) than flows under Existing Conditions during April through June, except in
12 wet and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM*
13 *II Model Results utilized in the Fish Analysis*).

14 In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater
15 than flows under Existing Conditions during April and June (to 19% greater), except in above
16 normal and below normal years during April (7% and 5% lower, respectively) and wet and critical
17 years during June (30% and 19% lower, respectively), but generally lower, by up to 31%, during
18 May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
20 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis
21 for Alternative 1A indicates that there would be small to moderate reductions in flows during the
22 period relative to Existing Conditions.

23 *Water Temperature*

24 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
25 bass spawning, embryo incubation, and initial rearing during April through June was examined in
26 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
27 range could lead to reduced spawning success and increased egg and larval stress and mortality.
28 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

29 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
30 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
31 there would be no temperature related effects in these rivers during the April through June period.

32 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of
33 the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation,
34 and initial rearing during April through June would be similar to or lower (up to 22% lower) than
35 the percentage under Existing Conditions in all water years except critical years (21% greater)
36 (Table 11-5-64).

37 Collectively, these results indicate that the impact would not be significant because Alternative 5
38 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of
39 striped bass. Therefore, no mitigation is necessary. Flows in all rivers except the San Joaquin and
40 Stanislaus rivers during the April through June spawning, incubation, or initial rearing period under
41 Alternative 5 would generally be similar to or greater than flows under Existing Conditions. Flows in

1 the San Joaquin and Stanislaus rivers would be lower under Alternative 5, although this effect would
2 not be biologically meaningful to striped bass. The percentage of months outside the 59°F to 68°F
3 water temperature range would generally be lower under Alternative 5 than under Existing
4 Conditions.

5 ***American Shad***

6 In general, Alternative 5 would slightly improve the quality and quantity of upstream habitat
7 conditions for American shad relative to NAA.

8 *Flows*

9 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
10 Clear Creek were examined during the April through June American shad adult migration and
11 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
12 quality for spawning.

13 In the Sacramento River upstream of Red Bluff, flows under A5_LLTP would generally be similar to or
14 greater (to 15% greater) than flows under NAA during April through June (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*).

16 In the Trinity River below Lewiston Reservoir, flows under A5_LLTP would generally be similar to
17 NAA during April through June except in above normal years in April (11% lower) (Appendix 11C,
18 *CALSIM II Model Results utilized in the Fish Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A5_LLTP would generally be similar to or greater
20 (to 9% greater) than flows under NAA during April through June for each month and water year
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A5_LLTP would generally be substantially
23 greater (to 83% greater) than flows under NAA during April through June (Appendix 11C, *CALSIM II*
24 *Model Results utilized in the Fish Analysis*).

25 In the American River at Nimbus Dam, flows under A5_LLTP would generally be greater (to 44%)
26 than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized*
27 *in the Fish Analysis*).

28 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
29 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
30 flows relative to the NAA.

31 *Water Temperature*

32 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
33 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
34 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
35 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
36 were not modeled in the San Joaquin River or Clear Creek.

37 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
38 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
39 there would be no temperature related effects in these rivers during the April through June period.

1 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the
2 60°F to 70°F water temperature range would generally be lower than the percentage under NAA in
3 all water year types (from 7% to 15% lower) (Table 11-5-65).

4 **Table 11-5-65. Difference and Percent Difference in the Percentage of Months during April–June in**
5 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F**
6 **to 70°F Water Temperature Range for American Shad Adult Migration and Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-8 (-17%)	-3 (-7%)
Above Normal	3 (8%)	-6 (-15%)
Below Normal	2 (8%)	-5 (-14%)
Dry	2 (5%)	-4 (-9%)
Critical	3 (8%)	-3 (-7%)
All	-1 (-2%)	-4 (-10%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

7
8 Collectively, these results indicate that the effect would not be adverse because Alternative 5 would
9 not cause a substantial reduction in American shad spawning or adult migration. Flows in all rivers
10 examined during the April through June adult migration and spawning period under Alternative 5
11 would generally be similar to or greater than flows under NAA. The percentage of months outside
12 the 60°F to 70°F water temperature range in the Feather River would generally be lower under
13 Alternative 5 than under NAA. There would be no temperature related effects in any other rivers
14 examined.

15 **CEQA Conclusion:** In general, Alternative 5 would slightly improve the quality and quantity of
16 upstream habitat conditions for American shad relative to Existing Conditions.

17 *Flows*

18 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
19 Clear Creek were examined during the April through June American shad adult migration and
20 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
21 quality for spawning.

22 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
23 greater (to 13% greater) than flows under Existing Conditions during April through June, except in
24 wet and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM*
25 *II Model Results utilized in the Fish Analysis*).

26 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
27 greater (to 28% greater) than flows under Existing Conditions during April through June, except in
28 critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*).

30 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to
31 14% greater) than flows under Existing Conditions during April through June regardless of water
32 year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or
2 greater (to 62% greater) than flows under Existing Conditions during April through June, except in
3 wet and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM*
4 *II Model Results utilized in the Fish Analysis*).

5 In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater
6 than flows under Existing Conditions during April and June (to 19% greater), except in above
7 normal and below normal years during April (7% and 5% lower, respectively) and wet and critical
8 years during June (30% and 19% lower, respectively), and generally lower, by up to 31%, during
9 May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
11 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis
12 for Alternative 1A indicates that there would be small to moderate reductions in flows during the
13 period relative to Existing Conditions.

14 *Water Temperature*

15 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
16 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
17 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
18 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
19 were not modeled in the San Joaquin River or Clear Creek.

20 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
21 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
22 there would be no temperature related effects in these rivers during the April through June period.

23 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of
24 the 60°F to 70°F water temperature range would be greater than the percentage under Existing
25 Conditions in all water years (5% to 8% greater) except wet years (17% lower) (Table 11-5-65).
26 These are small increases that would not have biologically meaningful negative effects on migration
27 and spawning success.

28 Collectively, these results indicate that the impact would not be significant because Alternative 5
29 would not cause a substantial reduction in American shad adult migration and spawning habitat,
30 and no mitigation is necessary. Flows in all rivers examined except the San Joaquin and Stanislaus
31 rivers during the April through June adult migration and spawning period under Alternative 5
32 would generally be similar to or greater than flows under Existing Conditions. Flows in the San
33 Joaquin and Stanislaus rivers would be lower under Alternative 5, although this effect would not be
34 biologically meaningful to American shad. The percentage of months outside the 60°F to 70°F water
35 temperature range in the Feather River would generally be slightly greater under Alternative 5 than
36 under Existing Conditions but would not have biologically meaningful effects on spawning and
37 migration success. There would be no temperature related effects in any other rivers examined.

38 ***Threadfin Shad***

39 In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for
40 threadfin shad relative to NAA.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during April through August threadfin shad spawning period. Lower
4 flows could reduce the quantity and quality of instream habitat available for spawning.

5 In the Sacramento River upstream of Red Bluff, April through August flows under A5_LLT would
6 generally be similar to or greater (up to 15% greater) than flows under NAA, and to 14% lower
7 compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
9 greater (to 28% greater) than flows under NAA, and a single flow reduction, 11% lower, compared
10 to NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would nearly always be similar to or
12 greater (to 10% greater) than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in*
13 *the Fish Analysis*).

14 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater than
15 flows under NAA from April through July (up to 42% greater), with two isolated exceptions (to 32%
16 lower), and lower during August (up to 34% lower) except in above normal years (Appendix 11C,
17 *CALSIM II Model Results utilized in the Fish Analysis*). Moderate flow reductions in dry and critical
18 years during July and August would have a localized effect late in the period.

19 In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater
20 than flows under NAA from April through July (up to 44% greater) except in above normal years
21 during July (10% lower), and lower during August (to 35% lower) in all but above normal years
22 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate flow reductions in
23 drier water years during August would be partially offset by increases in flow in adjoining months
24 and would not have biologically meaningful effects.

25 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
26 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
27 flows relative to the NAA.

28 *Water Temperature*

29 The percentage of months below 68°F water temperature threshold for the April through August
30 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
31 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
32 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
33 Creek.

34 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
35 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
36 there would be no temperature-related effects in these rivers throughout the year.

37 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT below
38 68°F would be greater than the percentage under NAA in wetter water year types (8% to 14%
39 greater), and similar to or slightly lower (5% lower) in dry and critical years, respectively (Table 11-
40 5-66). The increases would be of relatively small magnitude in terms of absolute percentages (5% to
41 7%) and would not have biologically meaningful effects on the shad population.

1 **Table 11-5-66. Difference and Percent Difference in the Percentage of Months during April–August**
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 68°F**
 3 **Water Temperature Threshold for Threadfin Shad Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-8 (-13%)	5 (8%)
Above Normal	-22 (-29%)	7 (13%)
Below Normal	-17 (-24%)	7 (14%)
Dry	-31 (-42%)	-1 (-3%)
Critical	-30 (-46%)	-2 (-5%)
All	-20 (-29%)	3 (7%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4
 5 Collectively, these results indicate that the effect would not be adverse because Alternative 5 would
 6 not cause a substantial reduction in spawning habitat. Flows in all rivers examined during the April
 7 through August spawning period under Alternative 5 would generally be similar to or greater than
 8 flows under NAA. There would be isolated, small-magnitude flow reductions in some month and
 9 water year types that would not have biologically meaningful effects. There would be moderate flow
 10 reductions in drier water years late in the period in the Feather River (during July and August) and
 11 the American River (during August) that would have localized effects but would not have
 12 biologically meaningful effects on the threadfin shad population. The percentage of months below
 13 the spawning temperature threshold in the Feather River would be moderately greater under
 14 Alternative 5 relative to NAA, but this increase is not expected to have a biologically meaningful
 15 effect on the threadfin shad population based on the relatively small magnitude of the absolute
 16 increases, and the fact that they would occur at a single location and not in all water year types.
 17 There would be no temperature-related effects in any other rivers examined.

18 **CEQA Conclusion:** In general, Alternative 5 would not affect the quality and quantity of upstream
 19 habitat conditions for threadfin shad relative to Existing Conditions.

20 *Flows*

21 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 22 Clear Creek were examined during April through August spawning period. Lower flows could reduce
 23 the quantity and quality of instream habitat available for spawning.

24 In the Sacramento River upstream of Red Bluff, flows under A5_LLT during April through August
 25 would generally be similar to or greater than flows under Existing Conditions (to 13% greater),
 26 except in wet and below normal years during May (18% and 6% lower, respectively) (Appendix
 27 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
 29 greater than flows under Existing Conditions (to 28% greater) from April to August, except in
 30 critical years during May and August (6% and 25% lower, respectively) and in wet years during July
 31 (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would nearly always be similar to or
 33 greater than flows under Existing Conditions (to 14% greater) throughout the period, except in

1 critical years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
2 *Analysis*).

3 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (up to
4 86% greater) than flows under Existing Conditions during April through August, except in wetter
5 water years during May (to 37% lower), in drier water years during July (to 20% lower), and in
6 drier water years during August (to 54% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
7 *the Fish Analysis*). Moderate flow reductions in drier water years during July and August would have
8 a localized effect late in the period.

9 In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater
10 (to 20% greater) than flows under Existing Conditions in drier water years during April, in dry years
11 during May, and in below normal and dry years during June (Appendix 11C, *CALSIM II Model Results*
12 *utilized in the Fish Analysis*). Flows under A5_LLT would be similar to or lower than flows under
13 Existing Conditions for the remainder of the period (to 52%). Flow reductions in drier water years,
14 when effects on habitat conditions would be more critical, would be moderate but inconsistent
15 month to month by water year type, with substantial flow reductions during August that would have
16 a localized effect late in the period.

17 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
18 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis
19 for Alternative 1A indicates that there would be small to moderate reductions in flows during the
20 period relative to Existing Conditions.

21 *Water Temperature*

22 The percentage of months below 68°F water temperature threshold for the April through August
23 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
24 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
25 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
26 Creek.

27 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
28 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
29 there would be no temperature-related effects in these rivers during the April through November
30 period.

31 In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water
32 temperature threshold for threadfin shad spawning under A5_LLT would be 13% to 46% lower than
33 the percentage under Existing Conditions, depending on water year type (Table 11-5-66).

34 Collectively, these results indicate that the impact would not be significant because Alternative 5
35 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers
36 examined during the April through August spawning period under Alternative 5 would generally be
37 similar to or greater than flows under Existing Conditions. There would be isolated, small-
38 magnitude flow reductions in some month and water year types that would not have biologically
39 meaningful effects. There would be moderate flow reductions in drier water years late in the period
40 in the Feather River (during July and August) and the American River (during August) that would
41 have localized effects but would not have biologically meaningful effects on the threadfin shad
42 population. The percentage of months outside all temperature thresholds in the Feather River would
43 generally be generally lower under Alternative 5 than under Existing Conditions, indicating that

1 there would be a net temperature-related benefit of Alternative 5 to threadfin shad relative to
2 Existing Conditions. There would be no temperature related effects in any other waterways
3 examined.

4 **Largemouth Bass**

5 In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for
6 largemouth bass relative to NAA.

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
9 Clear Creek were examined during the March through June largemouth bass spawning period.

10 Lower flows could reduce the quantity and quality of instream spawning habitat.

11 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
12 greater (to 15% greater) than flows under NAA during March through June (Appendix 11C, *CALSIM*
13 *II Model Results utilized in the Fish Analysis*).

14 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
15 greater (to 28% greater) than flows under NAA during March through June except in above normal
16 years during April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
18 (to 29% greater) than flows under NAA during March through June for each month and water year
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be substantially
21 greater (to 83% greater) than flows under NAA during March through June.

22 In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 44%)
23 than flows under NAA regardless of water year type.

24 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
25 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
26 flows relative to the NAA.

27 *Water Temperature*

28 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
29 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
30 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
31 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
32 Creek.

33 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
34 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
35 there would be no temperature-related effects in these rivers during the March through June period.

36 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the
37 59°F to 75°F water temperature range would be similar to or lower than the percentage under NAA in
38 all water years except dry years (5% greater) (Table 11-5-67).

1 **Table 11-5-67. Difference and Percent Difference in the Percentage of Months during March–June**
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**
 3 **59°F to 75°F Water Temperature Range for Largemouth Bass Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-9 (-16%)	0 (0%)
Above Normal	-14 (-27%)	0 (0%)
Below Normal	-13 (-28%)	-2 (-6%)
Dry	-17 (-35%)	1 (5%)
Critical	-17 (-38%)	-6 (-23%)
All	-13 (-26%)	-1 (-3%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **CEQA Conclusion:** In general, Alternative 5 would not reduce the quality and quantity of upstream
 6 habitat conditions for largemouth bass relative to Existing Conditions.

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 9 Clear Creek were examined during the March through June largemouth bass spawning period.
 10 Lower flows could reduce the quantity and quality of instream spawning habitat.

11 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
 12 greater (to 13% greater) than flows under Existing Conditions during March through June, except in
 13 below normal years of March (10% lower), and wet and below normal years during May (18% and
 14 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
 16 greater (to 28% greater) than flows under Existing Conditions during March through June, except in
 17 below normal years in March (6% lower) and in critical years during May (6% lower) (Appendix
 18 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to
 20 29% greater) than flows under Existing Conditions during March through June regardless of water
 21 year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or
 23 greater (to 86% greater) than flows under Existing Conditions during March through June, except in
 24 below normal years in March (48% lower), and in wet and above normal years during May (37%
 25 and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater
 27 than flows under Existing Conditions during March, April, and June (to 19% greater), except in
 28 above normal and below normal years during April (7% and 5% lower, respectively) and wet and
 29 critical years during June (30% and 19% lower, respectively), and generally lower, by up to 31%,
 30 during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
 32 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis

1 for Alternative 1A indicates that there would be small to moderate reductions in flows during the
2 period relative to Existing Conditions.

3 *Water Temperature*

4 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
5 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
6 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
7 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
8 Creek.

9 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
10 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
11 there would be no temperature-related effects in these rivers during the March through June period.

12 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLТ outside of
13 the 59°F to 75°F water temperature range for largemouth bass spawning would be lower (to 38%)
14 than the percentage under Existing Conditions in all water years (Table 11-5-67).

15 *Sacramento Tule Perch*

16 The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 5
17 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a
18 detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

19 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would
20 be the same as described immediately above. The impacts would be less than significant.

21 *Sacramento-San Joaquin Roach – California species of special concern*

22 In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for
23 Sacramento-San Joaquin Roach relative to NAA.

24 *Flows*

25 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
26 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
27 period. Lower flows could reduce the quantity and quality of instream habitat available for
28 spawning.

29 In the Sacramento River upstream of Red Bluff, flows under A5_LLТ would generally be similar to or
30 greater (to 15% greater) than flows under NAA during March through June (Appendix 11C, *CALSIM*
31 *II Model Results utilized in the Fish Analysis*).

32 In the Trinity River below Lewiston Reservoir, flows under A5_LLТ would generally be similar to or
33 greater (to 28% greater) than flows under NAA during March through June except in above normal
34 years in April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 In Clear Creek at Whiskeytown Dam, flows under A5_LLТ would generally be similar to or greater
36 (to 29% greater) than flows under NAA during March through June for each month and water year
37 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be substantially
2 greater (to 83% greater) than flows under NAA during March through June (Appendix 11C, *CALSIM*
3 *II Model Results utilized in the Fish Analysis*).

4 In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 44%)
5 than flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized*
6 *in the Fish Analysis*).

7 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
8 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
9 flows relative to the NAA.

10 *Water Temperature*

11 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
12 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
13 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
14 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
15 River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
17 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
18 there would be no temperature-related effects in these rivers during the March through June period.

19 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures
20 would be below the 60.8°F water temperature threshold for roach spawning initiation under
21 A5_LLT would be similar to or lower (to 5% lower) than the percentage under NAA in all water year
22 types (Table 11-5-68).

23 **Table 11-5-68. Difference and Percent Difference in the Percentage of Months during March–June**
24 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the**
25 **60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach**
26 **Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-13%)	0 (0%)
Below Normal	-4 (-7%)	2 (4%)
Dry	-13 (-23%)	-1 (-3%)
Critical	-17 (-30%)	-2 (-5%)
All	-11 (-19%)	-0.3 (-1%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

27

28 **CEQA Conclusion:** In general, Alternative 5 would not affect the quality and quantity of upstream
29 habitat conditions for Sacramento-San Joaquin Roach relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
4 period. Lower flows could reduce the quantity and quality of instream habitat available for
5 spawning.

6 In the Sacramento River upstream of Red Bluff, flows under A5_LLTP would generally be similar to or
7 greater (to 13% greater) than flows under Existing Conditions during March through June, except in
8 below normal years of March (10% lower), and in wet and below normal years during May (18%
9 and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the Trinity River below Lewiston Reservoir, flows under A5_LLTP would generally be similar to or
11 greater (to 28% greater) than flows under Existing Conditions during March through June, except in
12 below normal years in March (6% lower) and in critical years during May (6% lower) (Appendix
13 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 In Clear Creek at Whiskeytown Dam, flows under A5_LLTP would always be similar to or greater (to
15 29% greater) than flows under Existing Conditions during March through June regardless of water
16 year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the Feather River at Thermalito Afterbay, flows under A5_LLTP would generally be similar to or
18 greater (to 86% greater) than flows under Existing Conditions during March through June, except in
19 below normal years in March (48% lower), and in wet and above normal years during May (37%
20 and 7% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the American River at Nimbus Dam, flows under A5_LLTP would generally be similar to or greater
22 than flows under Existing Conditions during March, April, and June (to 19% greater), except in
23 above normal and below normal years during April (7% and 5% lower, respectively) and in wet and
24 critical years during June (30% and 19% lower, respectively), but generally lower, by up to 31%,
25 during May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
27 under Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis
28 for Alternative 1A indicates that there would be small to moderate reductions in flows during the
29 period relative to Existing Conditions.

30 *Water Temperature*

31 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
32 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
33 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
34 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
35 River or Clear Creek.

36 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
37 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
38 there would be no temperature-related effects in these rivers during the March through June period.

39 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures
40 would be below the 60.8°F water temperature threshold for roach spawning initiation under

1 A5_LLT would be lower (to 30%) than the percentage under Existing Conditions in all water years
2 (Table 11-5-68).

3 **Hardhead – California species of special concern**

4 In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for
5 hardhead relative to NAA.

6 *Flows*

7 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
8 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
9 could reduce the quantity and quality of instream habitat available for spawning.

10 In the Sacramento River upstream of Red Bluff, April and May flows under A5_LLT would generally
11 be similar to or greater (to 15% greater) than flows under NAA throughout the period (Appendix
12 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 In the Trinity River below Lewiston Reservoir, April and May flows under A5_LLT would generally
14 be similar to or greater (to 17% greater) than flows under NAA throughout the (Appendix 11C,
15 *CALSIM II Model Results utilized in the Fish Analysis*).

16 In Clear Creek at Whiskeytown Dam, April and May flows under A5_LLT would always to be similar
17 to flows under NAA throughout the period regardless of water year type (Appendix 11C, *CALSIM II*
18 *Model Results utilized in the Fish Analysis*).

19 In the Feather River at Thermalito Afterbay, April and May flows under A5_LLT would generally be
20 substantially greater (up to 70% greater) than flows under NAA throughout the period (Appendix
21 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the American River at Nimbus Dam, flows under A5_LLT would be similar to flows under NAA in
23 April. During May, flows under A5_LLT would generally be greater than flows under NAA (up to 15%
24 greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
26 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
27 flows relative to the NAA.

28 *Water Temperature*

29 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
30 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
31 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
32 spawning success and increased egg and larval stress and mortality. Water temperatures were not
33 modeled in the San Joaquin River or Clear Creek.

34 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
35 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
36 there would be no temperature-related effects in these rivers throughout the year.

37 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the
38 range would be similar to or lower (to 18%) than the percentage under NAA in all water year types
39 (Table 11-5-69).

1 **Table 11-5-69. Difference and Percent Difference in the Percentage of Months during April–May in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F**
 3 **to 64°F Water Temperature Range for Hardhead Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	2 (3%)	0 (0%)
Above Normal	-9 (-14%)	0 (0%)
Below Normal	18 (42%)	-4 (-6%)
Dry	-8 (-15%)	-3 (-6%)
Critical	-8 (-15%)	-8 (-18%)
All	-1 (-1%)	-2 (-4%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **CEQA Conclusion:** In general, Alternative 5 would not affect the quality and quantity of upstream
 6 habitat conditions for hardhead relative to Existing Conditions.

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 9 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
 10 could reduce the quantity and quality of instream habitat available for spawning.

11 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
 12 greater (to 13% greater) than flows under Existing Conditions throughout the period, except in wet
 13 and below normal years during May (18% and 6% lower, respectively) (Appendix 11C, *CALSIM II*
 14 *Model Results utilized in the Fish Analysis*).

15 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
 16 greater (to 17% greater) than flows under Existing Conditions throughout the period, except in
 17 critical years during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 18 *Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would always be similar to or greater (to
 20 10% greater) than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II*
 21 *Model Results utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be similar to or
 23 greater (to 62% greater) than flows under Existing Conditions throughout the period, except in wet
 24 and above normal years during May (37% and 7% lower, respectively) (Appendix 11C, *CALSIM II*
 25 *Model Results utilized in the Fish Analysis*).

26 In the American River at Nimbus Dam, flows under A5_LLT would be similar to or greater (to 12%
 27 greater) than flows under Existing Conditions during April, with some exceptions (up to 7% lower)
 28 and generally lower than flows under Existing Conditions (to 24%) during May, except in dry years
 29 (9% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

30 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
 31 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
 32 moderate reductions in flows during the period relative to Existing Conditions.

1 *Water Temperature*

2 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
3 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
4 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
5 spawning success and increased egg and larval stress and mortality. Water temperatures were not
6 modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
8 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
9 Alternative 1A.

10 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside of
11 the 59°F to 64°F water temperature range for hardhead spawning would be similar to or lower (to
12 15% lower) than the percentage under Existing Conditions in all water years except below normal
13 years (42% greater) (Table 11-5-69). The isolated increase corresponds to a relatively moderate
14 absolute increase of 18% and occurs in a single water year type, and would not have biologically
15 meaningful effects on hardhead spawning success.

16 ***California Bay Shrimp***

17 The effect of water operations on spawning habitat of California bay shrimp under Alternative 5
18 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a
19 detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects would not be adverse.

20 ***CEQA Conclusion:*** The impact of water operations on spawning habitat of California bay shrimp
21 would be the same as described immediately above. The impacts would be less than significant.

22 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**
23 **Species of Primary Management Concern**

24 Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-
25 covered species of primary management concern.

26 ***Striped Bass***

27 The discussion under Alternative 5, Impact AQUA-202 for striped bass also addressed the embryo
28 incubation and initial rearing period. That analysis indicates that there is no adverse effect on
29 striped bass rearing during that period. Other effects of water operations on rearing habitat for
30 striped bass under Alternative 5 would be similar to that described for Alternative 1A (see
31 Alternative 1A, Impact AQUA-5). That discussion under delta smelt addresses the type, magnitude
32 and range of impact mechanisms that are relevant to the aquatic environment and aquatic species.
33 The effects would not be adverse.

34 ***CEQA Conclusion:*** As described above the impacts on striped bass rearing habitat would be less
35 than significant.

36 ***American Shad***

37 The effects of water operations on rearing habitat for American shad under Alternative 5 would be
38 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed
39 discussion, please see Alternative 1A, Impact AQUA-203. The effects would not be adverse.

1 **CEQA Conclusion:** As described above the impacts on American shad rearing habitat would be less
2 than significant.

3 **Threadfin Shad**

4 The effects of water operations on rearing habitat for threadfin shad under Alternative 5 would be
5 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed
6 discussion, please see Alternative 1A, Impact AQUA-203. The effects would not be adverse.

7 **CEQA Conclusion:** As described above the impacts on threadfin shad rearing habitat would be less
8 than significant.

9 **Largemouth Bass**

10 *Juveniles*

11 *Flows*

12 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
13 Clear Creek were examined during the April through November juvenile largemouth bass rearing
14 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
15 rearing.

16 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
17 greater (to 23%) than flows under NAA during all months but November with some exceptions (up
18 to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under
19 A5_LLT during November would be lower (up to 17% lower) depending on month, water year type,
20 and time period.

21 In the Trinity River below Lewiston Reservoir, April through November flows under A5_LLT would
22 generally be similar to or greater than flows under NAA during the April through November period
23 with the exception of some small flow reductions (up to 11% lower).

24 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
25 (to 10% greater) than NAA throughout the year (Appendix 11C, *CALSIM II Model Results utilized in*
26 *the Fish Analysis*).

27 In the Feather River at Thermalito Afterbay, April through November flows under A5_LLT would
28 generally be similar to or greater (to 47% greater) than flows under NAA with infrequent exceptions
29 (up to 32% lower) in every month but August and September. In August and September, flows
30 under A5_LLT would generally be lower (to 61% lower) than flows under NAA, with small to
31 substantial reductions in some of the drier water year types that would have a localized effect on
32 habitat conditions during August and/or September (Appendix 11C, *CALSIM II Model Results utilized*
33 *in the Fish Analysis*).

34 In the American River at Nimbus Dam, April through November flows under A5_LLT would
35 generally be greater (to 44% greater) than flows under NAA during all months but August, with
36 infrequent exceptions of flow reductions of small magnitude (up to 14% lower). Flows during the
37 month of August would generally be lower under A5_LLT relative to NAA (to 35% lower) with small
38 to moderate reductions in each of the drier water year types that would have a localized effect
39 during August (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
2 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
3 flows relative to the NAA.

4 *Water Temperature*

5 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
6 rearing during April through November was examined in the Sacramento, Trinity, Feather,
7 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
8 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
9 temperatures were not modeled in the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
11 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
12 there would be no temperature-related effects in these rivers during the April through November
13 period.

14 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under
15 NAA or A5_LLT (Table 11-5-70). As a result, there would be no difference in the percentage of
16 months in which the 88°F water temperature threshold is exceeded between Alternative 5 and NAA.

17 **Table 11-5-70. Difference and Percent Difference in the Percentage of Months during April–**
18 **November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed**
19 **the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

20

21 *Adult Rearing*

22 *Flows*

23 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
24 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows
25 could reduce the quantity and quality of instream habitat available for adult rearing.

26 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
27 greater (to 23% greater) than flows under NAA during all months but November with relatively
28 infrequent exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*). Flows under A5_LLT during November would be lower than flows under NAA (up to 15%
30 and 17% lower depending on month, water year type, and time period) (Appendix 11C, *CALSIM II*

1 *Model Results utilized in the Fish Analysis*). These are infrequent and small-magnitude flow
2 reductions that would not have biologically meaningful effects.

3 In the Trinity River below Lewiston Reservoir, year round flows under A5_LLT would generally be
4 similar to or greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16%
5 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
7 (to 10% greater) than NAA throughout the year, except in below normal years during March (6%
8 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 47%
10 greater) than flows under NAA during all months except August and September, with infrequent
11 exceptions (up to 32% lower). During August and September, flows under A5_LLT would generally
12 be lower (to 34 and 61% lower, respectively) than those under NAA, including in drier water years
13 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions coupled
14 with flow reductions in dry and critical years during July would have a localized effect on habitat
15 conditions during the summer months in drier water year types.

16 In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater
17 (to 44% greater) than flows under NAA throughout the year, except for August and October, with
18 some exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
19 Analysis*). Flows under A5_LLT would generally be lower than flows under NA in all but above
20 normal water years in August (to 35% lower), and in wet (8% lower) and below normal water years
21 (14% lower) during September. These are relatively infrequent and small-magnitude flow
22 reductions that would not have biologically meaningful negative effects.

23 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
24 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
25 flows relative to the NAA.

26 *Water Temperature*

27 The percentage of months above the 86°F water temperature threshold for year-round adult
28 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and
29 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
30 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
31 modeled in the San Joaquin River or Clear Creek.

32 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
33 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
34 there would be no temperature-related effects in these rivers during the year-round period.

35 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under
36 NAA or A5_LLT (Table 11-5-71). As a result, there would be no difference in the percentage of
37 months in which the 86°F water temperature threshold is exceeded between Alternative 5 and NAA.

1 **Table 11-5-71. Difference and Percent Difference in the Percentage of Months Year-Round in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**
 3 **Water Temperature Threshold for Adult Largemouth Bass Survival^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4
 5 Collectively, these results indicate that the effect would not be adverse because Alternative 5 would
 6 not cause a substantial reduction in juvenile and adult rearing or spawning habitat. Flows in all
 7 rivers examined during the year under Alternative 5 would generally be similar to or greater than
 8 flows under NAA in most months. Flows in July through September would generally be lower in the
 9 Feather River high-flow channel and in the American River below Nimbus Dam, although these
 10 reductions would not be biologically meaningful to the largemouth bass population. The
 11 percentages of years outside all temperature thresholds examined in the Feather River under
 12 Alternative 5 would generally be similar to or lower than NAA. There would be no temperature-
 13 related effects in any other waterways examined.

14 **CEQA Conclusion:** In general, Alternative 5 would not affect the quality and quantity of upstream
 15 habitat conditions for largemouth bass relative to Existing Conditions.

16 *Juveniles*

17 *Flows*

18 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 19 Clear Creek were examined during the April through November juvenile largemouth bass rearing
 20 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
 21 rearing.

22 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
 23 greater (to 64%) than flows under Existing Conditions in all months of the period but November
 24 with infrequent exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
 25 *Fish Analysis*). During November, flows under A5_LLT would be similar to or lower than flows under
 26 Existing Conditions (to 10% lower) in all water years, with relatively small reductions in dry and
 27 critical years (to 10% lower).

28 In the Trinity River below Lewiston Reservoir, flows under A5_LLT during April through July would
 29 generally be similar to or greater (to 28% greater) than flows under Existing Conditions throughout
 30 the year with infrequent exceptions (up to 14% lower), similar to flows under Existing Conditions
 31 during August and September except in critical years (to 34% lower), and similar to or lower than
 32 flows under Existing Conditions during October through November (to 29%) (Appendix 11C,

1 *CALSIM II Model Results utilized in the Fish Analysis*). The most consistent flow reductions would
2 occur in critical years from August through November; the remaining flow reductions in drier water
3 year types would be infrequent and/or of small magnitude.

4 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
5 (to 14% greater) than flows under Existing Conditions throughout the April through November
6 period, except in critical years during August through October (7% to 28% lower) and below normal
7 years in October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to
9 141% greater) than flows under Existing Conditions during April through October, with some
10 exceptions (to 59% lower), and lower in all but above normal years during November (to 29%
11 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions would
12 be isolated and/or of small magnitude except for moderate to substantial reductions in dry and
13 critical water years during July through September that would have a localized effect in those water
14 year types.

15 In the American River at Nimbus Dam, flows under A5_LLT would generally be similar to or greater
16 (to 19% greater) than flows under Existing Conditions during April and June with some exceptions
17 (up to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under
18 A5_LLT during May and July through November would generally be lower relative to Existing
19 Conditions (to 52% lower). Flow reductions in drier water years, when effects would be more
20 critical for habitat conditions, include moderate to substantial reductions for much of the period that
21 would have a localized effect on rearing conditions.

22 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
23 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
24 moderate reductions in flows during the period relative to Existing Conditions.

25 *Water Temperature*

26 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
27 rearing during April through November was examined in the Sacramento, Trinity, Feather,
28 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
29 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
30 temperatures were not modeled in the San Joaquin River or Clear Creek.

31 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
32 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
33 there would be no temperature-related effects in these rivers during the April through November
34 period.

35 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F
36 water temperature threshold for year-round juvenile largemouth bass occurrence under Existing
37 Conditions or A5_LLT (Table 11-5-70). As a result, there would be no difference in the percentage of
38 months in which the 88°F water temperature threshold is exceeded between Alternative 5 and
39 Existing Conditions.

1 *Adult Rearing*

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
4 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower
5 flows could reduce the quantity and quality of instream habitat available for adult rearing.

6 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
7 greater (to 64% greater) than flows under Existing Conditions during all months but November with
8 some exceptions (to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
9 *Analysis*). Flows under A5_LLT during November would be lower than flows under Existing
10 Conditions (to 10% lower).

11 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
12 greater (to 48% greater) than flows under Existing Conditions throughout most of the year with
13 infrequent exceptions during January through July and December (to 17% lower), similar to flows
14 under Existing Conditions during August and September except in critical years (25% and 34%
15 lower, respectively), and lower than flows under Existing Conditions in most water year types
16 during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
17 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat
18 conditions, would be most persistent in critical years during July through January (small to
19 moderate flow reductions), and would have a localized effect on rearing conditions for that specific
20 water year type.

21 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
22 (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal
23 years in October (6% lower) and critical years during August through November (7% to 28% lower)
24 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to
26 141% greater) than those under Existing Conditions during all months of the year except January
27 and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results*
28 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under
29 Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some
30 exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when
31 effects on habitat conditions would be more critical, consist of moderate to substantial reductions in
32 dry (to 60% lower) and in critical (to 47% lower) years during July through September that would
33 have a localized effect on rearing conditions in those water year types. These reductions would be
34 partially offset by increases in flow in the preceding months and October.

35 In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27%
36 greater) than flow under Existing Conditions from February through April, and June, with some
37 exceptions (to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
38 Flows under A5_LLT would generally be lower (to 52% lower) than flows under Existing Conditions
39 in January, May, and July through December, with some exceptions (to 27% greater). There would
40 be persistent, moderate to substantial flow reductions in all water year types, including drier water
41 years, during August (to 52% lower), September (to 42% lower), November (to 31% lower),
42 December (to 21% lower), and January (drier years only, to 20% lower).

1 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
2 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
3 moderate reductions in flows during the period relative to Existing Conditions.

4 *Water Temperature*

5 The percentage of months above the 86°F water temperature threshold for year-round adult
6 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and
7 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
8 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
9 modeled in the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
11 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
12 there would be no temperature-related effects in these rivers during the April through November
13 period.

14 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F
15 water temperature range for year-round adult largemouth bass occurrence under Existing
16 Conditions or A5_LLT (Table 11-5-71). As a result, there would be no difference in the percentage of
17 months in which the 86°F water temperature threshold is exceeded between Alternative 5 and
18 Existing Conditions.

19 Collectively, these results indicate that the impact would not be significant because Alternative 5
20 would not cause a substantial reduction in largemouth bass habitat, and no mitigation is necessary.
21 Flows under A5_LLT would generally be similar to or greater than flows under Existing Conditions
22 in most locations, with the exception of infrequent, relatively small-magnitude flow reductions that
23 would not have biologically meaningful effects on the largemouth bass population. Flows would be
24 substantially lower during the majority of the year-round adult rearing period in the American
25 River, but because of the migratory ability and widespread distribution of largemouth bass
26 throughout the Central Valley, these reductions would not affect the largemouth bass population.
27 Reduced flows in other rivers would not have biologically meaningful effects on largemouth bass.
28 The percentages of years outside all temperature thresholds would generally be lower under
29 Alternative 5 than under Existing Conditions in the Feather River. There are no temperature-related
30 effects in any other waterways examined.

31 ***Sacramento Tule Perch***

32 In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for
33 Sacramento tule perch relative to NAA.

34 *Flows*

35 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
36 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
37 reduce the quantity and quality of instream habitat available for rearing.

38 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
39 greater (to 23% greater) than flows under NAA during all months but November with relatively
40 infrequent exceptions (up to 14% lower compared to NAA) (Appendix 11C, *CALSIM II Model Results*
41 *utilized in the Fish Analysis*). Flows under A5_LLT during November would be lower than flows

1 under NAA (up to 15% and 17% lower depending on month, water year type, and time period).
2 These are infrequent and small-magnitude flow reductions that would not have biologically
3 meaningful effects.

4 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
5 greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16% lower)
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
8 (to 10% greater) than NAA throughout the year, except in below normal years during March (6%
9 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally greater (to 47%
11 greater) than flows under NAA during all months except August and September, with infrequent
12 exceptions (to 32% lower). During August and September, flows under A5_LLT would generally be
13 lower (to 34 and 61% lower, respectively) than those under NAA, including in drier water years
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions coupled
15 with flow reductions in dry and critical years during July would have a localized effect on habitat
16 conditions during the summer months in drier water year types.

17 In the American River at Nimbus Dam, flows under A5_LLT would generally be lower than flows
18 under NAA in all but above normal water years in August (to 35% lower), and in wet (8% lower)
19 and below normal water years (14% lower) during September. These are relatively infrequent and
20 small-magnitude flow reductions that would not have biologically meaningful negative effects
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
23 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
24 flows relative to the NAA.

25 *Water Temperature*

26 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-
27 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,
28 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds
29 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water
30 temperatures were not modeled in the San Joaquin River or Clear Creek.

31 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
32 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
33 there would be no temperature-related effects in these rivers throughout the year.

34 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT exceeding
35 the 72°F threshold would be greater than the percentage under NAA by 13% to 67% depending on
36 water year type. In both cases the relative differences would be large due to small values being
37 compared, and the absolute differences in percent exceedance would be small (1% to 6%) and
38 would not have biologically meaningful effects on Sacramento tule perch (Table 11-5-72).

39 The percentage of months under A5_LLT exceeding the 75°F threshold would be similar to or
40 greater than the percentage under NAA (to 100% greater) (Table 11-5-72). The absolute differences

1 in percent exceedance would be only 1% and would not have biologically meaningful effects on
2 Sacramento tule perch.

3 **Table 11-5-72. Difference and Percent Difference in the Percentage of Months Year-Round in**
4 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F**
5 **Water Temperature Thresholds for Sacramento Tule Perch Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
72°F Threshold		
Wet	1 (43%)	1 (40%)
Above Normal	2 (NA)	2 (67%)
Below Normal	4 (NA)	1 (17%)
Dry	11 (NA)	6 (52%)
Critical	13 (300%)	2 (13%)
All	5 (408%)	2 (33%)
75°F Threshold		
Wet	1 (NA)	1 (100%)
Above Normal	0 (NA)	0 (NA)
Below Normal	1 (NA)	1 (100%)
Dry	2 (NA)	1 (50%)
Critical	7 (1,000%)	1 (9%)
All	2 (1,800%)	1 (37%)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

6
7 Collectively, these results indicate that the effect would not be adverse because Alternative 5 would
8 not cause a substantial reduction in rearing habitat. Flows throughout the year in all rivers
9 examined under Alternative 5 would generally be similar to or greater than flows under NAA in
10 most months. Flows in July through September would generally be lower in the Feather River high-
11 flow channel and in the American River below Nimbus Dam, although these reductions would not be
12 biologically meaningful to Sacramento tule perch. The percentages of years outside both
13 temperature thresholds under Alternative 5 would generally be similar to or slightly greater than
14 the percentages under NAA. There would be no temperature related effects in any other waterways
15 examined.

16 **CEQA Conclusion:** In general, Alternative 5 would not affect the quality and quantity of upstream
17 habitat conditions for Sacramento tule perch relative to Existing Conditions.

18 *Flows*

19 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
20 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
21 reduce the quantity and quality of instream habitat available for rearing.

22 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
23 greater (to 64% greater) than flows under Existing Conditions during all months but November with
24 some exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

1 *Analysis*). Flows under A5_LLT during November would be lower than flows under Existing
2 Conditions (up to 10% lower).

3 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
4 greater (to 48% greater) than flows under Existing Conditions throughout most of the year with
5 infrequent exceptions during January through July and December (to 17% lower), similar to flows
6 under Existing Conditions during August and September except in critical years (25% and 34%
7 lower), respectively), and lower than flows under Existing Conditions in most water year types
8 during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
9 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat
10 conditions, would be most persistent in critical years during July through January (small to
11 moderate flow reductions), and would have a localized effect on rearing conditions for that specific
12 water year type.

13 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
14 (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal
15 years in October (6% lower) and critical years during August through November (7% to 28% lower)
16 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to
18 141% greater) than those under Existing Conditions during all months of the year except January
19 and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results*
20 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under
21 Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some
22 exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when
23 effects on habitat conditions would be more critical, consist of moderate to substantial reductions in
24 dry (to 60% lower) and critical (to 47% lower) years during July through September that would
25 have a localized effect on rearing conditions in those water year types.

26 In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27%
27 greater) from February through April, and June, with some exceptions (up to 30% lower) than flows
28 under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
29 Flows under A5_LLT would generally be up to 52% lower than flows under Existing Conditions
30 during January, May, and July through December, with some exceptions. There would be persistent,
31 moderate to substantial flow reductions in all water year types, including drier water years, during
32 August through December (up to 52% lower), and January (drier years only, to 20% lower).

33 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
34 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
35 moderate reductions in flows during the period relative to Existing Conditions.

36 *Water Temperature*

37 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round
38 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,
39 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead
40 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not
41 modeled in Clear Creek or the San Joaquin River.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
2 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
3 there would be no temperature-related effects in these rivers during the year.

4 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT exceeding
5 72°F relative to the percentage under Existing Conditions would be similar to or greater, to 300%
6 (Table 11-5-72). Despite the high relative percentages from the comparisons, the absolute values for
7 the increases would be small, ranging from 1% to 13%. The percentage of months under A5_LLT
8 exceeding 75°F would be similar to the percentage under Existing Conditions in all water years
9 except critical years (1,000% greater). Despite the high relative percentages from the comparisons,
10 the absolute values for the increases would be small, ranging from 1% to 7%, and would not have
11 biologically meaningful effects on Sacramento tule perch.

12 Collectively, these results indicate that the impact would not be significant because Alternative 5
13 would not cause a substantial reduction in Sacramento tule perch habitat, and no mitigation is
14 necessary. Flows under A5_LLT would generally be similar to or greater than flows under Existing
15 Conditions in most locations, with the exception of infrequent, relatively small-magnitude flow
16 reductions that would not have biologically meaningful effects on the Sacramento tule perch
17 population. Flows would be substantially lower during the majority of the year-round adult rearing
18 period in the American River, but based on the results for the other locations, these reductions
19 would not affect the Sacramento tule perch population in the region. Reduced flows in other rivers
20 including Trinity River and the San Joaquin and Stanislaus rivers would not have biologically
21 meaningful effects on Sacramento tule perch. The percentages of years outside both temperature
22 thresholds would generally be lower under Alternative 5 than under Existing Conditions. There
23 would be no temperature related effects in any other waterways examined.

24 ***Sacramento-San Joaquin Roach***

25 In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for
26 Sacramento-San Joaquin roach relative to NAA.

27 *Juvenile and Adult Rearing*

28 *Flows*

29 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
30 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
31 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
32 rearing.

33 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
34 greater (to 23% greater) than flows under NAA during all months but November with relatively
35 infrequent exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
36 *Analysis*). Flows under A5_LLT during November would be lower than flows under NAA (up to 15%
37 and 17% lower depending on month, water year type, and time period). These are infrequent and
38 small-magnitude flow reductions that would not have biologically meaningful effects.

39 In the Trinity River below Lewiston Reservoir, year round flows under A5_LLT would generally
40 similar to or greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16%
41 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
2 (to 10% greater) than NAA throughout the year, except in below normal years during March (6%
3 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 47%
5 greater) than flows under NAA during all months except August and September, with infrequent
6 exceptions (to 32% lower). During August and September, flows under A5_LLT would generally be
7 lower (to 34 and 61% lower, respectively) than those under NAA, including in drier water years
8 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions coupled
9 with flow reductions in dry and critical years during July would have a localized effect on habitat
10 conditions during the summer months in drier water year types.

11 In the American River at Nimbus Dam, flows under A5_LLT would generally be lower than flows
12 under NAA in all but above normal water years in August (to 35% lower), and in wet (8% lower)
13 and below normal water years (14% lower) during September (Appendix 11C, *CALSIM II Model
14 Results utilized in the Fish Analysis*). These are relatively infrequent and small-magnitude flow
15 reductions that would not have biologically meaningful negative effects.

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
17 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
18 flows relative to the NAA.

19 *Water Temperature*

20 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
21 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
22 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing
23 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San
24 Joaquin River or Clear Creek.

25 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
26 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
27 there would be no temperature-related effects in these rivers throughout the year.

28 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under
29 NAA or A5_LLT (Table 11-5-73). As a result, there would be no difference in the percentage of
30 months in which the 86°F water temperature threshold is exceeded between Alternative 5 and NAA.

1 **Table 11-5-73. Difference and Percent Difference in the Percentage of Months Year-Round in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**
 3 **Water Temperature Range for Sacramento-San Joaquin Roach Survival^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4
 5 Collectively, these results indicate that the effect would not be adverse because Alternative 5 would
 6 not cause a substantial reduction in spawning and juvenile and adult Sacramento-San Joaquin roach
 7 rearing habitat. Flows in all rivers examined during the year under Alternative 5 would generally be
 8 similar to or greater than flows under NAA in most months. Flows would generally be lower during
 9 August and September in the Feather River high-flow channel and during August in the American
 10 River below Nimbus Dam, although these reductions would not be biologically meaningful to the
 11 Sacramento-San Joaquin roach population. The percentages of years outside both temperature
 12 thresholds under Alternative 5 in the Feather River would be similar to or lower than the
 13 percentages under NAA. There would be no temperature related effects in any other waterways
 14 examined.

15 **CEQA Conclusion:** In general, Alternative 5 would not affect the quality and quantity of upstream
 16 habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

17 *Juvenile and Adult Rearing*

18 *Flows*

19 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 20 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
 21 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
 22 rearing.

23 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
 24 greater (to 64% greater) than flows under Existing Conditions during all months but November with
 25 some exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 26 *Analysis*). Flows under A5_LLT during November would be lower than flows under Existing
 27 Conditions (to 10% lower).

28 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
 29 greater (to 48% greater) than flows under Existing Conditions throughout most of the year with
 30 infrequent exceptions during January through July and December (to 17% lower), similar to flows
 31 under Existing Conditions during August and September except in critical years (25% and 34%
 32 lower, respectively), and lower than flows under Existing Conditions in most water year types

1 during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
2 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat
3 conditions, would be most persistent in critical years during July through January (small to
4 moderate flow reductions), and would have a localized effect on rearing conditions for that specific
5 water year type.

6 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
7 (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal
8 years in October (6% lower) and critical years during August through November (7% to 28% lower)
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to
11 141% greater) than flows under Existing Conditions during all months of the year except January
12 and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results*
13 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under
14 Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some
15 exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when
16 effects on habitat conditions would be more critical, consist of moderate to substantial reductions in
17 dry (to 60% lower) and critical (to 47% lower) years during July through September that would
18 have a localized effect on rearing conditions in those water year types.

19 In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27%
20 greater) from February through April, and June, with some exceptions (up to 30% lower) than flows
21 under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
22 Flows under A5_LLT would generally be up to 52% lower than flows under Existing Conditions
23 during January, May, and July through December, with some exceptions. There would be persistent,
24 moderate to substantial flow reductions in all water year types, including drier water years, during
25 August through December (up to 52% lower), and January (drier years only, to 20% lower).

26 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
27 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
28 moderate reductions in flows during the period relative to Existing Conditions.

29 *Water Temperature*

30 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
31 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
32 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced
33 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.
34 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

35 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
36 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
37 there would be no temperature-related effects in these rivers during the April through November
38 period.

39 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water
40 temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or
41 A5_LLT (Table 11-5-73). As a result, there would be no difference in the percentage of months in
42 which the 86°F water temperature threshold is exceeded between Alternative 5 and Existing
43 Conditions.

1 Collectively, these results indicate that the impact would not be significant because Alternative 5
2 would not cause a substantial reduction in Sacramento-San Joaquin roach habitat, and no mitigation
3 is necessary. Flows under A5_LLT would generally be similar to or greater than flows under Existing
4 Conditions in many locations. Flows would be substantially lower during the majority of the year-
5 round adult rearing period in the American River, but based on the results for the other locations,
6 these reductions would not affect roach at a population level. Reduced flows in other rivers would
7 not have biologically meaningful effects on the Sacramento-San Joaquin roach population. The
8 percentages of years outside both temperature thresholds in the Feather River under Alternative 5
9 would be similar to or lower than the percentages under Existing Conditions. There would be no
10 temperature related effects in any other waterways examined.

11 **Hardhead**

12 In general, Alternative 5 would not affect the quality and quantity of upstream habitat conditions for
13 hardhead relative to NAA.

14 *Juvenile and Adult Rearing*

15 *Flows*

16 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
17 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
18 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
19 adult rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
21 greater (to 23% greater) than flows under NAA during all months but November with relatively
22 infrequent exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
23 *Analysis*). Flows under A5_LLT during November would be lower than flows under NAA (up to 15%
24 and 17% lower depending on month, water year type, and time period). These are infrequent and
25 small-magnitude flow reductions that would not have biologically meaningful effects.

26 In the Trinity River below Lewiston Reservoir, year round flows under A5_LLT would generally be
27 similar to or greater (to 12% greater) than flows under NAA with infrequent exceptions (up to 16%
28 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
30 (to 10% greater) than NAA throughout the year, except in below normal years during March (6%
31 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to 47%
33 greater) than flows under NAA during all months except August and September, with infrequent
34 exceptions (up to 32% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
35 During August and September, flows under A5_LLT would generally be lower (up to 34 and 61%
36 lower, respectively) than those under NAA, including in drier water years. These flow reductions
37 coupled with flow reductions in dry and critical years during July would have a localized effect on
38 habitat conditions during the summer months in drier water year types.

39 In the American River at Nimbus Dam, flows under A5_LLT would generally be lower than flows
40 under NAA in all but above normal water years in August (to 35% lower) (Appendix 11C, *CALSIM II*
41 *Model Results utilized in the Fish Analysis*), and in wet (8% lower) and below normal water years

1 (14% lower) during September. These are relatively infrequent and small-magnitude flow reduction
2 that would not have biologically meaningful negative effects.

3 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
4 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
5 flows relative to the NAA.

6 *Water Temperature*

7 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for
8 juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American,
9 and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat
10 quality and increased stress and mortality. Water temperatures were not modeled in the San
11 Joaquin River or Clear Creek.

12 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
13 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
14 there would be no temperature-related effects in these rivers throughout the year.

15 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLT outside the
16 range would be similar to or lower than the percentage under NAA in all water year except in below
17 normal years (7% greater) (Table 11-5-74).

18 **Table 11-5-74. Difference and Percent Difference in the Percentage of Months Year-Round in**
19 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F**
20 **to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A5_LLT	NAA vs. A5_LLT
Wet	-6 (-8%)	-3 (-4%)
Above Normal	-11 (-15%)	-6 (-10%)
Below Normal	-6 (-8%)	5 (7%)
Dry	-5 (-7%)	2 (4%)
Critical	-7 (-10%)	0 (0%)
All	-7 (-9%)	-0.4 (-1%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

21
22 Collectively, these results indicate that the effect would not be adverse because Alternative 5 would
23 not cause a substantial reduction in spawning and juvenile and adult hardhead rearing. Flows under
24 Alternative 5 in all rivers examined during most months would generally be similar to or greater
25 than flows under NAA. Flows in July through September would generally be lower in the Feather
26 River high-flow channel and in the American River below Nimbus Dam, although these reductions
27 would not be biologically meaningful to the hardhead population. The percentages of years outside
28 both temperature thresholds in the Feather River would generally be lower under Alternative 5 than
29 under NAA. There would be no temperature related effects in any other waterways examined.

30 **CEQA Conclusion:** In general, Alternative 5 would not affect the quality and quantity of upstream
31 habitat conditions for hardhead relative to Existing Conditions.

1 *Juvenile and Adult Rearing*

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
4 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
5 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
6 adult rearing.

7 In the Sacramento River upstream of Red Bluff, flows under A5_LLT would generally be similar to or
8 greater (to 64% greater) than flows under Existing Conditions during all months but November with
9 some exceptions (up to 24% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
10 *Analysis*). Flows under A5_LLT during November would be lower than flows under Existing
11 Conditions (up to 10% lower).

12 In the Trinity River below Lewiston Reservoir, flows under A5_LLT would generally be similar to or
13 greater (to 48% greater) than flows under Existing Conditions throughout most of the year with
14 infrequent exceptions during January through July and December (to 17% lower), similar to flows
15 under Existing Conditions during August and September except in critical years (25% and 34%
16 lower), respectively), and lower than flows under Existing Conditions in most water year types
17 during October and November (to 29% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
18 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat
19 conditions, would be most persistent in critical years during July through January (small to
20 moderate flow reductions), and would have a localized effect on rearing conditions for that specific
21 water year type.

22 In Clear Creek at Whiskeytown Dam, flows under A5_LLT would generally be similar to or greater
23 (to 29% greater) than flows under Existing Conditions throughout the year, except in below normal
24 years in October (6% lower) and critical years during August through November (7% to 28% lower)
25 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In the Feather River at Thermalito Afterbay, flows under A5_LLT would generally be greater (to
27 141% greater) than those under Existing Conditions during all months of the year except January
28 and November, with some exceptions (up to 60% lower) (Appendix 11C, *CALSIM II Model Results*
29 *utilized in the Fish Analysis*). Flows under A5_LLT would generally be lower than flows under
30 Existing Conditions in January (to 45% lower) and November (up to 29% lower), with some
31 exceptions (up to 7% greater). The most persistent flow reductions in drier water year types, when
32 effects on habitat conditions would be more critical, consist of moderate to substantial reductions in
33 dry (to 60% lower) and critical (to 47% lower) years during July through September that would
34 have a localized effect on rearing conditions in those water year types.

35 In the American River at Nimbus Dam, flows under A5_LLT would generally be greater (to 27%
36 greater) from February through April, and June, with some exceptions (up to 30% lower) than flows
37 under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
38 Flows under A5_LLT would generally be up to 52% lower than flows under Existing Conditions
39 during January, May, and July through December, with some exceptions. There would be persistent,
40 moderate to substantial flow reductions in all water year types, including drier water years, during
41 August through December (up to 52% lower), and January (drier years only, to 20% lower).

1 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 5 would be the same as those
2 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
3 moderate reductions in flows during the period relative to Existing Conditions.

4 *Water Temperature*

5 The percentage of months in which year-round in-stream temperatures would be outside of the
6 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was
7 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures
8 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.
9 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 5
11 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
12 there would be no temperature-related effects in these rivers during the April through November
13 period.

14 In the Feather River below Thermalito Afterbay, the percentage of months under A5_LLTP outside of
15 the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be
16 lower (to 15% lower) than the percentage under Existing Conditions in all water years (Table 11-5-
17 74).

18 Collectively, these results indicate that the impact would not be significant because Alternative 5
19 would not cause a substantial reduction in hardhead habitat, and no mitigation is necessary. Flows
20 under A5_LLTP would generally be similar to or greater than flows under Existing Conditions in many
21 locations. Flows would be substantially lower during the majority of the year-round adult rearing
22 period in the American River, but based on the results for the other locations, these reductions
23 would not affect hardhead at a population level. Reduced flows in other rivers would not have
24 biologically meaningful effects on hardhead. The percentages of years outside both temperature
25 thresholds in the Feather River under Alternative 5 would be similar to or lower than the
26 percentages under Existing Conditions. There would be no temperature related effects in any other
27 waterways examined.

28 *California Bay Shrimp*

29 The effect of water operations on rearing habitat of California bay shrimp under Alternative 5 would
30 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed
31 discussion, please see Alternative 1A, Impact AQUA-203. These effects would not be adverse.

32 **CEQA Conclusion:** As described above the impacts on rearing habitat of California bay shrimp would
33 be less than significant.

34 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered** 35 **Aquatic Species of Primary Management Concern**

36 Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-
37 covered species of primary management concern.

38 *Striped Bass*

39 Monthly flows in the Sacramento River downstream of the north Delta intake would decrease (2-
40 11% for NAA) under Alternative 5 during the adult striped bass migration. Sacramento River flows

1 are highly variable interannually, and striped bass are still able to migrate upstream the Sacramento
2 River during lower flow years. The effect of reduced Sacramento flows under Alternative 5 would
3 not be adverse.

4 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
5 significant because the changes in flow (13–14% lower compared to Existing Conditions) would not
6 interfere substantially with movement of pre-spawning striped bass through the Delta. No
7 mitigation would be required.

8 ***American Shad***

9 Flows in the Sacramento River below the north Delta intake facilities would be lower than NAA
10 during March–May. Monthly flows on average would be 9–19% lower compared to NAA. Flows from
11 the San Joaquin River at Vernalis would be unchanged. Sacramento River flows are highly variable
12 interannually, and American shad are still able to migrate upstream the Sacramento River during
13 lower flow years. Overall, the impact to American shad migration habitat conditions would not be
14 adverse under Alternative 5.

15 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
16 significant because the changes in flow (10–20% lower compared to Existing Conditions) would not
17 interfere substantially with movement of American shad from the Delta to upstream spawning
18 habitat. No mitigation would be required.

19 ***Threadfin Shad***

20 Threadfin shad are semi-anadromous, moving between freshwater and brackish water habitats.
21 Threadfin shad found in the Delta do not actively migrate upstream to spawn. Therefore there is no
22 effect on migration habitat conditions.

23 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
24 significant because flow changes in the Delta under Alternative 5 would not alter movement
25 patterns for threadfin shad. No mitigation would be required.

26 ***Largemouth Bass***

27 Largemouth bass are non-migratory fish within the Delta. Therefore they do not use the Delta as
28 migration habitat corridor. There would be no effect.

29 **CEQA Conclusion:** As described immediately above, flow changes under Alternative 5 would not
30 affect largemouth movements within the Delta. No mitigation would be required.

31 ***Sacramento Tule Perch***

32 Similar with largemouth bass, Sacramento tule perch are a non-migratory species and do not use the
33 Delta as a migration corridor as they are a resident Delta species. There would be no effect.

34 **CEQA Conclusion:** As described immediately above, flow changes would not affect Sacramento tule
35 perch movements within the Delta. No mitigation would be required.

36 ***Sacramento-San Joaquin Roach***

37 For Sacramento-San Joaquin roach the overall flows and temperature in upstream rivers during
38 migration to their spawning grounds would be similar to those described under Alternative 5,

1 Impact AQUA-202 for spawning. As described there, the flows would slightly improve the upstream
2 conditions relative to NAA. These conditions would not be adverse.

3 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
4 conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

5 **Hardhead**

6 For hardhead the overall flows and temperature in upstream rivers during migration to their
7 spawning grounds would be similar to those described under Alternative 5, Impact AQUA-202 for
8 spawning. As described there, the flows would slightly improve the upstream conditions relative to
9 NAA. These conditions would not be adverse.

10 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
11 conditions for hardhead would not be significant and no mitigation is required.

12 **California Bay Shrimp**

13 The effect of water operations on migration conditions of California bay shrimp under Alternative 5
14 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-204). For a
15 detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects would not be adverse.

16 **CEQA Conclusion:** As described above the impacts on migration conditions of California bay shrimp
17 would be less than significant.

18 **Restoration Measures (CM2, CM4–CM7, and CM10)**

19 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic** 20 **Species of Primary Management Concern**

21 Refer to Impact AQUA-7 under delta smelt for a discussion of the effects of construction of
22 restoration measures on non-covered species of primary management concern. That discussion
23 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
24 to the aquatic environment and aquatic species. The potential effects of the construction of
25 restoration measures under Alternative 5 would be similar to those described for Alternative 1A
26 (see Alternative 1A, Impact AQUA-7). However, the potential effects of restoration construction
27 activities would be less than described for Alternative 1A because of the reduced acreage of tidal
28 habitat that would be restored (25,000 acres for Alternative 5 rather than 65,000 acres for
29 Alternative 1A). The effects would not be adverse.

30 **CEQA Conclusion:** As described immediately above, the impacts of the construction of restoration
31 measures would be less than significant.

32 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-** 33 **Covered Aquatic Species of Primary Management Concern**

34 Refer to Impact AQUA-8 under delta smelt for a discussion of the effects of contaminants associated
35 with restoration measures on non-covered species of primary management concern. That
36 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that
37 are relevant to the aquatic environment and aquatic species. The potential effects of the
38 construction of contaminants associated with restoration measures under Alternative 5 would be
39 similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). However, the

1 potential effects of contaminants associated with restoration measures would be less than described
2 for Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000
3 acres for Alternative 5 rather than 65,000 acres for Alternative 1A). These effects would not be
4 adverse.

5 **CEQA Conclusion:** As described immediately above, the impacts of contaminants associated with
6 restoration measures would be less than significant.

7 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**
8 **Primary Management Concern**

9 Refer to Impact AQUA-9 under delta smelt for a discussion of the effects of restored habitat
10 conditions on non-covered species of primary management concern. That discussion under delta
11 smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the
12 aquatic environment and aquatic species. Although there are minor differences the effects are
13 similar. The potential effects of restored habitat conditions under Alternative 5 would be similar to
14 those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). In addition, see Alternative
15 1A, Impact AQUA-207 for a discussion of the different effects on non-covered species of primary
16 management concern. Also, the potential effects of restored habitat conditions would be less than
17 described for Alternative 1A because of the reduced acreage of tidal habitat that would be restored
18 (25,000 acres for Alternative 5 rather than 65,000 acres for Alternative 1A. The effects range from
19 slightly beneficial to beneficial.

20 **CEQA Conclusion:** As described immediately above, the impacts of restored habitat conditions
21 would range from slightly beneficial to beneficial.

22 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**
23 **Primary Management Concern (CM12)**

24 Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of methylmercury
25 management on non-covered species of primary management concern. That discussion under delta
26 smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the
27 aquatic environment and aquatic species. The potential effects of methylmercury management
28 under Alternative 5 would be similar to those described for Alternative 1A (see Alternative 1A,
29 Impact AQUA-10). Also, the potential effects of methylmercury would be less than described for
30 Alternative 1A because of the reduced acreage of tidal habitat that would be restored (25,000 acres
31 for Alternative 5 rather than 65,000 acres for Alternative 1A. These effects would not be adverse.

32 **CEQA Conclusion:** As described immediately above, the impacts of methylmercury management
33 would be less than significant.

34 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**
35 **Aquatic Species of Primary Management Concern (CM13)**

36 Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive aquatic
37 vegetation management on non-covered species of primary management concern. That discussion
38 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
39 to the aquatic environment and aquatic species. The potential effects of invasive aquatic vegetation
40 management under Alternative 5 would be similar to those described for Alternative 1A (see
41 Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth bass)

1 and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory fish
2 which improves their hunting success. Sacramento tule perch also use the cover of aquatic plants in
3 the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the amount of
4 invasive aquatic habitat will negatively affect these predatory species and Sacramento tule perch.
5 However, this control will not substantially reduce the ability of the predatory species to hunt and
6 there will still be many other habitats in which the predatory species can successfully hunt and in
7 which Sacramento tule perch will thrive. The effect on them will not be adverse. Control of invasive
8 aquatic vegetation would not occur within California bay shrimp habitat and there would be no
9 effect on them.

10 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of
11 invasive aquatic vegetation management on non-covered species of primary management concern.
12 There are minor differences and the effects are similar except for predatory species (striped bass
13 and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding
14 habitat for predatory fish which improves their hunting success. Control of invasive aquatic
15 vegetation would not occur within California bay shrimp habitat and there would be no effect on
16 them. Sacramento tule perch use the cover of aquatic plants in the Sacramento and San Joaquin
17 rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will
18 negatively affect the predatory species and Sacramento tule perch. However, this control will not
19 substantially reduce the ability of the predatory species to hunt and there will still be many other
20 habitats in which the predatory species can successfully hunt and in which Sacramento tule perch
21 will thrive. Therefore the effect on them will not be significant and no mitigation is required.

22 **Other Conservation Measures (CM12–CM19 and CM21)**

23 The effects of other conservation measures under Alternative 5 would be similar for all non-covered
24 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by
25 individual species. The effects are also the same as those discussed for Alternative 1A.

26 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of 27 Primary Management Concern (CM12)**

28 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered 29 Aquatic Species of Primary Management Concern (CM13)**

30 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic 31 Species of Primary Management Concern (CM14)**

32 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic 33 Species of Primary Management Concern (CM15)**

34 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of 35 Primary Management Concern (CM16)**

36 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of 37 Primary Management Concern (CM17)**

38 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of 39 Primary Management Concern (CM18)**

1 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**
2 **of Primary Management Concern (CM19)**

3 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**
4 **Aquatic Species of Primary Management Concern (CM21)**

5 *NEPA Effects:* Detailed discussions regarding the potential effects of these nine impact mechanisms
6 on the non-covered aquatic species of primary management concern are the same as those
7 described under Alternative 1A for delta smelt (Impacts AQUA-10 through AQUA-18). That
8 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that
9 are relevant to the aquatic environment and aquatic species. As with delta smelt, the effects on these
10 non-covered species would range from no effect, to not adverse, to beneficial.

11 *CEQA Conclusion:* The impacts of the nine impact mechanisms listed above would range from no
12 impact, to less than significant, to beneficial, and no mitigation is required (see discussion under
13 Alternative 1A for delta smelt (Impacts AQUA-10 through AQUA-18)).

14 **Upstream Reservoirs**

15 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

16 Similar to the description for Alternative 1A, this effect would not be adverse because coldwater fish
17 habitat in the CVP and SWP upstream reservoirs under Alternative 5 would not be substantially
18 reduced when compared to the No Action Alternative.

19 *CEQA Conclusion:* Similar to the description for Alternative 1A, Alternative 5 would reduce the
20 quantity of coldwater fish habitat in the CVP and SWP as shown in Table 102. There would be a
21 greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant
22 impact. These results are primarily caused by four factors: differences in sea level rise, differences in
23 climate change, future water demands, and implementation of the alternative. The analysis
24 described above comparing Existing Conditions to Alternative 5 does not partition the effect of
25 implementation of the alternative from those of sea level rise, climate change and future water
26 demands using the model simulation results presented in this chapter. However, the increment of
27 change attributable to the alternative is well informed by the results from the NEPA analysis, which
28 found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 5, if
29 adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
30 therefore would not in itself result in a significant impact on coldwater habitat in upstream
31 reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Like Alternative 1A, Alternative 6A would convey water from five fish-screened intakes (Intakes 1 through 5) in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through tunnels to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, this would be an isolated conveyance, no longer involving operation of the existing SWP/CVP south Delta points of diversion at Clifton Court Forebay and the Tracy Fish Facility on Old River. A map and schematic depicting the conveyance facilities associated with Alternative 6A are provided in Mapbook M3-1 and Figure 3-13; characteristics of this alternative are summarized in Table 11-7.

Alternative 6A would discontinue water diversions at the existing SWP/CVP south Delta facilities, and convey up to 15,000 cfs from the north Delta under Scenario D, which also includes criteria to meet Fall X2 objectives in accordance with the USFWS BiOp (U.S. Fish and Wildlife Service 2008a). Water conveyance operations under Scenario D are described in detail in Section 3.6.4.2 and water quality effects including salinity are discussed in Chapter 8 Water Quality under Alternative 6A.

Under Alternative 6A, physical and structural components would be similar to those under Alternative 1A. However, the existing hydraulic connections between the SWP/CVP south Delta points of diversions at Clifton Court Forebay and the Tracy Fish Facility on Old River would be closed. Although other portions of the south Delta export facility (i.e., pump stations and conveyance systems) would continue to operate, there would be no water diversions at the facility, and therefore no entrainment or other direct effects on aquatic species. An overview of the proposed water conveyance features and characteristics (i.e., lengths, volumes, etc. is presented in Table 11-7. Detailed discussions of water conveyance facilities components, including construction detail, are provided in Section 3.6.1.

Delta Smelt

Construction and Maintenance of CM1

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The potential effects of construction of water conveyance facilities on delta smelt or designated critical habitat would be the same as described under Alternative 1A, Impact AQUA-1, because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel reshaping. As concluded there, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or critical habitat.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-1, the impact of the construction of water conveyance facilities on delta smelt or critical habitat would be less than significant except for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

8 ***NEPA Effects:*** The potential effects of the maintenance of water conveyance facilities under
9 Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-2). As
10 concluded under Alternative 1A, Impact AQUA-2, the effect would not be adverse for delta smelt or
11 designated critical habitat.

12 ***CEQA Conclusion:*** As described in Alternative 1A, Impact AQUA-2, the impact of the maintenance of
13 water conveyance facilities on delta smelt or critical habitat would be less than significant and no
14 mitigation would be required.

15 **Water Operations of CM1**

16 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

17 ***Water Exports from SWP/CVP South Delta Facilities***

18 Entrainment losses of delta smelt at the SWP/CVP south Delta facilities would be completely
19 eliminated because there would be no south delta exports under Alternative 6A operations.

20 ***Water Exports from SWP/CVP North Delta Intake Facilities***

21 The impact would be similar to Impact AQUA-3 in Alternative 1A for north Delta intakes, because
22 potential entrainment, impingement, and predation risks at the proposed north Delta facilities
23 would be limited since delta smelt rarely occur in the vicinity. In addition the intakes would be
24 screened to exclude fish larger than 15 mm SL. Alternative 6A would have five north delta intakes,
25 the same number planned under Alternative 1A. Therefore potential entrainment, impingement, and
26 predation risks would be the same as compared to Alternative 1A (0–2% entrainment).

27 ***Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct***

28 Potential entrainment of larval delta smelt at the NBA, as estimated by particle-tracking models, was
29 low, averaging 1.5% under Alternative 6A compared to 2.0% under NAA, or a 26% reduction in
30 relative terms (Table 11-6A-1).

1 **Table 11-6A-1. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt**
2 **Entrained by the North Bay Aqueduct under Alternative 6A and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A6A_LLT	A6A_LLT vs. EXISTING CONDITIONS	A6A_LLT vs. NAA
2.1	2.0	1.5	-0.62 (-30%)	-0.52 (-26%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario

3

4 **NEPA Effects:** In conclusion, under Alternative 6A entrainment of delta smelt would be eliminated at
5 the south Delta SWP/CVP facilities (due to lack of south Delta exports) and slightly reduced at the
6 NBA and agricultural diversions. Entrainment and impingement could potentially occur at the
7 proposed north Delta intakes, but the risk would be low due to the location, design and operation of
8 intakes. Potential impacts at the north Delta intakes would be reduced further by monitoring and
9 adaptive management by the Real-Time Response Team. The effect of Alternative 6A on delta smelt
10 entrainment is considered to be beneficial.

11 **CEQA Conclusion:** As described above, under Alternative 6A delta smelt entrainment would be
12 eliminated at south Delta facilities. Entrainment of larval delta smelt and impingement of juveniles
13 and adults would potentially occur at the five proposed north Delta intakes, but the magnitude of
14 this effect would be low because delta smelt occur infrequently in the vicinity. Potential entrainment
15 of larvae would be slightly reduced (<1%) at the NBA compared to Existing Conditions (Table 11-
16 6A-1).

17 Overall, the impact on delta smelt entrainment would be beneficial because of the elimination of
18 entrainment and associated pre-screen predation loss at the south Delta facilities.

19 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
20 **Delta Smelt**

21 **NEPA Effects:** The effects of operations under Alternative 6A on abiotic spawning habitat would be
22 the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta
23 intakes would not reduce available spawning habitat. In-Delta water temperatures, which can affect
24 spawning timing, would not change across Alternatives, because they would be in thermal
25 equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect
26 of Alternative 6A operations on spawning would not be adverse, because there would be little
27 change in abiotic spawning conditions for delta smelt.

28 **CEQA Conclusion:** As described above, operations under Alternative 6A would not reduce abiotic
29 spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the
30 impact would be less than significant, and no mitigation would be required.

31 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

32 Juvenile and larval delta smelt generally rear throughout the west Delta, Suisun Bay, Suisun Marsh,
33 and in Cache Slough. Other areas in the Delta may also be used for rearing. For purposes of this
34 analysis, an abiotic habitat index (Feyrer et al. 2011) was applied that is based on correlations
35 between turbidity and salinity, and detection of delta smelt in the Fall Midwater Trawl and generally

1 increases with increased Delta outflows (Feyrer et al. 2011). This method applies only to the west
2 Delta, Suisun Bay, and Suisun Marsh, and does not include any other potential rearing areas,
3 including Cache Slough, where smelt are known to rear. The primary driver related to potential
4 changes in rearing habitat from Alternative 6A based on flow alone, is fall outflow because of its
5 assumed potential to shrink or expand the area of suitable habitat in the west Delta, Suisun Marsh,
6 or Suisun Bay based on Feyrer et al. (2011).

7 The average abiotic habitat index under Alternative 6A without habitat restoration would increase
8 by 845 hectares (17%) relative to NAA (Table 11-6A-2, Figure 11-6A-1). Alternative 6A would
9 further benefit delta smelt with habitat restoration, particularly CM2 and CM4 in the Suisun Marsh,
10 West Delta, and Cache Slough ROAs, which are closer to delta smelt's main range. Habitat restoration
11 has the potential to increase spawning and rearing habitat and could supplement food production
12 and export to rearing areas. However, the overall effects of habitat restoration and the mechanism of
13 Fall X2 correlation are uncertain and current efforts (FlaSH studies) are underway to better
14 understand the relationship between Fall X2 actions, suitable rearing habitat for delta smelt, and
15 delta smelt abundance.

16 With habitat restoration, Alternative 6A would result in an increase in the abiotic habitat index by
17 about 2,400 hectares (a 50% increase compared to NAA) averaged across all water year types and
18 assuming 100% habitat occupancy. These effects are due to the inundation of new areas of the Delta
19 resulting from habitat restoration implementation, which will open up additional habitat for delta
20 smelt. It is unlikely though that all of the restored habitat would be fully utilized by delta smelt.
21 When analyzing effects by water year types, the relative increase in abiotic habitat index would be
22 greatest in dry years (79% compared to NAA) and below normal years (76% compared to NAA).

23 **NEPA Effects:** Despite the uncertainties discussed above, the effect of Alternative 6A on delta smelt
24 would be beneficial because of the increase in abiotic habitat under Alternative 6A even without
25 habitat restoration actions.

26 **Table 11-6A-2. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 6A and**
27 **Existing Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year Type**

Water Year	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
All	1,730 (43%)	845 (17%)	3,302 (83%)	2,416 (50%)
Wet	2,565 (55%)	369 (5%)	4,581 (97%)	2,384 (35%)
Above Normal	2,244 (59%)	576 (10%)	3,894 (102%)	2,226 (41%)
Below Normal	1,368 (33%)	1,516 (38%)	2,884 (70%)	3,032 (76%)
Dry	1,322 (37%)	1,413 (41%)	2,667 (75%)	2,758 (79%)
Critical	484 (16%)	483 (16%)	1,428 (48%)	1,427 (48%)

Shading indicates a greater than 5% decrease in estimated abiotic habitat acres from baseline.

Note: Negative values indicate lower habitat indices under the alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

28

29 **CEQA Conclusion:** Without BDCP habitat restoration efforts, delta smelt fall abiotic habitat index
30 under Alternative 6A would increase 43% relative to Existing Conditions. With the implementation
31 of the BDCP habitat restoration actions (CMs 2, 4, 5, 6, and 7), the abiotic habitat index would

1 increase by 83% when averaged across all water year types. The increase in abiotic habitat would be
2 most substantial in wetter water year types (a 97–102% increase) compared to the CEQA Existing
3 Conditions. The impact on delta smelt rearing habitat would be beneficial because of the increase in
4 abiotic habitat, even without the benefit of habitat restoration actions. No mitigation would be
5 required.

6 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

7 The effects of operations under Alternative 6A on migration conditions would be the same as
8 described for Alternative 1A (Impact AQUA-6). Alternative 6A would not affect the first flush of
9 winter precipitation and the turbidity cues associated with adult delta smelt migration. In-Delta
10 water temperatures would not change across Alternatives, because they would be in thermal
11 equilibrium with atmospheric conditions and not strongly influenced by the flow changes under
12 BDCP operations.

13 **NEPA Effects:** There would be no substantial change in the number of stressful or lethal condition
14 days under Alternative 6A. Thus the effect on delta smelt migration conditions would not be
15 adverse.

16 **CEQA Conclusion:** As described above, operations under Alternative 6A would not substantially
17 alter the turbidity cues associated with winter flush events that may initiate migration, nor would
18 there be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt
19 migration conditions would be less than significant, and no mitigation would be required.

20 **Restoration Measures (CM2, CM4–CM7, and CM10)**

21 Alternative 6A has the same Restoration Measures as Alternative 1A. Because no substantial
22 differences in restoration-related fish effects are anticipated anywhere in the affected environment
23 under Alternative 6A compared to those described in detail for Alternative 1A, the fish effects of
24 restoration measures described for delta smelt under Alternative 1A (Impact AQUA-7 through
25 Impact AQUA-9) also appropriately characterize effects under Alternative 6A.

26 The following impacts are those presented under Alternative 1A that are identical for Alternative
27 6A.

28 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

29 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta** 30 **Smelt**

31 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

32 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms
33 on delta smelt are the same as those described under Alternative 1A. The effects would not be
34 adverse, and generally beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt
35 with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of
36 methylmercury on delta smelt are uncertain.

37 **CEQA Conclusion:** All three of the impact mechanisms listed above would be beneficial or less than
38 significant, and no mitigation is required.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 Alternative 6A has the same other conservation measures as Alternative 1A. Because no substantial
3 differences in other conservation-related fish effects are anticipated anywhere in the affected
4 environment under Alternative 6A compared to those described in detail for Alternative 1A, the fish
5 effects of other conservation measures described for delta smelt under Alternative 1A (Impact
6 AQUA-10 through Impact AQUA-18) also appropriately characterize effects under Alternative 6A.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative
8 6A.

9 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

10 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

11 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

12 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

13 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

14 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

15 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

16 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

17 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**
18 **(CM21)**

19 *NEPA Effects:* Detailed discussions regarding the potential effects of these impact mechanisms on
20 delta smelt are the same as those described under Alternative 1A (Impact AQUA-10 through 18).
21 The effects range from no effect, to not adverse, to beneficial.

22 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
23 less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is
24 required.

25 **Longfin Smelt**

26 **Construction and Maintenance of CM1**

27 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

28 *NEPA Effects:* The potential effects of construction of water conveyance facilities on longfin smelt
29 would be the same as those described for Alternative 1A (see Impact AQUA-19), because the same
30 five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of
31 existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel
32 reshaping. As concluded there, environmental commitments and mitigation measures would be
33 available to avoid and minimize potential effects, and the effect would not be adverse for longfin
34 smelt.

1 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-19, the impact of the
2 construction of water conveyance facilities on longfin smelt would be less than significant except for
3 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and
4 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

11 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

12 **NEPA Effects:** The potential effects of maintenance of water conveyance facilities on longfin smelt
13 would be the same as those described for Alternative 1A (see Impact AQUA-20), which concluded
14 that the effect would not be adverse for longfin smelt.

15 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-20, the impact of the
16 maintenance of water conveyance facilities on longfin smelt would be less than significant and no
17 mitigation would be required.

18 **Water Operations of CM1**

19 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

20 **Water Exports from SWP/CVP South Delta Facilities**

21 Entrainment to the south delta facilities would be eliminated for all life stages of longfin smelt
22 because there would be no south delta exports under Alternative 6A.

23 **Water Exports from SWP/CVP North Delta Intake Facilities**

24 The proposed new north Delta intakes could increase entrainment potential in this area and locally
25 attract piscivorous fish (i.e., predators), but entrainment and predation losses of longfin smelt at the
26 north Delta would be extremely low because this species is only expected to occur occasionally in
27 very low numbers this far upstream.

28 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

29 Particle entrainment at the NBA, representing potential larval longfin smelt entrainment, was low
30 for both starting distributions (wetter and drier). Particle entrainment averaged 0.12-15% under
31 Alternative 6A, which was 0.04% greater than NAA, or 39-47% greater entrainment in relative
32 terms (Table 11-6A-3).

1 **Table 11-6A-3. Average Percentage (and Difference) of Particles Representing Larval Longfin Smelt**
2 **Entrained by the North Bay Aqueduct under Alternative 6A and Baseline Scenarios**

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A6A_LLТ	A6A_LLТ vs. EXISTING CONDITIONS	A6A_LLТ vs. NAA
Wetter	0.20	0.08	0.12	-0.09 (-42.0%)	0.04 (47%)
Drier	0.25	0.11	0.15	-0.10 (-40.1%)	0.04 (39%)

Note: 60-day runs of PTM. Negative difference values indicate lower entrainment under the alternative compared to the baseline scenario.

3

4 **Predation Associated with Entrainment**

5 Pre-screen loss attributed to predation at the south Delta facilities would be eliminated because
6 there would be no entrainment to those facilities under Alternative 6A. Predation loss at the
7 proposed north Delta intakes and the alternate NBA intake would be limited because longfin smelt
8 occur only rarely that far upstream. The effect under Alternative 6A would be beneficial because of
9 the reduction of predation loss.

10 **NEPA Effects:** The effect under Alternative 6A would be beneficial to the species because of the
11 elimination of entrainment and predation loss for both juveniles and adults at the south Delta
12 facilities.

13 **CEQA Conclusion:** Entrainment loss of juvenile longfin smelt would be eliminated to the south Delta
14 facilities because there would be no south Delta exports under Alternative 6A. Entrainment to the
15 north Delta intakes would be low since longfin smelt would not occur in the vicinity of the intakes.
16 Reductions in larval longfin smelt entrainment to agricultural diversions is also expected under
17 Alternative 6A. Larval entrainment to the NBA would be reduced slightly compared to Existing
18 Conditions; however, total entrainment to that facility would affect less than 1% of the population.

19 The impact statement and conclusion for predation associated with entrainment would be the same
20 as described above. Predation loss of juveniles and adults at the south Delta facilities would be
21 effectively eliminated because there would be no south Delta entrainment under Alternative 6A.
22 Predation risk at the SWP/CVP north Delta intakes and the alternate NBA intake would be low
23 because longfin smelt rarely occur in that vicinity. In conclusion, the impact under Alternative 6A
24 would be beneficial because of the elimination of entrainment and entrainment-related predation
25 loss at the south Delta facilities.

26 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**
27 **Habitat for Longfin Smelt**

28 Longfin smelt spawn in late winter and early spring in the Sacramento River below Rio Vista and in
29 the lower San Joaquin River (Moyle 2002; California Department of Fish and Game 2009b). Eggs are
30 thought to be deposited on sand, gravel or hard substrate. Flows in this region are strongly
31 influenced by tides. Averaged across all water years, flows in the Sacramento River at Rio Vista
32 under Alternative 6A would be similar (<5% difference) to those under Alternative 1A during the
33 longfin smelt spawning period. Therefore, effects under Alternative 6A would likely be similar to
34 those under Alternative 1A, which was determined to be not adverse. Thus the effect on spawning
35 habitat under Alternative 6A would also not be adverse. The indices of abundance of longfin smelt

1 based on the Fall Midwater, Bay Otter, and Bay Midwater trawl indices have been correlated to
 2 outflow (expressed as the location of X2) in the preceding winter and spring months, when longfin
 3 smelt spawning and rearing occurs (January through June) (Kimmerer 2002a; Kimmerer et al. 2009;
 4 Rosenfield and Baxter 2007; Mac Nally et al. 2010; Thomson et al. 2010). Based on Kimmerer et al.
 5 2009, reduced outflows in January through June under Alternative 6A compared to the NAA has the
 6 potential to reduce longfin smelt abundance. Longfin smelt abundance averaged across water years
 7 would be increased 15% (based on Fall Midwater Trawl indices) to 19% (based on Bay Otter Trawl
 8 indices) compared to NAA. Longfin smelt abundance would be increased approximately 29–43%
 9 under Alternative 6A compared to the NAA in dry and critical water year types (Table 11-6A-4).

10 **Table 11-6A-4. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in the**
 11 **Fall Midwater Trawl or Bay Otter Trawl^a**

WY Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
All	-915 (-18%)	561 (15%)	-2,986 (-21%)	1,770 (19%)
Wet	-5,548 (-31%)	816 (7%)	-22,928 (-35%)	3,221 (8%)
Above Normal	-2,893 (-34%)	-61 (-1%)	-10,251 (-39%)	-206 (-1%)
Below Normal	-857 (-20%)	442 (15%)	-2,686 (-24%)	1,334 (18%)
Dry	-28 (-1%)	465 (29%)	-77 (-2%)	1,260 (35%)
Critical	150 (16%)	284 (35%)	361 (19%)	675 (43%)

Shading indicates 10% or greater decrease in abundance relative to baseline.

^a Based on the X2-Relative Abundance Regressions of Kimmerer et al. (2009).

12
 13 Averaged across all water year types, Delta outflow under Alternative 6A would be similar (<10%
 14 change) to NAA during the January–June period. Other components of Alternative 6A have the
 15 potential to increase recruitment per unit of flow. These analyses do not take into account any
 16 potential changes in spawning or rearing conditions related to non-operational components of
 17 Alternative 6A, including habitat restoration.

18 Once larval smelt reach rearing habitat in the west Delta and Suisun Bay, they would likely benefit
 19 from habitat restoration actions (CM2 and CM4), which are intended to provide additional food
 20 production and export to longfin smelt rearing areas. This may provide potential benefits to longfin
 21 smelt, particularly from Suisun Marsh, West Delta, and Cache Slough ROAs.

22 **NEPA Effects:** Overall, the effect of Alternative 6A would not be adverse and may be beneficial
 23 because there would typically be an increase in longfin smelt abundances and restored spawning
 24 and rearing habitat. Investigations suggest that spring outflow is the primary driver for the
 25 observed relationship between outflow and longfin smelt recruitment (Thomson et al. 2010.
 26 However, despite the growing body of evidence that supports the positive correlation between
 27 longfin smelt abundance and spring outflow, the specific timing and amount of outflow needed to
 28 conserve longfin smelt, are generally unknown. Therefore, the overall benefits are not certain,
 29 especially in light of potential increases in food resources in the Plan Area and other benefits to
 30 spawning and rearing habitat.

31 **CEQA Conclusion:** Overall, the results of the Impact AQUA-22 CEQA analysis indicate that effects on
 32 spawning habitat under Alternative 6A would be less than significant, and no mitigation is required.

1 Flows at Rio Vista under Alternative 6A would be similar to Existing Conditions during the spawning
2 period. When averaged across all water years, Sacramento River flows at Rio Vista under Alternative
3 6A would be similar to Existing Conditions in January and February (<10% difference) and reduced
4 slightly in December and March (11% reduction). In addition, Sacramento River at Rio Vista flows
5 under Alternative 6A would be similar to Alternative 1A (<5% difference) from December through
6 March.

7 Despite the similarities in spawning habitat, the difference in rearing habitat between Existing
8 Conditions and Alternative 6A could be significant because Alternative 6A could cause substantial
9 reductions in modeled population indices of longfin smelt, contrary to the NEPA conclusion set forth
10 above. In general, under Alternative 6A water operations, the quantity and quality of rearing habitat
11 for longfin smelt would be reduced relative to Existing Conditions (Table 11-6A-4).

12 Relative longfin smelt abundance averaged across all water years would be reduced 18–21%
13 compared to Existing Conditions (Table 11-6A-4). Relative abundance by water year type would be
14 reduced under Alternative 6A in all water year types, with the largest differences occurring in wet,
15 above normal, and below normal water years (20–39% lower abundance). Average Delta outflows
16 under Alternative 6A would be increased 11% in January but reduced 11–21% from April to June
17 relative to Existing Conditions. Delta outflows in February and March would be similar to Existing
18 Conditions.

19 Collectively, the results of the Impact AQUA-22 CEQA analysis indicate that the difference in rearing
20 habitat between the CEQA baseline and Alternative 6A could be significant because Delta outflows
21 would be reduced in the spring, which would have the potential to contribute to substantial
22 reductions in longfin smelt abundances.

23 The CALSIM flow outputs between Existing Conditions in the late long-term implementation period
24 and Alternative 6A indicate that differences between Existing Conditions and Alternative 6A found
25 above would generally be due to climate change, sea level rise, and future demand, and not the
26 alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
27 level rise and climate change, could be similar to the NEPA conclusion, and therefore would not in
28 itself result in a significant impact on rearing habitat for longfin smelt.

29 Several habitat restoration conservation measures (CM2 and CM4) may also improve the quality of
30 spawning and rearing habitat for longfin smelt, by increasing suitable habitat area and food
31 production in the Delta. However, given the uncertainty of the outcome related to habitat
32 restoration, the uncertainty regarding the actual mechanism for the outflow-abundance relationship
33 from Kimmerer et al. (2009), and the modeled change in winter-spring outflow, the impact may still
34 be significant, and mitigation would be required. With implementation of Mitigation Measures
35 AQUA-22a through 22c, habitat restoration and reduced larval entrainment would reduce this
36 impact to less than significant, so no additional mitigation would be required.

37 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**
38 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**
39 **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

40 Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

1 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**
2 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

3 Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

4 **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**
5 **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

6 Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

7 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

8 Discussion provided above, under Impact AQUA-22

9 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

10 Discussion provided above, under Impact AQUA-22

11 **Restoration and Conservation Measures**

12 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
13 substantial differences in fish effects are anticipated anywhere in the affected environment under
14 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
15 longfin smelt under Alternative 1A (Impacts AQUA-25 through Impact AQUA-36) also appropriately
16 characterize effects under Alternative 6A.

17 The following impacts are those presented under Alternative 1A that are identical for Alternative
18 6A.

19 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

20 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**
21 **Smelt**

22 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

23 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

24 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**
25 **(CM13)**

26 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

27 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

28 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

29 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

30 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

31 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

1 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**
2 **(CM21)**

3 *NEPA Effects:* As described in Alternative 1A (Impact AQUA-25 through AQUA-36) these restoration
4 and conservation measure impact mechanisms have been determined to range from no effect, to not
5 adverse, or beneficial effects to longfin smelt for NEPA purposes. Specifically for AQUA-26, the
6 effects of contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides
7 would not be adverse. The effects of methylmercury on longfin smelt are uncertain.

8 *CEQA Conclusion:* These restoration and conservation measure impact mechanisms would be
9 considered to range from no impact, to less than significant, or beneficial, for the reasons identified
10 for Alternative 1A, and no mitigation is required.

11 **Winter-Run Chinook Salmon**

12 **Construction and Maintenance of CM1**

13 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
14 **(Winter-Run ESU)**

15 *NEPA Effects:* The potential effects of construction of water conveyance facilities on Chinook salmon
16 would be the same as those described for Alternative 1A (see Impact AQUA-37), because the same
17 five intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of
18 existing shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel
19 reshaping.

20 As concluded there, environmental commitments and mitigation measures would be available to
21 avoid and minimize potential effects, and the effect would not be adverse for winter-run Chinook
22 salmon.

23 *CEQA Conclusion:* As described under Alternative 1A, Impact AQUA-37 for Chinook salmon, the
24 impact of the construction of water conveyance facilities on Chinook salmon would be less than
25 significant except for construction noise associated with pile driving. Implementation of Mitigation
26 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
27 significant.

28 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
29 **of Pile Driving and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

31 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
32 **and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

1 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
2 **(Winter-Run ESU)**

3 **NEPA Effects:** The potential effects of maintenance of water conveyance facilities on Chinook salmon
4 would be the same as those described for Alternative 1A (see Impact AQUA-38), which concluded
5 that the effect would not be adverse for Chinook salmon.

6 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-38, the impact of the
7 maintenance of water conveyance facilities on Chinook salmon would be less than significant and no
8 mitigation would be required.

9 **Water Operations of CM1**

10 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**
11 **Run ESU)**

12 ***Water Exports from SWP/CVP South Delta Facilities***

13 Entrainment losses of juvenile winter-run Chinook salmon at the SWP/CVP south Delta export
14 facilities would be eliminated under Alternative 6A because there would be no south Delta exports
15 under this Alternative. Pre-screen loss of Chinook salmon at the south Delta facilities is attributed to
16 predation and assumed to be proportional to entrainment loss.

17 ***Water Exports from SWP/CVP North Delta Intake Facilities***

18 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
19 entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north
20 Delta intakes would have state-of-the-art screens to exclude juvenile fish.

21 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

22 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
23 entrainment and impingement effects for juvenile salmonids would be minimal because intakes
24 would have state-of-the-art screens installed.

25 **NEPA Effects:** In conclusion, Alternative 6A would eliminate south Delta entrainment for all races of
26 Chinook salmon, which would be a beneficial effect.

27 **CEQA Conclusion:** Entrainment losses of juvenile Chinook salmon at the south Delta facilities would
28 be eliminated under Alternative 6A for all salmon races and water year types compared to Existing
29 Conditions. The reduction in entrainment would be a beneficial impact.

30 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
31 **Chinook Salmon (Winter-Run ESU)**

32 In general, Alternative 6A would not affect the quantity and quality of spawning and egg incubation
33 habitat for winter-run Chinook salmon relative to the NEPA point of comparison.

34 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were
35 examined during the May through September winter-run Chinook salmon spawning period
36 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the
37 instream area available for spawning and egg incubation. Flows under A6A_LLT during May through

1 July would nearly always be similar to or greater than flows under NAA. Flows under A6A_LLT
2 during August through September would generally be lower than flows under NAA by up to 23%
3 depending on location, month, and water year type.

4 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the
5 May through September winter-run Chinook salmon spawning and egg incubation period. May
6 Shasta storage volume under A6A_LLT be similar to or greater than storage under NAA in all water
7 year types (Table 11-6A-5).

8 **Table 11-6A-5. Difference and Percent Difference in May Water Storage Volume (thousand acre-**
9 **feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-59 (-1%)	-25 (-1%)
Above Normal	-111 (-2%)	-25 (-1%)
Below Normal	-218 (-5%)	-20 (-1%)
Dry	-372 (-10%)	72 (2%)
Critical	-474 (-19%)	110 (6%)

10

11 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the
12 Sacramento River under A6A_LLT would be lower or similar to mortality under NAA except in below
13 normal water years (96%) (Table 11-6A-6). The increase in the percent of winter-run Chinook
14 salmon population subject to mortality would be 2% in below normal years. Therefore, the increase
15 in mortality of 2% from NAA to A6A_LLT, although relatively large, would be negligible at an
16 absolute scale to the winter-run Chinook salmon population. These results indicate that climate
17 change would cause the majority of the increase in winter-run Chinook salmon egg mortality.

18 **Table 11-6A-6. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook**
19 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	1 (230%)	-0.2 (-13%)
Above Normal	2 (365%)	0.05 (2%)
Below Normal	3 (266%)	2 (96%)
Dry	6 (376%)	-0.1 (-1%)
Critical	40 (148%)	-4 (-6%)
All	8 (174%)	-0.4 (-3%)

20

21 SacEFT predicts that the percentage of years with good spawning habitat availability would be
22 similar between NAA and A6A_LLT (Table 11-6A-7). SacEFT predicts that the percentage of years
23 with good (lower) redd scour risk under A6A_LLT would be identical to the percentage of years
24 under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under
25 A6A_LLT would be similar to that under NAA. SacEFT predicts that the percentage of years with
26 good (lower) redd dewatering risk under A6A_LLT would be 7% lower than NAA. These results
27 indicate that there would be small effects of Alternative 6A on redd dewatering risk.

Table 11-6A-7. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	-26 (-45%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-20 (-21%)	3 (4%)
Redd Dewatering Risk	2 (8%)	-2 (-7%)
Juvenile Rearing WUA	-19 (-38%)	6 (24%)
Juvenile Stranding Risk	5 (25%)	-6 (-19%)

WUA = Weighted Usable Area.

Water temperatures in the Sacramento River under Alternative 6A would be the same as those under Alternative 1A, Impact AQUA-40, which is that there would generally be no effects on water temperature in the Sacramento River.

NEPA Effects: Considering the range of results presented here for winter-run Chinook salmon spawning and egg incubation, this effect would not be adverse because it does not have the potential to substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg mortality. The reduction in flows of up to 23% in August and September would not translate into reductions in spawning habitat availability (Table 11-6A-7).

CEQA Conclusion: In general, Alternative 6A would not affect the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to the CEQA Existing Conditions.

CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined during the May through September winter-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under Existing Conditions during May through July, except in wet and below normal years during May (10% to 19% lower). Flows under A6A_LLT would generally be lower by up to 23% during August through September. This indicates that there would be a small to moderate effect of Alternative 6A on flows during two of the five months of the winter-run Chinook salmon spawning and egg incubation period.

Shasta Reservoir storage volume at the end of May under A6A_LLT would be generally lower than Existing Conditions (up to 19% lower) (Table 11-6A-5). This indicates that there would be a small to moderate effect of Alternative 6A on flows during the spawning and egg incubation period.

The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A6A_LLT would be 148% to 376% greater than mortality under Existing Conditions depending on water year type (Table 11-6A-6). These increases would have population-level effects only in dry and critical years, in which the absolute percent increase in mortality of the winter-run Chinook salmon population would be 6 and 40%, respectively. These results indicate that Alternative 6A would cause increased winter-run Chinook salmon mortality in the Sacramento River.

SacEFT predicts that there would be a 45% decrease in the percentage of years with good spawning availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions (Table 11-6A-7). SacEFT predicts that the percentage of years with good (lower) redd scour risk

1 under A6A_LLT would be identical to the percentage of years under Existing Conditions. SacEFT
2 predicts that the percentage of years with good egg incubation conditions under A6A_LLT would be
3 21% lower than under Existing Conditions. SacEFT predicts that the percentage of years with good
4 (lower) redd dewatering risk under A6A_LLT would be 8% greater than the percentage of years
5 under Existing Conditions. These results indicate that Alternative 6A would cause small to moderate
6 reductions in spawning habitat WUA and egg incubation conditions.

7 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
8 under Alternative 1A, Impact AQUA-40, which indicates there would be increased exceedances of
9 NMFS temperature thresholds in the Sacramento River.

10 **Summary of CEQA Conclusion**

11 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between
12 the CEQA baseline and Alternative 6A could be significant because, when compared to the CEQA
13 baseline, the alternative could substantially reduce suitable spawning habitat and substantially
14 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth
15 above, which is directly related to the inclusion of climate change effects in Alternative 6A.

16 Instream flows under Alternative 6A during two of the five months of the winter-run Chinook
17 salmon spawning and egg incubation period would be up to 23% lower than those under the CEQA
18 Existing Conditions. Egg mortality under Alternative 6A in dry and critical years, during which
19 winter-run Chinook salmon would already be stressed due to reduced flows and increased
20 temperatures, would be 6% and 40% greater, than the CEQA Existing Conditions (Table 11-6A-6).
21 Further, the extent of spawning habitat would be 45% lower due to Alternative 6A compared to the
22 CEQA Existing Conditions (Table 11-6A-7), which represents a substantial reduction in spawning
23 habitat and, therefore, in adult spawning and redd carrying capacity. This impact is a result of the
24 specific reservoir operations and resulting flows associated with this alternative.

25 These results are primarily caused by four factors: differences in sea level rise, differences in climate
26 change, future water demands, and implementation of the alternative. The analysis described above
27 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
28 the alternative from those of sea level rise, climate change and future water demands using the
29 model simulation results presented in this chapter. However, the increment of change attributable
30 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
31 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
32 implementation period, which does include future sea level rise, climate change, and water
33 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
34 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
35 effect of the alternative from those of sea level rise, climate change, and water demands.

36 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
37 Conditions in the late long-term implementation period and Alternative 6A indicates that flows and
38 reservoir storage in the locations and during the months analyzed above would generally be similar
39 between Existing Conditions and Alternative 6A. This indicates that the differences between Existing
40 Conditions and Alternative 6A found above would generally be due to climate change, sea level rise,
41 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative
42 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
43 therefore would not in itself result in a significant impact on spawning habitat for winter-run
44 Chinook salmon. This impact is found to be less than significant and no mitigation is required.

1 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
2 **(Winter-Run ESU)**

3 In general, Alternative 6A would not affect the quantity and quality of rearing habitat for fry and
4 juvenile winter-run Chinook salmon relative to the NAA.

5 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
6 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
7 *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing
8 habitat. Flows under A6A_LLT would generally be similar to or greater than flows under during
9 October and December with some exceptions during October (up to 9% lower), but generally lower
10 (up to 21% lower) than flows under NAA during August, September, and November.

11 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
12 measured as weighted usable area, under A6A_LLT would be 24% greater than the percentage of
13 years under NAA (Table 11-6A-6). The percentage of years with good (low) juvenile stranding risk
14 under A6A_LLT is predicted to be 19% lower than under NAA. On an absolute scale, both rearing
15 habitat availability and stranding risk would be small (6%) and would not have a biologically
16 meaningful effect on winter-run Chinook salmon. This indicates that the quantity and quality of
17 habitat in the Sacramento River would be lower under A6A_LLT relative to NAA.

18 SALMOD predicts that winter-run Chinook salmon smolt equivalent habitat-related mortality under
19 A6A_LLT would be similar (3% reduction) to that under NAA.

20 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
21 under Alternative 1A, Impact AQUA-41, which indicates that there would be no effect on mean
22 monthly temperatures during the winter-run juvenile rearing period.

23 **NEPA Effects:** Collectively, these results indicate that the effect of Alternative 6A is not adverse
24 because it does not have the potential to substantially reduce the amount of suitable habitat or
25 substantially interfere with winter-run Chinook salmon rearing. Differences in flows are generally
26 small and inconsistent among months and water year types.

27 **CEQA Conclusion:** In general, Alternative 6A would not affect the quantity and quality of rearing
28 habitat for fry and juvenile winter-run Chinook salmon relative to the CEQA Existing Conditions.

29 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
30 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
31 *in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under
32 Existing Conditions in all months but September with some exceptions (up to 20% lower). Flows
33 during September under A6A_LLT would generally be lower than flows under Existing Conditions
34 (21% lower).

35 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
36 measured as weighted usable area, under A6A_LLT would be 38% lower than under Existing
37 Conditions (Table 11-6A-7). However, the percentage of years with good (low) juvenile stranding
38 risk under A6A_LLT is predicted to be 25% greater than under Existing Conditions. The 38%
39 decrease in rearing habitat availability would correspond to a 19% absolute difference, which would
40 be biologically meaningful, although the 25% increase in stranding risk would correspond to a 5%
41 absolute increase, which would not be biologically meaningful.

1 SALMOD predicts that winter-run Chinook salmon smolt equivalent habitat-related mortality under
2 A6A_LLTT would be 11% higher than under Existing Conditions.

3 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
4 under Alternative 1A, Impact AQUA-41, which indicates that there would be small temperature
5 increases under Alternative 1A during some months in the Sacramento River relative to Existing
6 Conditions.

7 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between
8 the CEQA baseline and Alternative 6A could be significant because, when compared to the CEQA
9 baseline, the alternative could substantially reduce suitable juvenile rearing habitat, contrary to the
10 NEPA conclusion set forth above, which is directly related to the inclusion of climate change effects
11 in Alternative 6A. Although differences in flows are small and inconsistent, both SacEFT and
12 SALMOD predict a reduction in juvenile rearing habitat availability under Alternative 6A, which
13 would increase competition for upstream food and space. Further, there would be small increases in
14 water temperature under Alternative 6A during part of the rearing period.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate
16 change, future water demands, and implementation of the alternative. The analysis described above
17 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
18 the alternative from those of sea level rise, climate change and future water demands using the
19 model simulation results presented in this chapter. However, the increment of change attributable
20 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
21 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
22 implementation period, which does include future sea level rise, climate change, and water
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
27 Conditions in the late long-term implementation period and Alternative 6A indicates that flows and
28 reservoir storage in the locations and during the months analyzed above would generally be similar
29 between Existing Conditions and Alternative 6A. This indicates that the differences between Existing
30 Conditions and Alternative 6A found above would generally be due to climate change, sea level rise,
31 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative
32 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
33 therefore would not in itself result in a significant impact on rearing habitat for winter-run Chinook
34 salmon. This impact is found to be less than significant and no mitigation is required.

35 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon** 36 **(Winter-Run ESU)**

37 In general, Alternative 6A would reduce migration conditions for winter-run Chinook salmon
38 relative to the NAA.

39 **Upstream of the Delta**

40 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November
41 juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run
42 Chinook salmon to migrate effectively down the Sacramento River. Flows under A6A_LLTT would be

1 up to 16% lower than under NAA during August, September, and November (Appendix 11C, *CALSIM*
2 *II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally similar to or
3 higher than flows under NAA during July and October with few exceptions.

4 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run
5 Chinook salmon upstream migration period (December through August) (Appendix 11C, *CALSIM II*
6 *Model Results utilized in the Fish Analysis*). A reduction in flows may reduce the olfactory cues
7 needed by adult winter-run Chinook salmon to return to natal spawning grounds in the upper
8 Sacramento River. Flows under A6A_LLT would generally be similar to or greater than those under
9 NAA, except during August, in which flows would be up to 10% lower under A6A_LLT.

10 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
11 under Alternative 1A, Impact AQUA-42, which indicates there would be no differences in water
12 temperatures between NAA and Alternative 1A.

13 **Through-Delta**

14 The effects on through-Delta migration were evaluated using the approach described in Alternative
15 1A, Impact AQUA-42.

16 **Juveniles**

17 During the juvenile winter-run Chinook salmon emigration period (November to early May), mean
18 monthly flows under Alternative 6A averaged across years would be lower (15% to 28% lower)
19 compared to NAA. Flows would be up to 34% lower in April of above normal years. As described in
20 Impact AQUA-42 for Alternative 1, *CM1 Water Facilities and Operation* includes bypass flow criteria
21 that will be managed in real time to minimize adverse effects of diversions at the north Delta intakes
22 on downstream-migrating salmonids.

23 The north Delta facilities would replace aquatic habitat and likely attract piscivorous fish around the
24 intake structures. The five NDD intakes would remove or modify habitat along that portion of the
25 migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation
26 losses at the north Delta intakes, as estimated by the bioenergetics model, would be less than 2%
27 compared to the annual production estimated for the Sacramento Valley (Table 11-1A-17). A
28 conservative assumption of 5% loss per intake would yield a cumulative loss of 18.5% of juvenile
29 winter-run Chinook that reach the north Delta (Appendix 5F, *Biological Stressors*). This assumption
30 is uncertain and represents an upper bound estimate. This topic is further discussed in Alternative
31 1A, Impact AQUA-42.

32 Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon was
33 modeled by the DPM. Average survival under Alternative 6A would be 33.5% across all years, 26.3%
34 in drier years, and 45.7% in wetter years (Table 11-6A-8). Compared to NAA, juvenile survival
35 would decrease less than 1% (a 1-3% relative decrease) for all years, drier years and wetter years
36 scenarios.

1 **Table 11-6A-8. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon**
2 **under Alternative 6A**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wetter Years	46.3	46.1	45.7	-0.7 (-1%)	-0.4 (-1%)
Drier Years	28.0	27.1	26.3	-1.7 (-6%)	-0.9 (-3%)
All Years	34.9	34.2	33.5	-1.3 (-4%)	-0.7 (-2%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

3

4 **Adults**

5 Attraction flow was estimated by the percentage of Sacramento River-origin water at Collinsville
6 (Table 11-6A-9). The proportion of Sacramento River water in the Delta during the adult winter-run
7 migration period (December to June) would be slightly reduced 6% to 8% in January and February,
8 and reduced 10% to 13% in March to May compared to NAA. The reductions in percentage are less
9 than the 20% change in dilution reported to cause a significant change in migration by Fretwell
10 (1989). Although Sacramento River attraction flows would be reduced during these months relative
11 to NAA, the Sacramento River would still represent 55–69% of Delta flows.

12 **Table 11-6A-9. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
13 **San Joaquin River during the Adult Chinook Migration Period for Alternative 6A**

Month	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	63	3	-5
November	60	66	63	3	-3
December	67	66	67	0	1
January	76	75	69	-7	-6
February	75	72	64	-11	-8
March	78	76	64	-14	-12
April	77	75	62	-15	-13
May	69	65	55	-14	-10
San Joaquin River					
September	0.3	0.1	5.5	5.2	5.4
October	0.2	0.3	8.1	7.9	7.8
November	0.4	1.0	10.7	10.3	9.7
December	0.9	1.0	7.7	6.8	6.7
January	1.6	1.7	8.1	6.5	6.4
February	1.4	1.5	8.4	7	6.9
March	2.6	2.8	10.3	7.7	7.5
April	6.3	6.6	14.9	8.6	8.3

Shading indicates 10% or greater decrease in abundance relative to baseline.

1 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 6A is adverse due to the
2 cumulative effects associated with five north Delta intake facilities, including mortality related to
3 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to
4 reduced flows downstream of the intakes) associated with the five NDD intakes. Upstream of the
5 Delta in the Sacramento River, there would be no effect of Alternative 6A relative to NAA on
6 upstream flows or water temperatures during the juvenile and adult migration periods.

7 Adult attraction flows under Alternative 6A would be lower than those under NAA, but adult
8 attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

9 Near-field effects of Alternative 6A NDD on winter-run Chinook salmon related to impingement and
10 predation associated with five new intakes could result in substantial effects on juvenile migrating
11 winter-run Chinook salmon, although there is high uncertainty regarding the potential effects.
12 Estimates within the effects analysis range from very low levels of effects (2% mortality) to very
13 significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented
14 with the intent of providing localized and temporary reductions in predation pressure at the NDD.
15 Additionally, several pre-construction surveys to better understand how to minimize losses
16 associated with the five new intake structures will be implemented as part of the final NDD screen
17 design effort. Alternative 6A also includes an Adaptive Management Program and Real-Time
18 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide
19 adequate migration conditions for winter-run Chinook salmon. However, at this time, due to the
20 absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of
21 mortality expected from near-field effects at the NDD remains highly uncertain.

22 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
23 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
24 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A
25 predict improvements in smolt condition and survival associated with increased access to the Yolo
26 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
27 of each of these factors and how they might interact and/or offset each other in affecting salmonid
28 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

29 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
30 all of these elements of BDCP operations and conservation measures to predict smolt migration
31 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
32 migration survival under Alternative 6A would be similar to survival rates estimated for NAA.
33 Further refinement and testing of the DPM, along with several ongoing and planned studies related
34 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable
35 future. These efforts are expected to improve our understanding of the relationships and
36 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
37 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
38 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative
39 6A on winter-run Chinook salmon through-Delta survival remains uncertain.

40 Therefore, primarily as a result of unacceptable levels of uncertainty regarding the cumulative
41 impacts of near-field and far-field effects associated with the presence and operation of the five
42 intakes on winter-run Chinook salmon, this effect is adverse.

43 **CEQA Conclusion:** In general, Alternative 6A would affect migration conditions for winter-run
44 Chinook salmon relative to CEQA Existing Conditions.

1 **Upstream of the Delta**

2 Flows in the Sacramento River upstream of Red Bluff were examined during the July through
3 November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A6A_LLT for juvenile migrants would be generally similar to or greater than
5 flows under Existing Conditions, except during September, in which flows would be up to 21%
6 lower. Because these flow reductions occur in only one month during the five-month emigration
7 period, they would not cause biologically meaningful effects.

8 Flows under A6A_LLT in the Sacramento River upstream of Red Bluff during the December through
9 August adult winter-run Chinook salmon upstream migration period would generally be similar to
10 or greater than flows under Existing Conditions with few exceptions (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*).

12 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
13 under Alternative 1A, Impact AQUA-42, which indicates that there would be small increase in water
14 temperatures under Alternative during large portions of the juvenile and adult migration periods.

15 **Through-Delta**

16 As described above, through-Delta survival by emigrating juvenile winter-run Chinook salmon
17 would decrease 1.3% (4% relative decrease) across all water years and decrease 1.7% (6% relative
18 decrease) in drier years compared to Existing Conditions. Losses due to predation at the five north
19 Delta intakes could hypothetically range from less than 2% up to 19.2% of juvenile winter-run
20 Chinook that reach the north Delta.

21 Based on the proportion of Sacramento River flows, attraction flows and olfactory cues would be
22 slightly reduced (up to 15% lower) compared to Existing Conditions during the adult winter-run
23 adult Chinook salmon migration period (December to June) (Table 11-6A-9). Although Sacramento
24 River attraction flows would be reduced during these months relative to Existing Conditions, the
25 Sacramento River would still represent 55–67% of Delta flows.

26 **Summary of CEQA Conclusion**

27 In general, the impact is significant because Alternative 6A would reduce migration conditions for
28 winter-run Chinook salmon and the movement of fish would be substantially altered. Although
29 upstream flows would be similar between Existing Conditions and Alternative 6A, water
30 temperatures would be elevated for much of the juvenile and adult migration periods, which could
31 contribute to increased stress or mortality to migrating individuals. In the Delta, Alternative 6A
32 would result in a decrease in through-Delta survival of juvenile winter-run Chinook salmon,
33 increased predation at the five intakes, and loss of aquatic habitat associated with the five intake
34 structures. Based on the proportion of Sacramento River flows, olfactory cues would be similar
35 (<10% difference) to Existing Conditions for the winter-run adult Chinook salmon migration.

36 With respect to the NDD intakes, implementation of CM6 and CM15 would address these impacts,
37 but are not anticipated to reduce them to a level considered less than significant. Although
38 implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which
39 would be lost, it would not necessarily be located near the intakes and therefore would not fully
40 compensate for the lost habitat. Additionally, implementation of this measure would not fully
41 address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has
42 substantial uncertainties associated with its effectiveness such that it is considered to have no

1 demonstrable effect. Conservation measures that address habitat and predation losses, therefore,
2 would potentially minimize impacts to some extent but not to a less than significant level.

3 Applicable conservation measures are briefly described below and full descriptions are found in
4 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized
5 Reduction of Predatory Fishes (Predator Control) (CM15).

6 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
7 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat
8 habitats on the waterside side of levees along channels that provide rearing and outmigration
9 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side
10 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length
11 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10
12 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be
13 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel
14 margin enhancement would be performed only along channels that provide rearing and
15 outmigration habitat for juvenile salmonids. These include channels that are protected by
16 federal project levees—including the Sacramento River between Freeport and Walnut Grove
17 among several others.

18 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
19 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
20 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to
21 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are
22 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.
23 Therefore, this conservation measure is not intended to entirely remove predators at any
24 location, or substantially alter the abundance of predators at the scale of the Delta system. This
25 conservation measure would also not remove piscivorous birds. Because of uncertainties
26 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot
27 projects and research actions coupled with an adaptive management and monitoring program to
28 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to
29 occupy vacated areas; therefore, removal activities would need to be continuous during periods
30 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

31 Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent
32 necessary to reduce this impact to a less-than-significant level would fundamentally change the
33 alternative, thereby making it a different alternative than that which has been modeled and
34 analyzed. As a result, this impact is significant and unavoidable because there is no feasible
35 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
36 severity of the impact though not necessarily to a less-than-significant level.

37 **Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional**
38 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**
39 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

40 Please refer to Mitigation Measure AQUA-42a under Alternative 1A (Impact AQUA-42) for
41 winter-run Chinook salmon.

1 **Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts**
2 **on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

3 Please refer to Mitigation Measure AQUA-42b under Alternative 1A (Impact AQUA-42) for
4 winter-run Chinook salmon.

5 **Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement**
6 **Potentially Feasible Means to Minimize Effects on Winter-Run Chinook Salmon Migration**
7 **Conditions Consistent with CM1**

8 Please refer to Mitigation Measure AQUA-42c under Alternative 1A (Impact AQUA-42) for
9 winter-run Chinook salmon.

10 If feasible means are identified to reduce impacts on migration habitat consistent with the
11 overall operational framework of Alternative 6A without causing new significant adverse
12 impacts on other covered species, such means shall be implemented. If sufficient operational
13 flexibility to reduce effects on winter-run Chinook salmon habitat is not feasible under
14 Alternative 6A operations, achieving further impact reduction pursuant to this mitigation
15 measure would not be feasible under this alternative, and the impact on winter-run Chinook
16 salmon would remain significant and unavoidable.

17 **Restoration and Conservation Measures**

18 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
19 substantial differences in fish effects are anticipated anywhere in the affected environment under
20 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
21 winter-run Chinook salmon under Alternative 1A (Impact AQUA-43 through Impact AQUA-54) also
22 appropriately characterize effects under Alternative 6A.

23 The following impacts are those presented under Alternative 1A that are identical for Alternative
24 6A.

25 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**
26 **(Winter-Run ESU)**

27 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**
28 **Salmon (Winter-Run ESU)**

29 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**
30 **ESU)**

31 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**
32 **ESU) (CM12)**

33 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
34 **(Winter-Run ESU) (CM13)**

35 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**
36 **Run ESU) (CM14)**

1 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
2 **(Winter-Run ESU) (CM15)**

3 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**
4 **(CM16)**

5 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**
6 **(CM17)**

7 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**
8 **(CM18)**

9 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**
10 **ESU) (CM19)**

11 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
12 **(Winter-Run ESU) (CM21)**

13 *NEPA Effects:* These restoration and conservation impact mechanisms have been determined to
14 range from no effect, not adverse, or beneficial effects on winter-run Chinook salmon for NEPA
15 purposes, for the reasons identified for Alternative 1A (Impact AQUA-43 through 54). Specifically for
16 AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium,
17 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run
18 Chinook salmon are uncertain.

19 *CEQA Conclusion:* These impact mechanisms would be considered to range from no impact, to less
20 than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for
21 Alternative 1A, and no mitigation is required.

22 **Spring-Run Chinook Salmon**

23 **Construction and Maintenance of CM1**

24 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
25 **(Spring-Run ESU)**

26 *NEPA Effects:* The potential effects of construction of water conveyance facilities on spring-run
27 Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-55),
28 because the same five intakes would be constructed. As in Alternative 1A, this would convert 11,900
29 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of dredge
30 and channel reshaping.

31 As concluded there, environmental commitments and mitigation measures would be available to
32 avoid and minimize potential effects, and the effect would not be adverse for spring-run Chinook
33 salmon.

34 *CEQA Conclusion:* As described under Alternative 1A, Impact AQUA-37, the impact of the
35 construction of water conveyance facilities on Chinook salmon would be less than significant except
36 for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a
37 and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
8 **(Spring-Run ESU)**

9 ***NEPA Effects:*** The potential effects of maintenance of water conveyance facilities on Chinook salmon
10 would be the same as those described for Alternative 1A (see Impact AQUA-56), which concluded
11 that the effect would not be adverse for Chinook salmon.

12 ***CEQA Conclusion:*** As described under Alternative 1A, Impact AQUA-56, the impact of the
13 maintenance of water conveyance facilities on Chinook salmon would be less than significant and no
14 mitigation would be required.

15 **Water Operations of CM1**

16 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**
17 **ESU)**

18 ***Water Exports from SWP/CVP South Delta Facilities***

19 Entrainment losses of juvenile spring-run Chinook salmon to the SWP/CVP south Delta facilities
20 would be eliminated under Alternative 6A because there would be no south Delta exports under this
21 Alternative.

22 ***Water Exports from SWP/CVP North Delta Intake Facilities***

23 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
24 entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north
25 Delta intakes would have state-of-the-art screens to exclude juvenile fish.

26 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

27 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
28 entrainment and impingement effects for juvenile salmonids would be minimal because intakes
29 would have state-of-the-art screens installed.

30 ***NEPA Effects:*** In conclusion, Alternative 6A would eliminate south Delta entrainment for all races of
31 Chinook salmon, which would be a beneficial effect.

32 ***CEQA Conclusion:*** Entrainment losses of juvenile Chinook salmon at the south Delta facilities would
33 be eliminated under Alternative 6A for all salmon races and water year types compared to Existing
34 Conditions. The reduction in entrainment would be a beneficial impact. Overall, water operations
35 impacts on Chinook salmon would be less than significant and may be beneficial to the species

1 because of the elimination of entrainment loss at the south Delta facilities. No mitigation would be
2 required.

3 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
4 **Chinook Salmon (Spring-Run ESU)**

5 In general, Alternative 6A would not affect the quantity and quality of spawning and egg incubation
6 habitat for spring-run Chinook salmon relative to the NEPA point of comparison.

7 ***Sacramento River***

8 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
9 under Alternative 1A, Impact AQUA-58, which indicates that there would generally be no effects of
10 Alternative 1A on water temperatures during the spring-run spawning and egg incubation period in
11 the Sacramento River relative to NAA.

12 Flows in the Sacramento River upstream of Red Bluff during the spring-run Chinook salmon
13 spawning and incubation period (September through January) under A6A_LLT would generally be
14 similar to or greater than those under NAA during October, December, and January, with some
15 exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
16 Flows under A6A_LLT during September and November would generally be lower than those under
17 NAA (up to 17% lower).

18 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam
19 during the spring-run Chinook salmon spawning and egg incubation period (September through
20 January). Storage under A6A_LLT would be similar to or greater than storage under NAA in all water
21 year types (Table 11-6A-10).

22 **Table 11-6A-10. Difference and Percent Difference in September Water Storage Volume (thousand**
23 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-530 (-16%)	-18 (-1%)
Above Normal	-454 (-14%)	161 (6%)
Below Normal	-271 (-9%)	83 (3%)
Dry	-373 (-15%)	138 (7%)
Critical	-314 (-26%)	68 (8%)

24
25 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
26 Sacramento River under A6A_LLT would be lower than or similar to mortality under NAA in all
27 water year types except below normal years (19% greater) (Table 11-6A-11). The 19% increase in
28 mortality in below normal years would be a small negative effect on the spring-run Chinook salmon
29 population.

1 **Table 11-6A-11. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	16 (155%)	1 (4%)
Above Normal	18 (136%)	-4 (-11%)
Below Normal	37 (313%)	8 (19%)
Dry	50 (257%)	-6 (-8%)
Critical	22 (29%)	-1 (-1%)
All	28 (126%)	-0.4 (-1%)

3
4 SacEFT predicts that there would be a small difference (12% lower) in the percentage of years with
5 good spawning availability, measured as weighted usable area, under A6A_LLT relative to NAA
6 (Table 11-6A-12). SacEFT predicts that there would be no difference in the percentage of years with
7 good (lower) redd scour risk under A6A_LLT relative to NAA. SacEFT predicts that there would be a
8 15% decrease in the percentage of years with good (lower) egg incubation conditions under
9 A6A_LLT relative to NAA. SacEFT predicts that there would be a 35% increase in the percentage of
10 years with good (lower) redd dewatering risk under A6A_LLT relative to NAA.

11 **Table 11-6A-12. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
12 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	-15 (-21%)	6 (12%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-57 (-66%)	-5 (-15%)
Redd Dewatering Risk	-3 (-6%)	12 (35%)
Juvenile Rearing WUA	3 (14%)	3 (14%)
Juvenile Stranding Risk	-4 (-21%)	1 (7%)

WUA = Weighted Usable Area.

13
14 **Clear Creek**

15 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
16 (September through January) under A6A_LLT would generally be similar to or greater than flows
17 under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
19 comparing the magnitude of flow reduction each month over the incubation period compared to the
20 flow in September when spawning is assumed to occur. The greatest reduction in flows under
21 A6A_LLT would be the same as that under NAA in all water year types (Table 11-6A-13).

22 Water temperatures were not modeled in Clear Creek.

1 **Table 11-6A-13. Difference and Percent Difference in Greatest Monthly Reduction (Percent**
 2 **Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September**
 3 **through January Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

4

5 **Feather River**

6 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)
 7 where spring-run Chinook salmon primarily spawn during September through January (Appendix
 8 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would not differ
 9 from NAA because minimum Feather River flows are included in the FERC settlement agreement
 10 and would be met for all model scenarios.

11 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam
 12 during the spring-run Chinook salmon spawning and egg incubation period. Storage under A6A_LLT
 13 would be greater than storage under NAA in all water year types (Table 11-6A-14). This indicates
 14 that the majority of reduction in storage volume would be due to climate change rather than
 15 Alternative 6A.

16 **Table 11-6A-14. Difference and Percent Difference in September Water Storage Volume (thousand**
 17 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-754 (-26%)	260 (14%)
Above Normal	-576 (-24%)	215 (14%)
Below Normal	-497 (-25%)	112 (8%)
Dry	-13 (-1%)	340 (34%)
Critical	-23 (-2%)	165 (21%)

18

19 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
 20 comparing the magnitude of flow reduction each month over the egg incubation period compared to
 21 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
 22 during October through January were identical among A6A_LLT and NAA (Appendix 11C, *CALSIM II*
 23 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 6A on
 24 redd dewatering in the Feather River low-flow channel.

1 Water temperatures in the Feather River under Alternative 6A would be the same as those under
2 Alternative 1A, Impact AQUA-58, which indicates that there would be no effect of Alternative 1A on
3 water temperatures in the Feather River relative to NAA during the spring-run spawning and egg
4 incubation period.

5 **NEPA Effects:** Based on these results, it is concluded that the effect would not be adverse because
6 habitat would not be substantially reduced. Flows in the Sacramento River would be reduced by up
7 to 17% in two months during the five-month spawning and egg incubation period, although flows in
8 other rivers would not differ from the NEPA point of comparison. Storage volume in the Sacramento
9 and Feather rivers would be greater under Alternative 6A. Biological modeling generally predicts
10 that spawning and egg incubation conditions for spring-run Chinook salmon in the Sacramento
11 River would improve. There would be no effects in Clear Creek.

12 **CEQA Conclusion:** In general, Alternative 6A would not affect the quantity and quality of spawning
13 and egg incubation habitat for spring-run Chinook salmon relative to CEQA Existing Conditions.

14 **Sacramento River**

15 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
16 under Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in
17 the exceedances of NMFS temperature thresholds under alternative 6A relative to Existing
18 Conditions.

19 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook
20 salmon spawning and incubation period (September through January). Flows under A6A_LLT during
21 September would generally be lower than those under Existing Conditions (up to 21% lower).
22 However, flows under A6A_LLT would be generally similar to or greater than those under Existing
23 Conditions during October through January with some exceptions (up to 9% lower) (Appendix 11C,
24 *CALSIM II Model Results utilized in the Fish Analysis*).

25 Shasta Reservoir Storage volume at the end of September would be 9% to 26% lower under
26 A6A_LLT relative to Existing Conditions (Table 11-6A-10).

27 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
28 Sacramento River under A6A_LLT would be 29% to 313% greater than mortality under Existing
29 Conditions depending on water year type (Table 11-6A-11).

30 SacEFT predicts that there would be a 21% decrease in the percentage of years with good spawning
31 availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions
32 (Table 11-6A-12). SacEFT predicts that there would be no difference in the percentage of years with
33 good (lower) redd scour risk under A6A_LLT relative to Existing Conditions. SacEFT predicts that
34 there would be a 66% decrease in the percentage of years with good (lower) egg incubation
35 conditions under A6A_LLT relative to Existing Conditions, respectively. SacEFT predicts that there
36 would be a 6% decrease in the percentage of years with good (lower) redd dewatering risk under
37 A6A_LLT relative to Existing Conditions. These results indicate that spawning and egg incubation
38 conditions for spring-run Chinook salmon would be poor relative to Existing Conditions.

39 **Clear Creek**

40 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
41 (September through January) under A6A_LLT would generally be similar to or greater than flows

1 under Existing Conditions except in critical years during September through November (6% to 28%
2 lower) and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results*
3 *utilized in the Fish Analysis*).

4 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
5 comparing the magnitude of flow reduction each month over the incubation period compared to the
6 flow in September when spawning is assumed to occur. The greatest reduction in flows would be
7 worse under A6A_LLT than reductions under Existing Conditions in above normal, dry, and critical
8 water years (Table 11-6A-13).

9 Water temperatures were not modeled in Clear Creek.

10 **Feather River**

11 Flows in the Feather River low-flow channel under A6A_LLT are not different from Existing
12 Conditions during the spring-run Chinook salmon spawning and egg incubation period (Appendix
13 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through January (800
14 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for all model
15 scenarios.

16 Oroville Reservoir storage volume at the end of September would be 24% to 26% lower under
17 A6A_LLT relative to Existing Conditions during wet, above normal, and below normal water years
18 and similar to storage under Existing Conditions during dry and critical water year types (Table 11-
19 6A-14).

20 Water temperatures in the Feather River under Alternative 6A would be the same as those under
21 Alternative 1A, Impact AQUA-58, which indicates that there would be substantial increases in the
22 exceedances of NMFS temperature thresholds under Alternative 6A relative to Existing Conditions.

23 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
24 comparing the magnitude of flow reduction each month over the incubation period compared to the
25 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
26 during October through January were identical between A6A_LLT and Existing Conditions
27 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no
28 effect of Alternative 6A on redd dewatering in the Feather River low-flow channel.

29 **Summary of CEQA Conclusion**

30 Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between
31 the CEQA baseline and Alternative 6A could be significant because, when compared to the CEQA
32 baseline, the alternative could substantially reduce suitable spawning and egg incubation habitat
33 and reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth
34 above, which is directly related to the inclusion of climate change effects in Alternative 6A. The
35 quality and quantity of spawning and egg incubation habitat for spring-run Chinook salmon in the
36 Sacramento River would be lower under Alternative 6A relative to the Existing Conditions, which
37 would reduce the ability of spring-run Chinook salmon to spawn successfully. There would be no
38 effects on spawning and egg incubation conditions in the Feather River and Clear Creek.

39 These results are primarily caused by four factors: differences in sea level rise, differences in climate
40 change, future water demands, and implementation of the alternative. The analysis described above
41 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of

1 the alternative from those of sea level rise, climate change and future water demands using the
2 model simulation results presented in this chapter. However, the increment of change attributable
3 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
4 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
5 implementation period, which does include future sea level rise, climate change, and water
6 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
7 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
8 effect of the alternative from those of sea level rise, climate change, and water demands.

9 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
10 Conditions in the late long-term implementation period and Alternative 6A indicates that flows and
11 reservoir storage in the locations and during the months analyzed above would generally be similar
12 between Existing Conditions and Alternative 6A. This indicates that the differences between Existing
13 Conditions and Alternative 6A found above would generally be due to climate change, sea level rise,
14 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative
15 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
16 therefore would not in itself result in a significant impact on spawning and egg incubation habitat
17 for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is
18 required.

19 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring- 20 Run ESU)**

21 In general, Alternative 6A would not affect the quantity and quality of rearing habitat for fry and
22 juvenile spring-run Chinook salmon relative to the NEPA point of comparison.

23 ***Sacramento River***

24 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
25 under Alternative 1A, Impact AQUA-59, which indicates that there would be no differences (<5%) in
26 mean monthly water temperature between NAA and Alternative 1A in any month or water year type
27 throughout the period.

28 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
29 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
30 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November
31 under A6A_LLT would generally be lower than those under NAA (up to 23% lower). Flows during
32 the period would generally be similar to or greater than those under NAA with some exceptions.

33 As reported in Impact AQUA-40, May Shasta storage volume under A6A_LLT would be similar
34 (within 2%) to NAA in most water years types, but greater by 6% in critical water years (Table 11-
35 6A-5).

36 As reported in Impact AQUA-58, September Shasta storage volume would be similar to or greater
37 than storage under NAA in all water year types (Table 11-6A-10).

38 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under
39 A6A_LLT would be 14% greater than that under NAA (Table 11-6A-12). The percentage of years
40 with good (lower) juvenile stranding risk conditions under A6A_LLT would be 7% greater than
41 under NAA.

1 SALMOD predicts that spring-run Chinook salmon smolt equivalent habitat-related mortality would
2 be greater under A6A_LLT than NAA.

3 **Clear Creek**

4 Flows in Clear Creek during the year November through March rearing period under A6A_LLT
5 would nearly always be similar to or greater than flows under NAA, except in below normal years
6 during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Water temperatures were not modeled in Clear Creek.

8 **Feather River**

9 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
10 channel) during November through June were reviewed to determine flow-related effects on larval
11 and juvenile spring-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results
12 utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this
13 period under A6A_LLT would not differ from those under NAA. In the high-flow channel, flows
14 under A6A_LLT would be generally similar to or greater than flows under NAA during November
15 and during January through June, with some exceptions (up to 31% lower). Flows under A6A_LLT
16 would be generally lower than flows under NAA during December (up to 27% lower).

17 May Oroville storage under A6A_LLT would be similar to or greater than storage under NAA in all
18 water years (Table 11-6A-15).

19 **Table 11-6A-15. Difference and Percent Difference in May Water Storage Volume (thousand
20 acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-71 (-2%)	-25 (-1%)
Above Normal	-137 (-4%)	19 (1%)
Below Normal	-124 (-4%)	229 (8%)
Dry	-250 (-9%)	270 (12%)
Critical	-89 (-5%)	227 (15%)

21

22 As reported in Impact AQUA-58, September Oroville storage volume would always be greater than
23 under NAA (Table 11-6A-14).

24 Water temperatures in the Feather River under Alternative 6A would be the same as those under
25 Alternative 1A, Impact AQUA-59, which indicates that mean monthly water temperatures would
26 generally be similar between NAA and Alternative 1A during the period.

27 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
28 habitat would not be substantially reduced. There would be no consistent, high magnitude changes
29 in flows in any of the waterways examined.

30 **CEQA Conclusion:** In general, under Alternative 6A water operations, the quantity and quality of
31 rearing habitat for fry and juvenile spring-run Chinook salmon would be reduced relative to the
32 CEQA baseline. Differences between the anticipated future conditions under this alternative and
33 Existing Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change,

1 and not to the operational scenarios. As a result, the differences between Alternative 6A (which is
2 under LLT conditions that include future sea level rise and climate change) and the CEQA baseline
3 (Existing Conditions) may therefore either overstate the effects of Alternative 6A or suggest
4 significant effects that are largely attributable to sea level rise and climate change, and not to
5 Alternative 6A.

6 **Sacramento River**

7 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
8 under Alternative 1A, Impact AQUA-59, which indicates that there would be no differences in mean
9 monthly water temperature between Existing Conditions and Alternative 1A.

10 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
11 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
12 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during December at
13 Keswick and at Red Bluff under A6A_LLТ would be generally lower than those under Existing
14 Conditions (up to 12% and 11% lower, respectively), while flows during all other months would
15 generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to
16 7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 As reported Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A6A_LLТ
18 would be similar to Existing Conditions in wet and above normal water years, but lower by 5% to
19 19% in below normal, dry, and critical water years (Table 11-6A-5).

20 As reported in Impact AQUA-58, storage volume at the end of September under A6A_LLТ would be
21 9% to 26% lower relative to Existing Conditions in all water years (Table 11-6A-10).

22 SacEFT predicts that there would be a 21% decrease in the percentage of years with good spawning
23 availability, measured as weighted usable area, under A6A_LLТ relative to Existing Conditions
24 (Table 11-6A-12). SacEFT predicts that there would be no difference in the percentage of years with
25 good (lower) redd scour risk under A6A_LLТ relative to Existing Conditions. SacEFT predicts that
26 there would be a 66% decrease in the percentage of years with good (lower) egg incubation
27 conditions under A6A_LLТ relative to Existing Conditions. SacEFT predicts that there would be a 6%
28 decrease in the percentage of years with good (lower) redd dewatering risk under A6A_LLТ relative
29 to Existing Conditions.

30 SALMOD predicts that spring-run Chinook salmon smolt equivalent habitat-related mortality under
31 A6A_LLТ would be 28% lower than under Existing Conditions.

32 **Clear Creek**

33 Flows in Clear Creek during the November through March rearing period under A6A_LLТ would
34 generally be similar to or greater than flows under Existing Conditions, except for critical years
35 during November in which flows would be 6% lower (Appendix 11C, *CALSIM II Model Results*
36 *utilized in the Fish Analysis*).

37 Water temperatures were not model in Clear Creek.

38 **Feather River**

39 Relatively constant flows in the low-flow channel throughout this period under A6A_LLТ would not
40 differ from those under Existing Conditions. In the high-flow channel, flows under A6A_LLТ would

1 largely be lower during October through January and during July (up to 45% lower). Flows under
2 A6A_LLT would generally be similar to or greater than flows under Existing Conditions during the
3 rest of the year, with some exceptions (up to 46% lower).

4 May Oroville storage volume under A6A_LLT would be lower than Existing Conditions by 9% and
5 5% in dry and critical water years, respectively, but would be similar to Existing Conditions in all
6 other water year types (Table 11-6A-15).

7 As reported in Impact AQUA-156, September Oroville storage volume would be 24% to 26% lower
8 under A6A_LLT relative to Existing Conditions in wet, above normal, and below normal water years,
9 but similar to Existing Conditions in dry and critical water years (Table 11-6A-14).

10 **Summary of CEQA Conclusion**

11 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between
12 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
13 alternative could substantially reduce the amount of suitable habitat. Spring-run Chinook salmon fry
14 and juveniles rear in both the high-flow and low-flow channels of the Feather River. Flows and
15 water temperatures in the low-flow channel would be unchanged by Alternative 6A. However, flows
16 in the high-flow channel would be mostly lower by up to 45% during the half of the fry and juvenile
17 rearing period. This frequency, duration, and magnitude of flow reduction is expected to have a
18 significant impact on rearing fry and juveniles.

19 These results are primarily caused by four factors: differences in sea level rise, differences in climate
20 change, future water demands, and implementation of the alternative. The analysis described above
21 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
22 the alternative from those of sea level rise, climate change and future water demands using the
23 model simulation results presented in this chapter. However, the increment of change attributable
24 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
25 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
26 implementation period, which does include future sea level rise, climate change, and water
27 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
28 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
29 effect of the alternative from those of sea level rise, climate change, and water demands.

30 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
31 term implementation period and Alternative 6A indicates that flows in the locations and during the
32 months analyzed above would generally be similar between Existing Conditions during the LLT and
33 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
34 found above would generally be due to climate change, sea level rise, and future demand, and not
35 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
36 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
37 result in a significant impact on rearing habitat for spring-run Chinook salmon. This impact is found
38 to be less than significant and no mitigation is required.

1 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**
2 **(Spring-Run ESU)**

3 **Upstream of the Delta**

4 In general, Alternative 6A would reduce migration conditions for spring-run Chinook salmon
5 relative to the NEPA point of comparison.

6 ***Sacramento River***

7 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
8 under Alternative 1A, Impact AQUA-60, which indicates that there would be no differences (<5%) in
9 mean monthly water temperature between NAA and Alternative 1A.

10 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through
11 May juvenile Chinook salmon spring-run migration period. Flows under A6A_LLT during the period
12 would nearly always be similar to or greater than flows under NAA, except during January in critical
13 years (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through
15 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*
16 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during April through July would
17 always be similar to or greater than flows under NAA, but would be generally lower during August
18 (6% to 10% lower).

19 ***Clear Creek***

20 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
21 migration period under A6A_LLT would generally be similar to or greater than flows under NAA
22 except in critical years during November through January (7% to 14% lower) (Appendix 11C,
23 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would nearly always be
24 similar to or greater than flows under NAA except in below normal years during March (6% lower).

25 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
26 migration period under A6A_LLT would nearly always be similar to or greater than flows under NAA
27 except in critical water years during June (8% lower) (Appendix 11C, *CALSIM II Model Results*
28 *utilized in the Fish Analysis*).

29 Water temperatures were not modeled in Clear Creek.

30 ***Feather River***

31 Flows in the Feather River at the confluence with the Sacramento River were examined during the
32 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
33 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower
34 than flows under NAA during December (up to 18% lower), and similar to or greater than flows
35 under NAA during the rest of the period with few exceptions (up to 14% lower) (Appendix 11C,
36 *CALSIM II Model Results utilized in the Fish Analysis*).

37 Flows in the Feather River at the confluence with the Sacramento River were examined during the
38 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
39 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during April through

1 June would be similar to or greater than flows under NAA with few exceptions (up to 31% lower),
2 and flows during July and August would generally be lower than flows under NAA by up to 49%.

3 Water temperatures in the Feather River under Alternative 6A would be the same as those under
4 Alternative 1A, Impact AQUA-60, which indicates that there would be no differences in mean
5 monthly water temperature between NAA and Alternative 1A.

6 **Through-Delta**

7 The effects on through-Delta migration were evaluated using the approach described in Alternative
8 1A, Impact AQUA-42.

9 **Juveniles**

10 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows
11 below the north Delta intakes compared to baseline conditions. The north Delta export facilities
12 would replace aquatic habitat and likely attract piscivorous fish around the intake structures. As
13 described for Alternative 1A (see details in Impact AQUA-42), the five NDD intakes would remove or
14 modify habitat along that portion of the migration corridor (22 acres aquatic habitat and 11,900
15 linear feet of shoreline). Potential predation losses at the north Delta intakes, as estimated by the
16 bioenergetics model, would be 2% compared to the annual production estimated for the Sacramento
17 Valley (Table 11-1A-17). A conservative assumption of 5% loss per intake would yield a cumulative
18 loss of 19.2% of juvenile spring-run Chinook that reach the north Delta (Appendix 5F, *Biological*
19 *Stressors*). This assumption is uncertain and represents an upper bound estimate.

20 Through-Delta survival to Chipps Island by emigrating juvenile spring-run Chinook salmon was
21 modeled by the DPM. Average survival under Alternative 6A would be 29.0% across all years, 23.5%
22 in drier years, and 38.0% in wetter years (Table 11-6A-16). Juvenile survival would decrease
23 slightly compared to NAA, ranging from 0.8% lower in drier years (3% relative decrease) up to 2.4%
24 lower in wetter years (6% relative decrease). The effect on juvenile spring-run Chinook salmon
25 migration survival through the Delta would be adverse.

26 **Table 11-6A-16. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon**
27 **under Alternative 6A**

Water Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A6A_LL1	EXISTING CONDITIONS vs. A6A_LL1	NAA vs. A6A_LL1
Wetter Years	42.1	40.4	38.0	-4.1 (-10%)	-2.4 (-6%)
Drier Years	24.8	24.3	23.5	-1.2 (-5%)	-0.8 (-3%)
All Years	31.3	30.3	29.0	-2.3 (-7%)	-1.4 (-5%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

28

29 **Adults**

30 During the overall spring-run Chinook salmon upstream migration from March-June, the proportion
31 of Sacramento River in the Delta would be similar in June (<10% difference), but reduced from

1 March–May (Table 11-6A-17). During the months from March–May, proportion of Sacramento River
 2 flows under Alternative 6A would be 10–13% less than baseline when climate change effects are
 3 factored in (NAA). While the proportion of Sacramento River flows would be reduced under
 4 Alternative 6A, the Sacramento River would still represent a substantial 55–64% of Delta outflows.
 5 Therefore, olfactory cues would still be strong for upstream migrating spring-run adult Chinook
 6 salmon. However, uncertainty remains with regard to adult salmon behavioral response to
 7 anticipated changes in lower Sacramento River flow percentages. This topic is discussed further in
 8 Impact AQUA-42 in Alternative 1A.

9 **Table 11-6A-17. Percentage (%) of Water at Collinsville that Originated in the Sacramento River**
 10 **and San Joaquin River during the Adult Chinook Migration Period for Alternative 6A**

Month	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River					
September	60	65	61	1	-4
October	60	68	63	3	-5
November	60	66	63	3	-3
December	67	66	67	0	1
January	76	75	69	-7	-6
February	75	72	64	-11	-8
March	78	76	64	-14	-12
April	77	75	62	-15	-13
May	69	65	55	-14	-10
San Joaquin River					
September	0.3	0.1	5.5	5.2	5.4
October	0.2	0.3	8.1	7.9	7.8
November	0.4	1.0	10.7	10.3	9.7
December	0.9	1.0	7.7	6.8	6.7
January	1.6	1.7	8.1	6.5	6.4
February	1.4	1.5	8.4	7	6.9
March	2.6	2.8	10.3	7.7	7.5
April	6.3	6.6	14.9	8.6	8.3
Shading indicates 10% or greater decrease in abundance relative to baseline.					

11

12 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 6A is adverse due to the
 13 cumulative effects associated with five north Delta intake facilities, including mortality related to
 14 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to
 15 reduced flows downstream of the intakes) associated with the five NDD intakes. Upstream of the
 16 Delta migration conditions for spring-run Chinook salmon under Alternative 6A would not be
 17 adverse because flow and temperature conditions would generally be similar to those under the
 18 NEPA baseline.

19 Adult attraction flows under Alternative 6A would be lower than those under NAA, but adult
 20 attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

1 Near-field effects of Alternative 6A NDD on spring-run Chinook salmon related to impingement and
2 predation associated with five new intakes could result in substantial effects on juvenile migrating
3 spring-run Chinook salmon, although there is high uncertainty regarding the potential effects.
4 Estimates within the effects analysis range from very low levels of effects (~2% mortality) to very
5 significant effects (~ 19% mortality above current baseline levels). CM15 would be implemented
6 with the intent of providing localized and temporary reductions in predation pressure at the NDD.
7 Additionally, several pre-construction surveys to better understand how to minimize losses
8 associated with the five new intake structures will be implemented as part of the final NDD screen
9 design effort. Alternative 6A also includes an Adaptive Management Program and Real-Time
10 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide
11 adequate migration conditions for spring-run Chinook salmon. However, at this time, due to the
12 absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of
13 mortality expected from near-field effects at the NDD remains highly uncertain.

14 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
15 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
16 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A
17 predict improvements in smolt condition and survival associated with increased access to the Yolo
18 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
19 of each of these factors and how they might interact and/or offset each other in affecting salmonid
20 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

21 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
22 all of these elements of BDCP operations and conservation measures to predict smolt migration
23 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
24 migration survival under Alternative 6A would be similar to survival rates estimated for NAA.
25 Further refinement and testing of the DPM, along with several ongoing and planned studies related
26 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable
27 future. These efforts are expected to improve our understanding of the relationships and
28 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
29 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
30 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative
31 6A on spring-run Chinook salmon through-Delta survival remains uncertain.

32 Therefore, primarily due to unacceptable levels of uncertainty regarding the cumulative impacts of
33 near-field and far-field effects associated with the presence and operation of the five intakes on
34 spring-run Chinook salmon, this effect is adverse. While implementation of the conservation and
35 mitigation measures listed below would address these impacts, these are not anticipated to reduce
36 the impacts to a level considered not adverse.

37 **CEQA Conclusion:** In general, spring-run Chinook salmon migration conditions would be reduced
38 under Alternative 6A relative to Existing Conditions.

39 **Upstream of the Delta**

40 ***Sacramento River***

41 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
42 under Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in
43 mean monthly water temperature between NAA and Alternative 1A.

1 Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-
2 run Chinook salmon migration period under A6A_LLT would generally be similar to or greater than
3 flows under Existing Conditions except during December in below normal and dry years (7% and
4 6% lower, respectively), below normal years during March, April, and May (11%, 7%, 10% lower,
5 respectively), and wet years during May (16% lower) (Appendix 11C, *CALSIM II Model Results*
6 *utilized in the Fish Analysis*).

7 Flows in the Sacramento River upstream of Red Bluff during the April through August adult spring-
8 run Chinook salmon upstream migration period under A6A_LLT would generally be similar to or
9 greater than Existing Conditions, except in below normal years during April and May (7% and 10%
10 lower, respectively), wet years during May (16% lower), and dry and critical years during August
11 (6% and 20% lower, respectively).

12 **Clear Creek**

13 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
14 migration period under A6A_LLT would nearly always be similar to or greater than flows under
15 Existing Conditions except in critical years during November (6% lower) (Appendix 11C, *CALSIM II*
16 *Model Results utilized in the Fish Analysis*).

17 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
18 migration period under A6A_LLT would nearly always be similar to or greater than flows under
19 Existing Conditions with except during August in critical water years (17% lower) (Appendix 11C,
20 *CALSIM II Model Results utilized in the Fish Analysis*).

21 Water temperatures were not modeled in Clear Creek.

22 **Feather River**

23 Flows were examined for the Feather River at the confluence with the Sacramento River during the
24 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
25 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November through January and
26 during May under A6A_LLT would generally be lower than flows under Existing Conditions by up to
27 36%. Flows during February through April would generally be similar to or greater than flows under
28 Existing Conditions, with some exceptions (up to 15% lower).

29 Flows were examined for the Feather River at the confluence with the Sacramento River during the
30 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
31 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May through July under A6A_LLT
32 would generally be lower by up to 53% than flows under Existing Conditions. Flows during April
33 and August under A6A_LLT would generally be similar to or greater than flows under Existing
34 Conditions except in critical water years during April and dry years in August (6% and 34% lower,
35 respectively).

36 Water temperatures in the Feather River under Alternative 6A would be the same as those under
37 Alternative 1A, Impact AQUA-60, which indicates that there would be negligible differences in mean
38 monthly water temperature between Existing Conditions and Alternative 1A.

1 **Through-Delta**

2 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows
3 below the north Delta intakes compared to Existing Conditions. Through-Delta survival by
4 emigrating juvenile spring-run Chinook salmon would decrease 2.3% (7% relative decrease) under
5 Alternative 6A across all years compared to Existing Conditions (Table 11-6A-16). Losses due to
6 predation at the five north Delta intakes could hypothetically range from less than 2% up to 19.2%
7 of juvenile winter-run Chinook that reach the north Delta. Overall, the impact on juvenile Chinook
8 salmon migration through the Delta would be significant.

9 Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, declined
10 14% to 15% under Alternative 6A during the adult spring-run Chinook salmon migration period
11 (April-May) compared to Existing Conditions (Table 11-6A-17). Uncertainty remains with regard to
12 adult salmon behavioral response to anticipated changes in lower Sacramento River flow
13 percentages. For further discussion of the topic see the analysis for Impact AQUA-42 in Alternative
14 1A. Overall the impact on adult salmon upstream migration would be less than significant.

15 **Summary of CEQA Conclusion**

16 Collectively, these results indicate that the effect of Alternative 6A on spring-run Chinook salmon
17 migration conditions would be significant because the alternative would substantially interfere with
18 the movement of fish. Flows in the Feather River during a large portion of both the juvenile
19 emigration and adult immigration period would be frequently lower by up to 53% Although there
20 would be no effect of Alternative 6A in other upstream rivers. In the Delta, Alternative 6A would
21 result in a decrease in through-Delta survival of juvenile winter-run Chinook salmon, increased
22 predation at the five intakes, and loss of aquatic habitat associated with the five intake structures.
23 Based on the proportion of Sacramento River flows, olfactory cues would be 14% to 15% lower than
24 those under Existing Conditions for winter-run adult Chinook salmon migration.

25 Implementation of CM6 and CM15 would address these impacts, but are not anticipated to reduce
26 them to a level considered less than significant. Although implementation of *CM6 Channel Margin*
27 *Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be
28 located near the intakes and therefore would not fully compensate for the lost habitat. Additionally,
29 implementation of this measure would not fully address predation losses. *CM15 Localized Reduction*
30 *of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness
31 such that it is considered to have no demonstrable effect. Conservation measures that address
32 habitat and predation losses, therefore, would potentially minimize impacts to some extent but not
33 to a less than significant level. Consequently, as a result of these changes in migration conditions,
34 this impact is significant and unavoidable.

35 Applicable conservation measures are briefly described below and full descriptions are found in
36 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized
37 Reduction of Predatory Fishes (Predator Control) (CM15).

38 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
39 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat
40 habitats on the waterside side of levees along channels that provide rearing and outmigration
41 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side
42 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length
43 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10

1 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be
2 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel
3 margin enhancement would be performed only along channels that provide rearing and
4 outmigration habitat for juvenile salmonids. These include channels that are protected by
5 federal project levees—including the Sacramento River between Freeport and Walnut Grove
6 among several others.

7 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
8 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
9 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to
10 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are
11 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.
12 Therefore, this conservation measure is not intended to entirely remove predators at any
13 location, or substantially alter the abundance of predators at the scale of the Delta system. This
14 conservation measure would also not remove piscivorous birds. Because of uncertainties
15 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot
16 projects and research actions coupled with an adaptive management and monitoring program to
17 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to
18 occupy vacated areas; therefore, removal activities would need to be continuous during periods
19 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

20 In addition to these conservation measures, the implementation of the mitigation measures listed
21 below also has the potential to reduce the severity of the impact, although the effect would still
22 likely remain significant and unavoidable. These mitigation measures would provide an adaptive
23 management process, that may be conducted as a part of the Adaptive Management and Monitoring
24 Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and
25 developing appropriate minimization measures.

26 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**
27 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**
28 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

29 Although analysis conducted as part of the EIR/EIS determined that Alternative 1A would have
30 significant and unavoidable adverse effects on migration habitat, this conclusion was based on
31 the best available scientific information at the time and may prove to have been over- or
32 understated. Upon the commencement of operations of CM1 and continuing through the life of
33 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine
34 whether such effects would be as extensive as concluded at the time of preparation of this
35 document and to determine any potentially feasible means of reducing the severity of such
36 effects. This mitigation measure requires a series of actions to accomplish these purposes,
37 consistent with the operational framework for Alternative 6A.

38 The development and implementation of any mitigation actions shall be focused on those
39 incremental effects attributable to implementation of Alternative 6A operations only.
40 Development of mitigation actions for the incremental impact on migration habitat attributable
41 to climate change/sea level rise are not required because these changed conditions would occur
42 with or without implementation of Alternative 6A.

1 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**
2 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

3 Following commencement of initial operations of CM1 and continuing through the life of the
4 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
5 modified operations could reduce impacts to migration habitat under Alternative 6A. The
6 analysis required under this measure may be conducted as a part of the Adaptive Management
7 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

8 **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**
9 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**
10 **Conditions Consistent with CM1**

11 In order to determine the feasibility of reducing the effects of CM1 operations on spring-run
12 Chinook salmon habitat, the BDCP proponents will consult with FWS and the Department of Fish
13 and Wildlife to identify and implement any feasible operational means to minimize effects on
14 migration habitat. Any such action will be developed in conjunction with the ongoing monitoring
15 and evaluation of habitat conditions required by Mitigation Measure AQUA-60a.

16 If feasible means are identified to reduce impacts on migration habitat consistent with the
17 overall operational framework of Alternative 6A without causing new significant adverse
18 impacts on other covered species, such means shall be implemented. If sufficient operational
19 flexibility to reduce effects on spring-run Chinook salmon habitat is not feasible under
20 Alternative 6A operations, achieving further impact reduction pursuant to this mitigation
21 measure would not be feasible under this Alternative, and the impact on spring-run Chinook
22 salmon would remain significant and unavoidable.

23 **Restoration and Conservation Measures**

24 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
25 substantial differences in fish effects are anticipated anywhere in the affected environment under
26 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
27 spring-run Chinook salmon under Alternative 1A (Impact AQUA-61 through Impact AQUA-72) also
28 appropriately characterize effects under Alternative 6A.

29 The following impacts are those presented under Alternative 1A that are identical for Alternative
30 6A.

31 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**
32 **(Spring-Run ESU)**

33 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**
34 **Salmon (Spring-Run ESU)**

35 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

36 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**
37 **ESU) (CM12)**

1 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
2 **(Spring-Run ESU) (CM13)**

3 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**
4 **Run ESU) (CM14)**

5 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
6 **(Spring-Run ESU) (CM15)**

7 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**
8 **(CM16)**

9 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**
10 **(CM17)**

11 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**
12 **(CM18)**

13 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**
14 **ESU) (CM19)**

15 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
16 **(Spring-Run ESU) (CM21)**

17 *NEPA Effects:* These impact mechanisms have been determined to range from no effect, not adverse,
18 or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the reasons identified for
19 Alternative 1A (Impact AQUA-61 through 72). Specifically for AQUA-62, the effects of contaminants
20 on spring-run Chinook salmon with respect to selenium, copper, ammonia and pesticides would not
21 be adverse. The effects of methylmercury on spring-run Chinook salmon are uncertain.

22 *CEQA Conclusion:* These impact mechanisms would be considered to range from no impact, to less
23 than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for
24 Alternative 1A, and no mitigation is required.

25 **Fall-/Late Fall–Run Chinook Salmon**

26 **Construction and Maintenance of CM1**

27 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
28 **(Fall-/Late Fall–Run ESU)**

29 *NEPA Effects:* The potential effects of construction of water conveyance facilities on fall-run/late
30 fall-run Chinook salmon would be the same as those described for Alternative 1A (see Impact AQUA-
31 73), because the same five intakes would be constructed. As in Alternative 1A, this would convert
32 11,900 lineal feet of existing shoreline habitat into intake facilities and would require 27.3 acres of
33 dredge and channel reshaping. As concluded there, environmental commitments and mitigation
34 measures would be available to avoid and minimize potential effects, and the effect would not be
35 adverse for fall-run/late fall-run Chinook salmon.

1 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-73 for Chinook salmon, the
2 impact of the construction of water conveyance facilities on Chinook salmon would be less than
3 significant except for construction noise associated with pile driving. Implementation of Mitigation
4 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
5 significant.

6 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
7 **of Pile Driving and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

9 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
10 **and Other Construction-Related Underwater Noise**

11 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

12 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
13 **(Fall-/Late Fall-Run ESU)**

14 **NEPA Effects:** The potential effects of maintenance of water conveyance facilities on Chinook salmon
15 would be the same as those described for Alternative 1A (see Impact AQUA-74), which concluded
16 that the effect would not be adverse for Chinook salmon.

17 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-74, the impact of the
18 maintenance of water conveyance facilities on Chinook salmon would be less than significant and no
19 mitigation would be required.

20 **Water Operations of CM1**

21 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**
22 **Fall-Run ESU)**

23 ***Water Exports from SWP/CVP South Delta Facilities***

24 Entrainment losses of juvenile fall-run and late fall-run Chinook salmon to the SWP/CVP south Delta
25 facilities would be eliminated under Alternative 6A because there would be no south Delta exports
26 under this Alternative.

27 ***Water Exports from SWP/CVP North Delta Intake Facilities***

28 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
29 entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north
30 Delta intakes would have state-of-the-art screens to exclude juvenile fish.

31 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

32 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
33 entrainment and impingement effects for juvenile salmonids would be minimal because intakes
34 would have state-of-the-art screens installed.

35 **NEPA Effects:** In conclusion, Alternative 6A would eliminate south Delta entrainment for fall-run
36 Chinook salmon and late fall-run Chinook salmon, which would be a beneficial effect.

1 **CEQA Conclusion:** Entrainment losses of juvenile Chinook salmon at the south Delta facilities would
2 be eliminated under Alternative 6A for all salmon races and water year types compared to Existing
3 Conditions. The impact would be less than significant and may be beneficial. No mitigation would be
4 required.

5 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
6 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

7 In general, Alternative 6A would have negligible effects on spawning and egg incubation habitat for
8 fall-/ late-fall run Chinook salmon relative to the NEPA point of comparison.

9 **Sacramento River**

10 Water temperatures in the Sacramento River for Alternative 6A are not different from those for
11 Alternative 1A, Impact AQUA-76, which indicates that there would be no differences in mean
12 monthly water temperature between NAA and Alternative 1A.

13 **Fall-Run**

14 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-
15 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
16 *utilized in the Fish Analysis*). Flows under A6A_LLT would generally be greater than or similar to
17 NAA during October, December, and January, except in critical years during October and January
18 (7% and 11% lower) and above normal years during October (9% lower). During November, flows
19 under A6A_LLT would generally be lower by up to 13% than under NAA.

20 Shasta Reservoir storage at the end of September would affect flows during the fall-run Chinook
21 salmon spawning and egg incubation period. As reported in Impact AQUA-58, end of September
22 Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year
23 types (Table 11-6A-10).

24 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
25 Sacramento River under A6A_LLT would be similar to mortality under NAA in all water year types
26 (Table 11-6A-18).

27 **Table 11-6A-18. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook**
28 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	10 (105%)	1 (3%)
Above Normal	9 (86%)	-2 (-8%)
Below Normal	12 (109%)	0 (2%)
Dry	15 (102%)	-2 (-6%)
Critical	9 (30%)	-1 (-2%)
All	11 (80%)	-1 (-2%)

29

30 SacEFT predicts that there would be a 54% increase in the percentage of years with good spawning
31 availability for fall-run Chinook salmon, measured as weighted usable area, under A6A_LLT relative
32 to NAA (Table 11-6A-19). SacEFT predicts that there would be a 12% reduction in the percentage of
33 years with good (lower) redd scour risk under A6A_LLT relative to NAA. SacEFT predicts that there

1 would be a 16% increase in good years relative to NAA. SacEFT predicts that there would be a 4%
2 decrease in the percentage of years with good (lower) redd dewatering risk under A6A_LLT relative
3 to NAA.

4 **Table 11-6A-19. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
5 **for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	6 (13%)	19 (54%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-14 (-15%)	11 (16%)
Redd Dewatering Risk	-1 (-4%)	-1 (-4%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-11 (-35%)	0 (0%)

WUA = Weighted Usable Area.

6
7 *Late Fall–Run*

8 Sacramento River flows upstream of Red Bluff were examined for the February through May late
9 fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model*
10 *Results utilized in the Fish Analysis*). Flows under A6A_LLT would be greater than or similar to flows
11 under NAA throughout the period.

12 Shasta Reservoir storage at the end of September would affect flows during the late fall–run Chinook
13 salmon spawning and egg incubation period. As reported in Impact AQUA-58, end of September
14 Shasta Reservoir storage would be similar to or greater than storage under NAA in all water year
15 types (Table 11-6A-10).

16 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the
17 Sacramento River under A6A_LLT would be similar or slightly lower than mortality under NAA in all
18 water years (Table 11-6A-20).

19 **Table 11-6A-20. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook**
20 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	4 (175%)	-1 (-11%)
Above Normal	4 (152%)	-1 (-12%)
Below Normal	4 (301%)	0.4 (8%)
Dry	5 (185%)	0.1 (2%)
Critical	3 (144%)	0 (0%)
All	4 (185%)	-0.2 (-4%)

21
22 SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning
23 availability for late fall–run Chinook salmon, measured as weighted usable area, under A6A_LLT
24 relative to NAA (Table 11-6A-21). SacEFT predicts that there would be no difference in redd scour

1 risk, the percentage of years with good (lower) egg incubation conditions and redd dewatering risk
2 between A6A_LLT and NAA.

3 **Table 11-6A-21. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
4 **for Late Fall–Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	-7 (-13%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-5 (-8%)	0 (0%)
Juvenile Rearing WUA	15 (33%)	-3 (-5%)
Juvenile Stranding Risk	-29 (-40%)	-3 (-7%)

WUA = Weighted Usable Area.

5

6 **Clear Creek**

7 No water temperature modeling was conducted in Clear Creek.

8 **Fall-Run**

9 Clear Creek flows below Whiskeytown Reservoir were examined for the September through
10 February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to or greater than
12 flows under NAA in all water year types.

13 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
14 flow reduction each month over the incubation period compared to the flow in September when
15 spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during
16 September through February under A6A_LLT would be the same as the reduction under NAA for all
17 water year types (Table 11-6A-22).

18 **Table 11-6A-22. Difference and Percent Difference in Greatest Monthly Reduction (Percent**
19 **Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September**
20 **through February Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

21

1 **Feather River**

2 Water temperatures in the Feather River under Alternative 6A would be the same as those under
3 Alternative 1A, Impact AQUA-76, which indicates that temperatures conditions under Alternative 1A
4 would be similar to or better than those under NAA.

5 *Fall-Run*

6 Flows in the Feather River in the low-flow and high-flow channels were examined for the October
7 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,
8 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A6A_LLT
9 would be identical to those under NAA. Flows in the high-flow channel under A6A_LLT would
10 generally be similar to or greater than those under NAA, except during December (up to 27% lower)
11 and some water year types during other months (up to 24% lower).

12 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
13 comparing the magnitude of flow reduction each month over the incubation period compared to the
14 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during
15 November through January were identical between A6A_LLT and NAA (Appendix 11C, *CALSIM II*
16 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 6A on
17 redd dewatering in the Feather River low-flow channel.

18 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
19 Feather River under A6A_LLT would be lower than mortality under NAA in all water years (Table
20 11-6A-23).

21 **Table 11-6A-23. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook**
22 **Salmon Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	10 (723%)	-9 (-44%)
Above Normal	6 (540%)	-6 (-46%)
Below Normal	9 (520%)	-4 (-26%)
Dry	13 (601%)	-6 (-26%)
Critical	18 (378%)	-5 (-17%)
All	11 (534%)	-6 (-32%)

23

24 **American River**

25 Water temperatures in the American River under Alternative 6A would be the same as those under
26 Alternative 1A, AQUA-76, which indicates that there would be no differences in mean monthly water
27 temperature between NAA and Alternative 1A.

28 *Fall-Run*

29 Flows in the American River at the confluence with the Sacramento River were examined during the
30 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
31 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would nearly always
32 be similar to or greater than flows under NAA, except in below normal water years during
33 November (7% lower).

1 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
 2 comparing the magnitude of flow reduction each month over the incubation period compared to the
 3 flow in October when spawning is assumed to occur. The greatest reduction under A6A_LLT would
 4 be 32% and 44% greater in magnitude than under NAA in below normal and critical water years,
 5 and would be similar to or lower magnitude than under NAA in other water year types (Table 11-
 6 6A-24).

7 **Table 11-6A-24. Difference and Percent Difference in Greatest Monthly Reduction (Percent**
 8 **Change) in Instream Flow in the American River at Nimbus Dam during the October through**
 9 **January Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-8 (-37%)	17 (36%)
Above Normal	0.2 (1%)	10 (25%)
Below Normal	-42 (-219%)	-15 (-32%)
Dry	2 (5%)	0 (0%)
Critical	-6 (-11%)	-18 (-44%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

10

11 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
 12 American River under A6A_LLT would be similar to mortality under NAA in all water years (Table
 13 11-6A-25).

14 **Table 11-6A-25. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook**
 15 **Salmon Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	24 (160%)	1 (1%)
Above Normal	23 (219%)	1 (2%)
Below Normal	23 (186%)	1 (2%)
Dry	17 (104%)	1 (2%)
Critical	10 (47%)	0 (0%)
All	20 (133%)	1 (2%)

16

17 ***Stanislaus River***

18 *Fall-Run*

19 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
 20 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
 21 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 6A would be
 22 similar to flows under NAA throughout the period.

1 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
2 Alternative 1A, which indicates that there would be no differences (<5%) in mean monthly water
3 temperature between NAA and Alternative 1A throughout the October through January period.

4 ***San Joaquin River***

5 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
6 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
7 *utilized in the Fish Analysis*). Flows under Alternative 6A would be similar to flows under NAA
8 throughout the period.

9 Water temperature modeling was not conducted in the San Joaquin River.

10 ***Mokelumne River***

11 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
12 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
13 *utilized in the Fish Analysis*). Flows under Alternative 6A would be similar to flows under NAA
14 throughout the period.

15 Water temperature modeling was not conducted in the Mokelumne River.

16 ***NEPA Effects:*** Collectively, it is concluded that the effect would not be adverse because habitat
17 conditions are not substantially reduced. There are minimal reductions in flows or increases in
18 temperatures under Alternative 6A in all locations examined that would not translate into adverse
19 biological effects on fall-run Chinook salmon.

20 ***CEQA Conclusion:*** In general, under Alternative 6A water operations, the quantity and quality of
21 spawning and egg incubation habitat for fall-/late fall-run Chinook salmon would not be affected
22 relative to the CEQA baseline.

23 ***Sacramento River***

24 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
25 under Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large
26 negative effects of Alternative 1A on temperatures in the Sacramento River.

27 ***Fall-Run***

28 Flows in the Sacramento River upstream of Red Bluff were examined during the October through
29 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
30 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be greater than or
31 similar to Existing Conditions throughout the period, except in above normal and critical years
32 during October (9% for both) and below normal and dry years during December (7% and 6% lower,
33 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 Shasta storage volume at the end of September would be 9% to 26% lower under A6A_LLT relative
35 to Existing Conditions depending on water year type (Table 11-6A-10).

36 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
37 Sacramento River under A6A_LLT would be 30% to 109% greater than mortality under Existing
38 Conditions depending on water year type, which is a 9% to 15% increase on an absolute scale (Table
39 11-6A-18).

1 SacEFT predicts that there would be a 13% increase in the percentage of years with good spawning
2 availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions
3 (Table 11-6A-19). SacEFT predicts that there would be a 5% reduction in the percentage of years
4 with good (lower) redd scour risk under A6A_LLT relative to Existing Conditions. SacEFT predicts
5 that there would be a 15% decrease in the percentage of years with good (lower) egg incubation
6 conditions under A6A_LLT relative to Existing Conditions. SacEFT predicts that the percentage of
7 years with good (lower) redd dewatering risk under A6A_LLT are similar relative to Existing
8 Conditions.

9 *Late Fall–Run*

10 Flows in the Sacramento River upstream of Red Bluff were examined during the February through
11 May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
12 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be greater than or
13 similar to flows under Existing Conditions, except in below normal years during March through May
14 (7% to 11% lower) and wet years during May (16% lower).

15 Shasta storage volume at the end of September would be 9% to 26% lower under A6A_LLT relative
16 to Existing Conditions (Table 11-6A-10).

17 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the
18 Sacramento River under A6A_LLT would be 144% to 301% greater than mortality under Existing
19 Conditions (Table 11-6A-20). However, absolute differences in the percent of the late-fall population
20 subject to mortality would be minimal in all but dry water years, in which there is a 5% increase.

21 SacEFT predicts that there would be a 13% decrease in the percentage of years with good spawning
22 availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions
23 (Table 11-6A-21). SacEFT predicts that there would be a 7% decrease in the percentage of years
24 with good (lower) redd scour risk under A6A_LLT relative to Existing Conditions. SacEFT predicts
25 that there would be no difference in the percentage of years with good (lower) egg incubation
26 conditions under A6A_LLT relative to Existing Conditions. SacEFT predicts that there would be an
27 8% decrease in the percentage of years with good (lower) redd dewatering risk under A6A_LLT
28 relative to Existing Conditions.

29 **Clear Creek**

30 No water temperature modeling was conducted in Clear Creek.

31 *Fall-Run*

32 Flows in Clear Creek below Whiskeytown Reservoir under A6A_LLT during the September through
33 February fall-run Chinook salmon spawning and egg incubation period would generally be similar to
34 or greater than flows under Existing Conditions, except in below normal and critical water years
35 during October (6% lower for both) and critical years in November (6% lower).

36 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
37 flow reduction each month over the incubation period compared to the flow in September when
38 spawning occurred. The greatest monthly reduction in Clear Creek flows during October through
39 February under A6A_LLT would be similar to or lower magnitude than those under Existing
40 Conditions in wet and below normal water years, but the reduction would be 27%, 67%, and 33%

1 greater (absolute, not relative, differences) under A6A_LLT in above normal, dry, and critical water
2 years, respectively (Table 11-6A-22).

3 **Feather River**

4 Water temperatures in the Feather River under Alternative 6A would be the same as those under
5 Alternative 1A, Impact AQUA-76, which indicates that there would be moderate to large effects of
6 Alternative 1A on temperatures.

7 *Fall-Run*

8 Flows in the low-flow channel during October through January under A6A_LLT would be identical to
9 those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
10 Flows in the high-flow channel under A6A_LLT would generally be lower by up to 43% than flows
11 under Existing Conditions.

12 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
13 comparing the magnitude of flow reduction each month over the incubation period compared to the
14 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were
15 identical between A6A_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized*
16 *in the Fish Analysis*). Therefore, there would be no effect of Alternative 6A on redd dewatering in the
17 Feather River low-flow channel.

18 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
19 Feather River under A6A_LLT would be 378% to 723% greater than mortality under Existing
20 Conditions (Table 11-6A-23).

21 **American River**

22 Water temperatures in the American River under Alternative 6A would be the same as those under
23 Alternative 1A, which indicates that there would be moderate to large effects of Alternative 1A on
24 temperatures.

25 *Fall-Run*

26 Flows in the American River at the confluence with the Sacramento River were examined during the
27 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
28 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the American River at the
29 confluence with the Sacramento River under A6A_LLT would always be similar to or greater than
30 flows under Existing Conditions during October, but generally lower by up to 34% than flows under
31 Existing Conditions during November through January.

32 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
33 comparing the magnitude of flow reduction each month over the incubation period compared to the
34 flow in October when spawning is assumed to occur. The greatest monthly reduction in American
35 River flows during October through January under A6A_LLT would be up to 219% greater
36 magnitude than those under Existing Conditions in all but above normal and dry water years, in
37 which the greatest monthly reduction under A6A_LLT would be similar to or lower than that under
38 Existing Conditions (Table 11-6A-24).

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
2 American River under A6A_LLT would be 47% to 219% greater than mortality under Existing
3 Conditions depending on water year type (Table 11-6A-25).

4 **Stanislaus River**

5 *Fall-Run*

6 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
7 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
8 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be
9 lower than flows under Existing Conditions in all months and water year types by up to 16%.

10 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
11 Alternative 1A, AQUA-76, which indicates that there be no effects of Alternative 1A on temperatures
12 relative to Existing Conditions.

13 **San Joaquin River**

14 *Fall-Run*

15 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
16 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results
17 utilized in the Fish Analysis*). Flows under Alternative 6A would be similar to those under Existing
18 Conditions during November and December, 5% lower under Alternative 6A during October, and
19 6% greater under Alternative 6A during January.

20 Water temperature modeling was not conducted in the San Joaquin River.

21 **Mokelumne River**

22 *Fall-Run*

23 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
24 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results
25 utilized in the Fish Analysis*). Flows under Alternative 6A would be up to 14% lower than flows under
26 Existing Conditions during October and November, up to 15% greater than flows under Existing
27 Conditions during December and January.

28 Water temperature modeling was not conducted in the Mokelumne River.

29 **Summary of CEQA Conclusion**

30 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between
31 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
32 alternative could substantially reduce the amount of suitable habitat of fish, contrary to the NEPA
33 conclusion set forth above. There would be flow reductions in the Feather, American, and Stanislaus
34 rivers that are substantially large and frequent to affect the fall-run Chinook salmon population. In
35 addition, the Reclamation egg mortality model predicts moderate to substantial negative effects of
36 Alternative 6A on fall-run Chinook salmon egg survival in the Sacramento River.

37 These results are primarily caused by four factors: differences in sea level rise, differences in climate
38 change, future water demands, and implementation of the alternative. The analysis described above

1 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
2 the alternative from those of sea level rise, climate change and future water demands using the
3 model simulation results presented in this chapter. However, the increment of change attributable
4 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
5 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
6 implementation period, which does include future sea level rise, climate change, and water
7 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
8 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
9 effect of the alternative from those of sea level rise, climate change, and water demands.

10 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
11 term implementation period and Alternative 6A indicates that flows in the locations and during the
12 months analyzed above would generally be similar between Existing Conditions during the LLT and
13 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
14 found above would generally be due to climate change, sea level rise, and future demand, and not
15 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
16 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
17 result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact
18 is found to be less than significant and no mitigation is required.

19 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon** 20 **(Fall-/Late Fall-Run ESU)**

21 **Upstream of the Delta**

22 In general, Alternative 6A would not affect the quantity and quality of larval and juvenile rearing
23 habitat for fall-/late fall-run Chinook salmon relative to NAA.

24 ***Sacramento River***

25 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
26 under Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative
27 1A on temperature.

28 ***Fall-Run***

29 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
30 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
31 *Analysis*). Flows under A6A_LLТ would always be greater than or similar to flows under NAA, except
32 in critical years during January (11% lower).

33 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and
34 juvenile Chinook salmon rearing period. As reported in Alternative 1A, Impact AQUA-58, end of
35 September Shasta Reservoir storage would be similar to or greater than storage under NAA in all
36 water year types (Table 11-6A-10).

37 SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile
38 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A6A_LLТ
39 relative to NAA (Table 11-6A-19). SacEFT predicts that there would be no change in the percentage
40 of years with good (lower) juvenile stranding risk under A6A_LLТ relative to NAA.

1 SALMOD predicts that fall-run Chinook salmon smolt equivalent habitat-related mortality under
2 A6A_LLT would be similar to mortality under NAA.

3 *Late Fall–Run*

4 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run
5 Chinook salmon juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results*
6 *utilized in the Fish Analysis*). Flows during this period under A6A_LLT would generally be similar to
7 or greater than flows under NAA, with one exceptions (6% lower).

8 Shasta Reservoir storage at the end of September and May would affect flows during the late fall–
9 run larval and juvenile Chinook salmon rearing period. As reported in Impact AQUA-58, end of
10 September Shasta Reservoir storage would be similar to or greater than storage under NAA in all
11 water year types (Table 11-6A-10).

12 As reported in Impact AQUA-40, Shasta storage at the end of May under A6A_LLT would be similar
13 to or greater than storage under NAA for all water year types (Table 11-6A-5).

14 SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile
15 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under
16 A6A_LLT relative to NAA (Table 11-6A-21). SacEFT predicts that there would be a 7% reduction in
17 the percentage of years with “good” (lower) juvenile stranding risk under A6A_LLT relative to NAA.

18 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A6A_LLT would
19 be similar to (<5% difference) mortality under NAA.

20 **Clear Creek**

21 No water temperature modeling was conducted in Clear Creek.

22 *Fall-run*

23 Flows in Clear Creek below Whiskeytown Reservoir were examined in the January through May fall–
24 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
25 *Analysis*). Flows under A6A_LLT would almost always be similar to or greater than flows under NAA,
26 except in below normal years during March (6% reduction).

27 **Feather River**

28 Water temperatures in the Feather River under Alternative 6A would be the same as those under
29 Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative 1A on
30 temperature.

31 *Fall-run*

32 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
33 channel) during December through June were reviewed to determine flow-related effects on larval
34 and juvenile fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized*
35 *in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under
36 A6A_LLT would not differ from those under NAA. In the high-flow channel, flows during December
37 under A6A_LLT would be generally lower than under NAA (up to 27% lower). Flows during January

1 through June would generally be similar to or greater than flows under NAA with some exceptions
2 (up to 31% lower) under A6A_LLT.

3 As reported in Alternative 1A, Impact AQUA-59, May Oroville storage volume under A6A_LLT would
4 always be similar to or greater than storage under NAA, indicating that the difference relative to
5 NAA is primarily a result of climate change (Table 11-6A-15).

6 As reported in Alternative 1A, Impact AQUA-58, September Oroville storage volume would always
7 be similar to or greater than NAA (Table 11-6A-14).

8 **American River**

9 Water temperatures in the American River under Alternative 6A would be the same as those under
10 Alternative 1A, Impact AQUA-77, which indicates that there would be no effects of Alternative 1A on
11 temperature.

12 *Fall-Run*

13 Flows in the American River at the confluence with the Sacramento River were examined for the
14 January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C,
15 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be
16 similar to or greater than flows under NAA except in critical years during March (23% lower) and
17 dry and critical years during April (15% and 6% lower, respectively).

18 **Stanislaus River**

19 *Fall-Run*

20 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
21 January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C,
22 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows
23 under NAA throughout the period, regardless of water year type.

24 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
25 Alternative 1A, which indicates that there would be no effects of Alternative 1A on temperature.

26 **San Joaquin River**

27 *Fall-Run*

28 Flows in the San Joaquin River for Alternative 6A are not different from those for Alternative 1A,
29 which indicates that there would be no differences in flows during the period.

30 Water temperature modeling was not conducted in the San Joaquin River.

31 **Mokelumne River**

32 *Fall-Run*

33 Flows in the Mokelumne River for Alternative 6A are not different from those for Alternative 1A,
34 which indicates that there would be no differences in flows during the period.

35 Water temperature modeling was not conducted in the Mokelumne River.

1 **NEPA Effects:** Taken together, these results indicate that the effect would not be adverse because it
2 does not have the potential to substantially reduce the amount of suitable habitat of fish. Despite
3 small or intermittent flow reductions, there are no effects of Alternative 6A on fall-run or late-fall-
4 run Chinook salmon in that would rise to the level of adverse.

5 **CEQA Conclusion:** In general, under Alternative 6A water operations, the quantity and quality of
6 rearing habitat for fall-/late fall-run Chinook salmon would not be reduced relative to the CEQA
7 baseline.

8 **Sacramento River**

9 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
10 under Alternative 1A, which indicates that there would be no effects on temperatures during the
11 evaluated period.

12 *Fall-Run*

13 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
14 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
15 *Analysis*). Flows under A6A_LLT would generally be greater than or similar to flows under Existing
16 Conditions, except in below normal years during March through May (7% to 11% lower) and wet
17 years during May (16% lower).

18 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 9% to 26%
19 lower under A6A_LLT relative to Existing Conditions depending on water year type (Table 11-6A-
20 10).

21 SacEFT predicts that there would be an 15% increase in the percentage of years with good juvenile
22 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A6A_LLT
23 relative to Existing Conditions (Table 11-6A-19). SacEFT predicts that there would be a 35%
24 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A6A_LLT
25 relative to Existing Conditions.

26 SALMOD predicts that fall-run Chinook salmon smolt equivalent habitat-related mortality under
27 A6A_LLT would be 7% lower than mortality under Existing Conditions.

28 *Late Fall-Run*

29 Sacramento River flows upstream of Red Bluff were examined for the late fall-run Chinook salmon
30 juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*
31 *Fish Analysis*). Flows during the rest of the period under A6A_LLT would generally be similar to or
32 greater than those under Existing Conditions, with some exceptions (up to 16% lower).

33 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 9% to 26%
34 lower under A6A_LLT relative to Existing Conditions depending on water year type (Table 11-6A-
35 10).

36 As reported in Impact AQUA-40, end of May Shasta storage under A6A_LLT would be similar to
37 Existing Conditions in wet and above normal years, but lower by 5% to 19% in below normal, dry,
38 and critical water years (Table 11-6A-5).

1 SacEFT predicts that there would be a 33% increase in the percentage of years with good juvenile
2 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under
3 A6A_LLT relative to Existing Conditions (Table 11-6A-21). SacEFT predicts that there would be a
4 40% reduction in the percentage of years with “good” (lower) juvenile stranding risk under
5 A6A_LLT relative to Existing Conditions.

6 SALMOD predicts that late fall–run Chinook salmon smolt equivalent habitat-related mortality
7 under A6A_LLT would be 5% higher than mortality under Existing Conditions.

8 **Clear Creek**

9 No temperature modeling was conducted in Clear Creek.

10 *Fall-Run*

11 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-
12 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
13 *Analysis*). Flows under A6A_LLT would always be similar to or greater than flows under Existing
14 Conditions for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 **Feather River**

16 Water temperatures in the Feather River under Alternative 6A would be the same as those under
17 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher during
18 substantial portions of the periods evaluated.

19 *Fall-Run*

20 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
21 channel) during December through June were reviewed to determine flow-related effects on larval
22 and juvenile fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized*
23 *in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout the period under
24 A6A_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows
25 under A6A_LLT would be mostly lower (up to 43%) during December and January and mostly
26 similar to or greater than flows under Existing Conditions during the rest of the period with some
27 exceptions (up to 46% lower under A6A_LLT).

28 As reported under Impact AQUA-59, May Oroville storage volume under A6A_LLT would be lower
29 than Existing Conditions in dry and critical years (9% and 5% lower, respectively) and similar to
30 flows under Existing Conditions (<5% difference) in all other water year types (Table 11-6A-15).

31 As reported in Impact AQUA-58, September Oroville storage volume would be 24% to 26% lower
32 under A6A_LLT relative to Existing Conditions in wet, above normal, and below normal years and
33 similar to flows under Existing Conditions in the other water year types (Table 11-6A-14).

34 **American River**

35 Water temperatures in the American River under Alternative 6A would be the same as those under
36 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher in 3 months
37 during the 5-month period evaluated.

1 *Fall-Run*

2 Flows in the American River at the confluence with the Sacramento River were examined for the
3 January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C,
4 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be lower
5 than flows under Existing Conditions during January, April, and May (up to 34% lower), and
6 generally similar to or greater than flows under Existing Conditions during February and March,
7 except in critical years (8% and 25% lower, respectively).

8 **Stanislaus River**

9 *Fall-Run*

10 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
11 January through May fall-run larval and juvenile Chinook salmon rearing period (Appendix 11C,
12 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower
13 than flows under Existing Conditions by up to 36% throughout the period.

14 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
15 Alternative 1A, Impact AQUA-77, which indicates that temperatures would be higher throughout the
16 period evaluated.

17 **San Joaquin River**

18 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run
19 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*
20 *the Fish Analysis*). Mean monthly flows under A6A_LLT would generally be similar to flows under
21 Existing Conditions during February through May and 6% higher under A6A_LLT in January. Flows
22 would generally be lower by up to 16% in drier water year types under Alternative 6A relative to
23 Existing Conditions during February through May.

24 Water temperature modeling was not conducted in the San Joaquin River.

25 **Mokelumne River**

26 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook
27 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
28 *Analysis*). Flows under A6A_LLT would be up to 18% greater than those under Existing Conditions
29 during January and February, similar to flows under Existing Conditions during March, and lower by
30 up to 18% than flows under Existing Conditions during April and May.

31 Water temperature modeling was not conducted in the Mokelumne River.

32 **Summary of CEQA Conclusion**

33 Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between
34 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
35 alternative could substantially reduce the amount of suitable rearing habitat of fish, contrary to the
36 NEPA conclusion set forth above. Changes in Sacramento River flows under Alternative 6A would
37 substantially reduce the risk of stranding for late fall- and fall-run Chinook salmon. There would be
38 small to moderate flow reductions in the American, Stanislaus, and San Joaquin rivers under
39 Alternative 6A relative to Existing Conditions during large portions of the fall-run Chinook salmon

1 rearing period. These flow reductions would cause reductions in habitat quantity and quality for
2 rearing fall-run Chinook salmon.

3 These results are primarily caused by four factors: differences in sea level rise, differences in climate
4 change, future water demands, and implementation of the alternative. The analysis described above
5 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
6 the alternative from those of sea level rise, climate change and future water demands using the
7 model simulation results presented in this chapter. However, the increment of change attributable
8 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
9 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
10 implementation period, which does include future sea level rise, climate change, and water
11 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
12 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
13 effect of the alternative from those of sea level rise, climate change, and water demands.

14 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
15 term implementation period and Alternative 6A indicates that flows in the locations and during the
16 months analyzed above would generally be similar between Existing Conditions during the LLT and
17 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
18 found above would generally be due to climate change, sea level rise, and future demand, and not
19 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
20 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
21 result in a significant impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is
22 found to be less than significant and no mitigation is required.

23 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon** 24 **(Fall-/Late Fall-Run ESU)**

25 **Upstream of the Delta**

26 In general, Alternative 6A would reduce migration conditions for fall-/late fall-run Chinook salmon
27 relative to NAA.

28 ***Sacramento River***

29 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
30 under Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative
31 1A on temperatures throughout the periods evaluated relative to NAA.

32 ***Fall-Run***

33 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run Chinook salmon migrants
34 during February through May under A6A_LLTT would be similar to or greater than flows under NAA
35 throughout the February through May juvenile fall-run Chinook salmon migration period in all
36 water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

37 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon
38 upstream migration period (September through October) under A6A_LLTT would generally be lower
39 than those under NAA during September (up to 16% lower) and generally similar to or greater than
40 flows under NAA during October, except in critical years under NAA (7% lower) and above normal
41 years (9% lower).

1 *Late Fall–Run*

2 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run Chinook salmon
3 migrants (January through March) under A6A_LLT would nearly always be similar to or greater than
4 flows under NAA, except in critical years during January (11% lower) (Appendix 11C, *CALSIM II*
5 *Model Results utilized in the Fish Analysis*).

6 Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon
7 upstream migration period (December through February) under A6A_LLT would nearly always be
8 similar to or greater than those under NAA except in critical years during January (11% lower)
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 **Clear Creek**

11 Water temperature modeling was not conducted in Clear Creek.

12 *Fall-Run*

13 Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run Chinook
14 salmon migrants during February through May. Flows under A6A_LLT would nearly always be
15 similar to or greater than those under NAA, except in below normal years during March (6% lower)
16 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon
18 upstream migration period (September through October) under A6A_LLT would generally be
19 similar to or greater than those under NAA (Appendix 11C, *CALSIM II Model Results utilized in the*
20 *Fish Analysis*).

21 **Feather River**

22 Water temperatures in the Feather River under Alternative 6A would be the same as those under
23 Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative 1A on
24 temperatures throughout the periods evaluated relative to NAA.

25 *Fall-Run*

26 Flows in the Feather River at the confluence with the Sacramento River were reviewed for the fall-
27 run juvenile Chinook salmon migration period (February through May). Flows under A6A_LLT
28 would nearly always be greater than or similar to flows under NAA throughout the migration period,
29 except in dry and critical years during May (14% and 9% lower, respectively) (Appendix 11C,
30 *CALSIM II Model Results utilized in the Fish Analysis*).

31 **American River**

32 Water temperatures in the American River under Alternative 6A would be the same as those under
33 Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative 1A on
34 temperatures throughout the periods evaluated relative to NAA.

35 *Fall-Run*

36 Flows in the American River at the confluence with the Sacramento River were examined during the
37 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
38 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally similar to or

1 greater than flows under NAA, except in critical years during March (23% lower) and dry and
2 critical years during April (15% and 6% lower, respectively).

3 Flows in the American River at the confluence with the Sacramento River were examined during the
4 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
5 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be
6 similar to or greater than those under NAA except during wet and above normal years during
7 September (32% and 9% lower, respectively).

8 **Stanislaus River**

9 *Fall-Run*

10 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
11 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
12 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be nearly identical to flows
13 under NAA throughout the period. This indicates that climate change would affect juvenile migration
14 flows in the Stanislaus River, but Alternative 6A would not.

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
16 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
17 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be nearly identical
18 to flows under NAA throughout the period. This indicates that climate change would affect adult
19 migration flows in the Stanislaus River, but Alternative 6A would not.

20 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
21 Alternative 1A, Impact AQUA-78, which indicates that there would be no effect of Alternative 1A on
22 temperatures throughout the period evaluated relative to NAA.

23 **San Joaquin River**

24 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
25 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
26 *Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and water year
27 types throughout the period.

28 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
29 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
30 *in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and
31 water year types throughout the period.

32 Water temperature modeling was not conducted in the San Joaquin River.

33 **Mokelumne River**

34 Flows in the Mokelumne River at the Delta were examined during the February through May
35 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
36 *the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and
37 water year types throughout the period.

38 Flows in the Mokelumne River at the Delta were examined during the September and October adult
39 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*

1 *in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA in all months and
2 water year types throughout the period. Flows under A6A_LLT would be similar to those under NAA
3 in all months and water year types throughout the period.

4 Water temperature modeling was not conducted in the Mokelumne River.

5 **Through-Delta**

6 ***Sacramento River***

7 The effects on through-Delta migration were evaluated using the approach described in Alternative
8 1A, Impact AQUA-42. Through-Delta conditions on the Sacramento River would substantially impact
9 migration conditions relative to NAA.

10 *Fall-Run*

11 *Juveniles*

12 During the juvenile fall-run Chinook salmon emigration period (November to early May), mean
13 monthly flows in the Sacramento River below the north Delta intakes under Alternative 6A averaged
14 across years would be lower (15% to 26% lower) compared to NAA. Flows would be up to 34%
15 lower in April of above normal years.

16 The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish
17 around the intake structures. The predation effects of Alternative 6A would be the same as those
18 described for Alternative 1A, since there are five intakes for both alternatives. Estimates of potential
19 predation losses ranged from 1.8% (Table 11-1A-17) up to 20.3% (conservative assumption of 5%
20 loss per intake) of fall-run annual production (Appendix 5F, *Biological Stressors*).

21 Through-Delta survival by juvenile fall-run Chinook salmon under Alternative 6A averaged across
22 years would be 23.9% from the Sacramento River, similar to NAA, and 17.5% from the Mokelumne
23 River, an increase relative to NAA (Table 11-6A-26). In wetter years, mean survival would be 2.1%
24 lower from the Sacramento (7% relative decrease) and 2.7% greater (17% relative increase) from
25 the Mokelumne.

26 Overall, Alternative 6A would have a negative effect on fall-run Chinook salmon juvenile survival
27 due to habitat and predation losses at the NDD intakes.

1 **Table 11-6A-26. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**
2 **Alternative 6A**

Water Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A6A_LLT	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Sacramento River					
Wetter Years	34.5	31.1	29.0	-5.5 (-16%)	-2.1 (-7%)
Drier Years	20.6	20.8	20.8	0.2 (1%)	0.0 (0%)
All Years	25.8	24.7	23.9	-1.9 (-7%)	-0.8 (-3%)
Mokelumne River					
Wetter Years	17.2	15.7	18.4	1.3 (7%)	2.7 (17%)
Drier Years	15.6	15.9	17.0	1.3 (9%)	1.0 (6%)
All Years	16.2	15.9	17.5	1.3 (8%)	1.7 (10%)
San Joaquin River^a					
Wetter Years	19.3	20.3	14.0	-5.3 (-27%)	-6.2 (-31%)
Drier Years	10.0	9.5	8.9	-1.1 (-11%)	-0.7 (-7%)
All Years	13.5	13.6	10.8	-2.7 (-20%)	-2.8 (-20%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

^a Results for San Joaquin River runs may be anomalous when applying DPM to operations scenarios with low or no south Delta exports.

3

4 *Adults*

5 The adult fall-run Chinook salmon migration through the Delta occurs from September-December.
6 Attraction flow for fall-run adults, as estimated by the percentage of Sacramento River water at
7 Collinsville, under Alternative 6A were 1% greater to 5% lower compared to NAA, which is fairly
8 similar (Table 11-6A-28).

9 *Late Fall-Run*

10 *Juveniles*

11 During the juvenile late fall-run Chinook salmon emigration period (October to February), mean
12 monthly flows in the Sacramento River below the north Delta intakes under Alternative 6A averaged
13 across years would be lower (15% to 32% lower) compared to NAA. Flows would be up to 31%
14 lower in November of above normal years.

15 Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would
16 be 4.9% of the annual production estimated for the Sacramento Valley (Table 11-1A-17). A
17 conservative assumption of 5% loss per intake would yield a cumulative loss of 20.3% of juvenile
18 late fall-run Chinook that reach the north Delta. This assumption is uncertain and represents an
19 upper bound estimate (Appendix 5F, *Biological Stressors*).

1 Through-Delta survival to Chipps Island (DPM) by emigrating juvenile late fall-run Chinook salmon
 2 averaged 23.1% across all years, 20.6% in drier years, and 27.4% in wetter years (Table 11-6A-27).
 3 Compared to NAA, juvenile survival would decrease 0.1% to 0.4% (1% to 2% relative decrease).

4 **Table 11-6A-27. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon**
 5 **under Alternative 6A**

Water Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A6A	EXISTING CONDITIONS vs. A6A	NAA vs. A6A
Wetter Years	28.8	27.3	27.4	-1.4 (-5%)	0.1 (<1%)
Drier Years	18.8	20.2	20.6	1.8 (10%)	0.4 (2%)
All Years	22.5	22.9	23.1	0.6 (3%)	0.3 (1%)

Note: Delta Passage Model results for survival to Chipps Island.
 Wetter = Wet and Above Normal WYs (6 years).
 Drier = Below Normal, Dry and Critical WYs (10 years).

6

7 *Adults*

8 The adult late fall–run Chinook salmon migration is from November through March, peaking in
 9 January through March. The proportion of Sacramento River water in the Delta would be similar to
 10 baseline (<10% difference) most months, and reduced 12% in March compared to NAA. Therefore
 11 the effect under Alternative 6A would also not be adverse. However, uncertainty remains with
 12 regard to adult salmon behavioral response to anticipated changes in lower Sacramento River flow
 13 percentages. This topic is discussed further in Impact AQUA-42 in Alternative 1A.

14 ***San Joaquin River***

15 Through-Delta conditions on the San Joaquin River would be positive relative to NAA.

16 *Fall-Run*

17 *Juveniles*

18 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of
 19 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.
 20 There would be no flow changes associated with the Alternative 6A.

21 As modeled by DPM, average survival of juvenile San Joaquin River fall-run to Chipps Island would
 22 be slightly less (2.8% less survival, or 20% less in relative percentage) under Alternative 6A
 23 compared to NAA (Table 11-6A-26). The DPM results for wetter years suggest that migrating
 24 juveniles from the San Joaquin River would experience 6.2% lower survival in wetter years (31%
 25 less in relative percentage).

26 However, this result may be an anomaly of the Delta Passage Model. For certain Alternatives and
 27 operations scenarios with highly reduced south Delta exports (such as Alternative 6A), it can be
 28 problematic applying the DPM to San Joaquin River salmon. The DPM was run for 16 different water
 29 year conditions. As described in *BDCP Effects Analysis – Appendix 5.C Flow, Passage, Salinity and*
 30 *Turbidity*, in 1982 and 1983 there was considerably greater average south Delta export flows under

1 baseline/Existing Conditions scenarios (~6,000–8,000 cfs) than under proposed alternative
2 scenarios (40–2,000 cfs) which led to appreciably lower survival under Alternative 4 (Scenario H3)
3 because, as noted in the DPM methods, the DPM assumes a positive relationship between south
4 Delta exports and survival based on Newman’s (2010) modeling. For these two wet years,
5 nonoperation of the barrier at the Head of Old River was assumed under all scenarios. There is some
6 uncertainty regarding the effects that the very low south Delta exports modeled for Alternative 6A
7 scenarios in 1983 (i.e., 40–50 cfs) might have on San Joaquin River Chinook salmon smolt survival
8 because this level of exports is considerably lower than the minimum exports during the periods
9 modeled by Newman (2010; i.e., ~800 cfs).

10 A qualitative assessment is more appropriate given this modeling limitation. Under Alternative 6A,
11 survival of juvenile fall-run Chinook salmon would be expected to be similar or greater compared to
12 NAA, given that south Delta exports that could entrain juveniles into the central Delta would be
13 eliminated.

14 *Adults*

15 Alternative 6A would increase the proportion of San Joaquin River water in the Delta in September
16 through December by 5–10% (Table 11-6A-28). San Joaquin flows at Vernalis under Alternative 6A
17 would not be changed relative to NAA. Therefore overall adult migration conditions under
18 Alternative 6A would be improved relative to NAA. Alternative 6A would have a beneficial effect on
19 San Joaquin River basin fall-run Chinook salmon adults.

20 **NEPA Effects:** Overall, the results indicate that the effect of Alternative 6A is adverse due to the
21 cumulative effects associated with five north Delta intake facilities, including mortality related to
22 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to
23 reduced flows downstream of the intakes) associated with the five NDD intakes.

24 Upstream of the Delta, effects of Alternative 6A would not be adverse. Flows under Alternative 6A
25 during September, one of the two months of the fall-run adult Chinook salmon migration period, in
26 the Sacramento River would be up to 16% lower in most water year types. However, these
27 reductions would not be large enough to reduce the ability of adult fall-run Chinook salmon to sense
28 olfactory cues from their natal spawning grounds. There would be no biologically meaningful effects
29 in any other upstream waterways.

30 Adult attraction flows in the Delta under Alternative 6A would be lower than those under NAA, but
31 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

32 Near-field effects of Alternative 6A NDD on fall- and late fall-run Chinook salmon related to
33 impingement and predation associated with five new intakes could result in substantial effects on
34 juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty
35 regarding the potential effects. Estimates within the effects analysis range from very low levels of
36 effects (<2% mortality) to very significant effects (~ 20% mortality above current baseline levels).
37 CM15 would be implemented with the intent of providing localized and temporary reductions in
38 predation pressure at the NDD. Additionally, several pre-construction surveys to better understand
39 how to minimize losses associated with the five new intake structures will be implemented as part
40 of the final NDD screen design effort. Alternative 6A also includes an Adaptive Management Program
41 and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments
42 intended to provide adequate migration conditions for fall- and late fall-run Chinook salmon.
43 However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento

1 River/Delta, the degree of mortality expected from near-field effects at the NDD remains highly
2 uncertain.

3 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
4 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
5 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A
6 predict improvements in smolt condition and survival associated with increased access to the Yolo
7 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
8 of each of these factors and how they might interact and/or offset each other in affecting salmonid
9 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

10 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
11 all of these elements of BDCP operations and conservation measures to predict smolt migration
12 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
13 migration survival under Alternative 6A would be similar to survival rates estimated for NAA.
14 Further refinement and testing of the DPM, along with several ongoing and planned studies related
15 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable
16 future. These efforts are expected to improve our understanding of the relationships and
17 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
18 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
19 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative
20 6A on fall- and late fall-run Chinook salmon through-Delta survival remains uncertain.

21 Therefore, primarily due to reduced flows along with unacceptable levels of uncertainty regarding
22 the cumulative impacts of near-field and far-field effects associated with the presence and operation
23 of the five intakes on fall- and late fall-run Chinook salmon, this effect is adverse. While the
24 implementation of the conservation and mitigation measures described below would address these
25 impacts, these measures are not anticipated to reduce the impact to a level considered not adverse.

26 **CEQA Conclusion:** In general, Alternative 6A would reduce migration conditions for fall-/late fall-
27 run Chinook salmon.

28 **Upstream of the Delta**

29 ***Sacramento River***

30 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
31 under Alternative 1A, Impact AQUA-78, which indicates that temperatures would generally not
32 change under Alternative 1A during the periods evaluated relative to Existing Conditions.

33 ***Fall-Run***

34 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run Chinook salmon migrants
35 during February through May under A6A_LLTT would generally be similar to or greater than those
36 under Existing Conditions, except in below normal water years during March through May (7% to
37 11%) and wet years during May (16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
38 *Fish Analysis*).

39 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon
40 upstream migration period (September through October) under A6A_LLTT would generally be lower
41 than those under Existing Conditions during September (up to 21% lower) and similar to or greater

1 than flows under Existing Conditions during October, except in above normal and critical years (9%
2 lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 *Late Fall–Run*

4 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run Chinook salmon
5 migrants (January through March) under A6A_LLT would nearly always be similar to or greater than
6 flows under Existing Conditions, except in below normal water years during March (11% lower)
7 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon
9 upstream migration period (December through February) under A6A_LLT would nearly always be
10 similar to or greater than those under Existing Conditions, except in below normal and dry years
11 during December (7% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized*
12 *in the Fish Analysis*).

13 **Clear Creek**

14 Water temperature modeling was not conducted in Clear Creek.

15 *Fall-Run*

16 Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon
17 upstream migration period (February through May) under A6A_LLT would be similar to or greater
18 than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*
19 *utilized in the Fish Analysis*).

20 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon
21 upstream migration period (September through October) under A6A_LLT would generally be
22 similar to flows under Existing Conditions except in critical years (28% and 6% lower during
23 September and October, respectively) and below normal years during October (6% lower)
24 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 **Feather River**

26 Water temperatures in the Feather River under Alternative 6A would be the same as those under
27 Alternative 1A, Impact AQUA-78, which indicates that there would be no differences in
28 temperatures between Existing Conditions and Alternative 1A during the periods evaluated.

29 *Fall-Run*

30 Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile
31 Chinook salmon migration period (February through May) under A6A_LLT would generally be
32 similar to or greater than flows under Existing Conditions during February through April with some
33 exceptions (up to 15% lower), and generally lower than Existing Conditions during May (up to 25%
34 lower depending on water year type) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
35 *Analysis*).

36 Flows in the Feather River at the confluence with the Sacramento River during the September
37 through October fall-run Chinook salmon adult migration period under A6A_LLT would always be
38 greater than flows under Existing Conditions during September, and would generally be lower
39 compared to Existing Conditions during October (up to 13% lower depending on water year type).

1 **American River**

2 Water temperatures in the American River under Alternative 6A would be the same as those under
3 Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher under
4 Alternative 1A relative to Existing Conditions during substantial portions of the periods evaluated.

5 *Fall-Run*

6 Flows in the American River at the confluence with the Sacramento River were examined during the
7 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
8 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during February and March would
9 generally be similar to or greater than flows under Existing Conditions, except in critical years (8%
10 and 25% lower, respectively). Flows under A6A_LLT during April and May would be generally be
11 lower by up to 34% than flows under Existing Conditions depending on month and water year type.

12 Flows in the American River at the confluence with the Sacramento River were examined during the
13 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
14 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during September would
15 be 35% to 57% lower than flows under Existing Conditions. Flows under A6A_LLT during October
16 would always be similar to or greater than those under Existing Conditions.

17 **Stanislaus River**

18 *Fall-Run*

19 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
20 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
21 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would predominantly be lower
22 than flows under Existing Conditions by up to 36%.

23 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
24 Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher during
25 substantial portions of the juvenile migration period evaluated.

26 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
27 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
28 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during September would
29 generally be similar to flows under Existing Conditions, except during wet and above normal years
30 (17% and 6% lower, respectively). Flows under A6A_LLT during October would be 5% to 10%
31 lower than flows under Existing Conditions.

32 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
33 Alternative 1A, Impact AQUA-78, which indicates that temperatures would be higher under
34 Alternative 1A relative to 1A during September, but not October.

35 **San Joaquin River**

36 *Fall-Run*

37 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
38 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
39 *Analysis*). Mean monthly flows under A6A_LLT would be similar to Existing Conditions in all months,

1 although flows would generally be lower under A6A_LLT relative to Existing Conditions in drier
2 water years.

3 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
4 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
5 *in the Fish Analysis*). Flows under A6A_LLT would be lower than Existing Conditions by up to 11%
6 during both months.

7 Water temperature modeling was not conducted in the San Joaquin River.

8 **Mokelumne River**

9 *Fall-Run*

10 Flows in the Mokelumne River at the Delta were examined during the February through May
11 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized*
12 *in the Fish Analysis*). Flows under A6A_LLT would be similar to or up to 15% greater than those under
13 Existing Conditions during February and March, but up to 18% lower than flows under Existing
14 Conditions during April and May.

15 Flows in the Mokelumne River at the Delta were examined during the September and October adult
16 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
17 *in the Fish Analysis*). Flows under A6A_LLT would be up to 29% lower than those under Existing
18 Conditions depending on the month and water year type.

19 Water temperature modeling was not conducted in the Mokelumne River.

20 **Through-Delta**

21 **Sacramento River**

22 During the emigration periods for fall-run Chinook salmon and late fall-run Chinook salmon, mean
23 monthly flows in the Sacramento River below the north Delta intakes under Alternative 6A averaged
24 across years would be lower (15% to 32% lower) compared to Existing Conditions, and over 20% to
25 46% reduced in wetter years March to May. As discussed above, potential predation losses at the
26 five north Delta intakes could increase, ranging hypothetically from 2% up to 20% of emigrating
27 juveniles reaching the Delta.

28 Through-Delta survival of migrating fall-run Chinook salmon juveniles from the Sacramento would
29 be reduced (5.5% lower, a 16% relative decrease) in wetter years under Alternative 6A compared to
30 Existing Conditions, but slightly increased in the Mokelumne River (1.3% greater survival, or a 7%
31 relative increase) (Table 11-6A-26). Overall, the impact on juvenile migration would be less than
32 significant due to minor differences in survival across all water years and no mitigation would be
33 required.

34 Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10%
35 difference) to Existing Conditions for the fall-run adult Chinook salmon migration. The proportion of
36 Sacramento River flows would be 11–15% less from February–May compared to Existing
37 Conditions, which would overlap with the late fall–run adult Chinook salmon migrations. Although
38 Sacramento River olfactory cues would be reduced during these months relative to Existing
39 Conditions, the Sacramento River would still represent 55–64% of Delta flows from February–May.

1 Overall, olfactory cues would not affect the ability of Sacramento River Chinook salmon to successful
2 migrate upstream.

3 ***San Joaquin River***

4 ***Fall-Run***

5 There is a beneficial effect of Alternative 6A to all San Joaquin River basin fish due to positive Old
6 and Middle River flows during migratory months resulting in San Joaquin water moving westward
7 and contributing to Delta outflow. This is expected to eliminate entrainment at South Delta facilities
8 and reduce predation hotspots to promote greater survival to Chipps Island. Furthermore under
9 Alternative 6A, entrainment and entrainment-related mortality at the South Delta Facilities would
10 be eliminated.

11 Additionally, under Alternative 6A, the elimination of entrainment at the South Delta Facilities
12 would alleviate one of the primary concerns related to potential Old and Middle River corridor
13 habitat restoration. Successful restoration in this area would be expected to enhance rearing habitat,
14 food availability, and overall salmonid fitness and survival.

15 For San Joaquin basin fall-run adult Chinook salmon, the proportion of San Joaquin River flows in
16 the Delta would increase 5–10%, improving olfactory attraction cues. The increase in the proportion
17 of San Joaquin River flows at Collinsville would be due to a reduction in the contribution of flows
18 from the Sacramento River and the elimination of south delta exports under Alternative 6A.

19 **Summary of CEQA Conclusion**

20 Overall, the results indicate that the effect of Alternative 6A is adverse because it has the potential to
21 substantially decrease fall- and late fall-run Chinook salmon migration habitat conditions upstream
22 of the Delta. In addition, this alternative is adverse due to the cumulative effects associated with five
23 north Delta intake facilities, including mortality related to near-field effects (e.g. impingement and
24 predation) and far-field effects (reduced survival due to reduced flows downstream of the intakes)
25 associated with the five NDD intakes.

26 Flows in the Feather, American, Stanislaus, and Mokelumne rivers in September and October would
27 generally be lower than those under Existing Conditions, reducing olfactory cues for fall-run
28 Chinook salmon adult migrants, potentially delaying or preventing them from reaching these
29 spawning grounds. In addition, flows under Alternative 6A in the American River during two of the
30 four months of the juvenile fall-run Chinook salmon migration period would be lower than Existing
31 Conditions. Flows in the Stanislaus River throughout the fall-run juvenile Chinook salmon rearing
32 period would be predominantly lower under A6A_LLT relative to Existing Conditions. These flow
33 reductions would reduce the downstream migratory ability of juveniles, which could delay
34 smoltification and reduce survival. Temperatures would increase in the American, and Stanislaus
35 rivers, increasing stress and mortality of migrants.

36 In the Delta, the impact on emigrating juveniles would be significant due to the impacts associated
37 with predation and habitat loss from the five intakes under this alternative (similar to the previous
38 description under Impact AQUA-42). Implementation of CM6 and CM15 would address these
39 impacts, but are not anticipated to reduce them to a level considered less than significant. Although
40 implementation of *CM6 Channel Margin Enhancement* would provide habitat similar to that which
41 would be lost, it would not necessarily be located near the intakes and therefore would not fully
42 compensate for the lost habitat. Additionally, implementation of this measure would not fully

1 address predation losses. *CM15 Localized Reduction of Predatory Fishes (Predator Control)* has
2 substantial uncertainties associated with its effectiveness such that it is considered to have no
3 demonstrable effect. Conservation measures that address habitat and predation losses, therefore,
4 would potentially minimize impacts to some extent but not to a less than significant level.
5 Consequently, as a result of these changes in migration conditions, this impact is significant and
6 unavoidable.

7 Applicable conservation measures are briefly described below and full descriptions are found in
8 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized
9 Reduction of Predatory Fishes (Predator Control) (CM15).

10 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
11 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat
12 habitats on the waterside side of levees along channels that provide rearing and outmigration
13 habitat for juvenile salmonids. Linear miles of enhancement would be measured along one side
14 or the other of a given channel segment (e.g., if both sides of a channel are enhanced for a length
15 of 1 mile, this would account for a total of 2 miles of channel margin enhancement). At least 10
16 linear miles would be enhanced by year 10 of Plan implementation; enhancement would then be
17 phased in 5-mile increments at years 20 and 30, for a total of 20 miles at year 30. Channel
18 margin enhancement would be performed only along channels that provide rearing and
19 outmigration habitat for juvenile salmonids. These include channels that are protected by
20 federal project levees—including the Sacramento River between Freeport and Walnut Grove
21 among several others.

22 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
23 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
24 locations of high predation risk (i.e., predation “hotspots”). This conservation measure seeks to
25 benefit covered salmonids by reducing mortality rates of juvenile migratory life stages that are
26 particularly vulnerable to predatory fishes. Predators are a natural part of the Delta ecosystem.
27 Therefore, this conservation measure is not intended to entirely remove predators at any
28 location, or substantially alter the abundance of predators at the scale of the Delta system. This
29 conservation measure would also not remove piscivorous birds. Because of uncertainties
30 regarding treatment methods and efficacy, implementation of CM15 would involve discrete pilot
31 projects and research actions coupled with an adaptive management and monitoring program to
32 evaluate effectiveness. Effects would be temporary, as new individuals would be expected to
33 occupy vacated areas; therefore, removal activities would need to be continuous during periods
34 of concern. CM15 also recognizes that the NDD intakes would create new predation hotspots.

35 As discussed in detail for Alternative 1A, the effects of Alternative 6A operations on through-Delta
36 migration conditions for fall-/late fall-run Chinook salmon would be significant/adverse and
37 unavoidable, due to predation and habitat loss associated with the five intakes of the north Delta
38 facilities, and flow changes in the Feather and American Rivers. However, as with the conservation
39 measures, the implementation of the mitigation measures listed below also has the potential to
40 reduce the severity of the impact though not necessarily to a not adverse or a less-than-significant
41 level. These mitigation measures would provide an adaptive management process, that may be
42 conducted as a part of the Adaptive Management and Monitoring Program required by the BDCP
43 (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate minimization
44 measures.

1 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**
2 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**
3 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

4 Although analysis conducted as part of the EIR/EIS determined that Alternative 6A would have
5 significant and unavoidable adverse effects on migration habitat, this conclusion was based on
6 the best available scientific information at the time and may prove to have been over- or
7 understated. Upon the commencement of operations of CM1 and continuing through the life of
8 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine
9 whether such effects would be as extensive as concluded at the time of preparation of this
10 document and to determine any potentially feasible means of reducing the severity of such
11 effects. This mitigation measure requires a series of actions to accomplish these purposes,
12 consistent with the operational framework for Alternative 6A.

13 The development and implementation of any mitigation actions shall be focused on those
14 incremental effects attributable to implementation of Alternative 6A operations only.
15 Development of mitigation actions for the incremental impact on migration habitat attributable
16 to climate change/sea level rise are not required because these changed conditions would occur
17 with or without implementation of Alternative 6A.

18 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**
19 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**
20 **of CM1**

21 Following commencement of initial operations of CM1 and continuing through the life of the
22 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
23 modified operations could reduce impacts to migration habitat under Alternative 6A. The
24 analysis required under this measure may be conducted as a part of the Adaptive Management
25 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

26 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**
27 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**
28 **Migration Conditions Consistent with CM1**

29 In order to determine the feasibility of reducing the effects of CM1 operations on fall-run/late
30 fall-run Chinook salmon habitat, the BDCP proponents will consult with USFWS and the
31 Department of Fish and Wildlife to identify and implement any feasible operational means to
32 either effects on migration habitat. Any such action will be developed in conjunction with the
33 ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-
34 78a.

35 If feasible means are identified to reduce impacts on migration habitat consistent with the
36 overall operational framework of Alternative 6A without causing new significant adverse
37 impacts on other covered species, such means shall be implemented. If sufficient operational
38 flexibility to reduce effects on fall-run/late fall-run Chinook salmon habitat is not feasible under
39 Alternative 6A operations, achieving further impact reduction pursuant to this mitigation
40 measure would not be feasible under this Alternative, and the impact on fall-run/late fall-run
41 Chinook salmon would remain significant and unavoidable.

1 In the Delta on the San Joaquin River, because of increased flows, increased olfactory attraction cues,
 2 elimination of entrainment and associated predation at the south Delta facilities, and alleviation of
 3 entrainment and predation concerns related to restoration potential on the Old and Middle River
 4 corridor, Alternative 6A would be beneficial for fall-run Chinook salmon and no mitigation is
 5 required.

6 **Table 11-6A-28. Percentage (%) of Water at Collinsville that Originated in the Sacramento River**
 7 **and San Joaquin River during the Adult Chinook Migration Period for Alternative 6A**

Month	EXISTING CONDITIONS	NAA	A6A_LL1	EXISTING CONDITIONS vs. A6A_LL1	NAA vs. A6A_LL1
Sacramento River					
September	60	65	61	1	-4
October	60	68	63	3	-5
November	60	66	63	3	-3
December	67	66	67	0	1
January	76	75	69	-7	-6
February	75	72	64	-11	-8
March	78	76	64	-14	-12
April	77	75	62	-15	-13
May	69	65	55	-14	-10
San Joaquin River					
September	0.3	0.1	5.5	5.2	5.4
October	0.2	0.3	8.1	7.9	7.8
November	0.4	1.0	10.7	10.3	9.7
December	0.9	1.0	7.7	6.8	6.7
January	1.6	1.7	8.1	6.5	6.4
February	1.4	1.5	8.4	7	6.9
March	2.6	2.8	10.3	7.7	7.5
April	6.3	6.6	14.9	8.6	8.3
Shading indicates 10% or greater decrease in abundance relative to baseline.					

8

9 **Restoration and Conservation Measures**

10 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
 11 substantial differences in fish effects are anticipated anywhere in the affected environment under
 12 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
 13 fall- and late fall-run Chinook salmon under Alternative 1A (Impact AQUA-79 through Impact
 14 AQUA-90) also appropriately characterize effects under Alternative 6A.

15 The following impacts are those presented under Alternative 1A that are identical for Alternative
 16 6A.

17 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**
 18 **(Fall-/Late Fall-Run ESU)**

1 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**
2 **Salmon (Fall-/Late Fall-Run ESU)**

3 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**
4 **Run ESU)**

5 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**
6 **Run ESU) (CM12)**

7 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
8 **(Fall-/Late Fall-Run ESU) (CM13)**

9 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**
10 **/Late Fall-Run ESU) (CM14)**

11 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
12 **(Fall-/Late Fall-Run ESU) (CM15)**

13 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**
14 **Run ESU) (CM16)**

15 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**
16 **ESU) (CM17)**

17 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**
18 **ESU) (CM18)**

19 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**
20 **Fall-Run ESU) (CM19)**

21 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
22 **(Fall-/Late Fall-Run ESU) (CM21)**

23 **NEPA Effects:** These restoration and conservation measure impact mechanisms have been
24 determined to range from no effect, not adverse, or beneficial effects on fall- and late fall-run
25 Chinook salmon for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-79
26 through 90). Specifically for AQUA-80, the effects of contaminants on fall- and late fall-run Chinook
27 salmon with respect to selenium, copper, ammonia and pesticides would not be adverse. The effects
28 of methylmercury on fall- and late fall-run Chinook salmon are uncertain.

29 **CEQA Conclusion:** These restoration and conservation measure impact mechanisms would be
30 considered to range from no impact, to less than significant, or beneficial on fall- and late fall-run
31 Chinook salmon, for the reasons identified for Alternative 1A, and no mitigation is required.

1 **Steelhead**

2 **Construction and Maintenance of CM1**

3 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

4 The potential effects of construction of water conveyance facilities on steelhead would be the same
5 as those described for Alternative 1A (see Impact AQUA-91), because the same five intakes would be
6 constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat
7 into intake facilities and would require 27.3 acres of dredge and channel reshaping.

8 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-91, environmental commitments and
9 mitigation measures would be available to avoid and minimize potential effects, and the effect would
10 not be adverse for steelhead.

11 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-91, the impact of the
12 construction of water conveyance facilities on steelhead would be less than significant except for
13 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and
14 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

15 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
16 **of Pile Driving and Other Construction-Related Underwater Noise**

17 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

18 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
19 **and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

21 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

22 **NEPA Effects:** The potential impacts of the maintenance of water conveyance facilities under
23 Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-92),
24 which concluded that the impact would not be adverse for steelhead.

25 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-92, the impact of the
26 maintenance of water conveyance facilities on steelhead would be less than significant and no
27 mitigation would be required.

28 **Water Operations of CM1**

29 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

30 **Water Exports from SWP/CVP South Delta Facilities**

31 Entrainment losses at the SWP/CVP south Delta facilities would be completely eliminated under
32 Alternative 6A because there would be no south Delta exports under this alternative.

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
3 entrainment of juvenile salmonids at the north Delta intakes would be minimal because the north
4 Delta intakes would have state-of-the-art screens to exclude juvenile fish.

5 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

6 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
7 entrainment and impingement effects for juvenile salmonids would be minimal because intakes
8 would have state-of-the-art screens installed.

9 **NEPA Effects:** In conclusion, Alternative 6A would eliminate south Delta entrainment for steelhead,
10 which would be a beneficial effect.

11 **CEQA Conclusion:** Entrainment losses of steelhead at the south Delta facilities would be eliminated
12 under Alternative 6A compared to Existing Conditions. The impact would be less than significant
13 and may be beneficial. No mitigation would be required.

14 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
15 **Steelhead**

16 In general, Alternative 6A would have negligible effects on steelhead spawning habitat conditions
17 relative to the NEPA point of comparison.

18 **Sacramento River**

19 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
20 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
21 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*
22 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
23 incubation, and rapid reductions in flow can expose redds, leading to mortality. Flows under A6_LLT
24 throughout the period would generally be similar to or greater than those under NAA (up to 22%
25 higher) except in critical years during April (6% lower).

26 SacEFT predicts that under Alternative 6A compared to NAA (Table 11-6A-29), there would be a
27 small negative effect (-6% difference) on the percentage of years with good spawning availability
28 (measured as weighted usable area), a slightly greater improvement in redd dewatering risk (6%).
29 These results indicate that there would be a low effect of Alternative 6A on spawning habitat
30 quantity and an improved redd scour risk and no changes in temperature related egg incubation
31 conditions.

32 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
33 under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted
34 magnitude and frequency of water temperatures potentially affecting the quantity and quality of
35 spawning and incubation habitat under Alternative 1A and NAA would be comparable and would
36 therefore not affect long-term habitat conditions relative to NAA.

37 Overall in the Sacramento River, Alternative 6A would have negligible effects on water
38 temperatures, negligible effects (<5%) on mean monthly flows with the exception of several, small,
39 isolated increases and decreases (to 11%) that would not have biologically meaningful effects on
40 spawning conditions, and negligible (<5%) to small effects (to 6%) on egg survival, redd scour, and

1 redd dewatering habitat metrics computed using SacEFT, resulting in no biologically meaningful
2 effects on steelhead spawning in the Sacramento River.

3 **Table 11-6A-29. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
4 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	-3 (-4%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	0 (0%)	3 (6%)
Juvenile Rearing WUA	7 (17%)	3 (7%)
Juvenile Stranding Risk	-14 (-41%)	0 (0%)

WUA = Weighted Usable Area.

5

6 **Clear Creek**

7 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
8 (January through April). Flows under A6A_LLT would generally be similar to flows under NAA
9 throughout the period, except in below normal years during March (6% lower) (Appendix 11C,
10 *CALSIM II Model Results utilized in the Fish Analysis*).

11 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
12 monthly flow reduction would be identical between NAA and A6A_LLT for all water year types
13 (Table 11-6A-30).

14 No water temperature modeling was conducted in Clear Creek.

15 Overall in Clear Creek, project-related effects of Alternative 6A would have negligible effects (<5%)
16 on mean monthly flows, and flow reductions during the January to April steelhead spawning and egg
17 incubation period.

18 **Table 11-6A-30. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**
19 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**
20 **Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

21

1 **Feather River**

2 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
3 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
4 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
5 Flows in the low-flow channel under A6A_LLT would not differ from NAA because minimum Feather
6 River flows are included in the FERC settlement agreement and would be met for all model
7 scenarios (California Department of Water Resources 2006). Flows under A6A_LLT at Thermalito
8 Afterbay would generally be similar to or greater than flows under NAA (up to 40% higher), except
9 in critical years during January and April (24% and 7% lower, respectively).

10 Oroville Reservoir storage volume at the end of September and end of May influences flows
11 downstream of the dam during the steelhead spawning and egg incubation period. Storage volume
12 at the end of September under A6A_LLT would be greater than storage under NAA (up to 34%)
13 depending on water year type (Table 11-6A-14). May Oroville storage under A6A_LLT would be
14 similar to or greater than storage under NAA (up to 15%) (Table 11-6A-15).

15 Water temperatures in the Feather River under Alternative 6A would be the same as those under
16 Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted magnitude
17 and frequency of water temperatures potentially affecting the quantity and quality of spawning and
18 incubation habitat under Alternative 1A and NAA would be comparable and would therefore not
19 affect long-term habitat conditions relative to NAA.

20 Overall in the Feather River low-flow channel, Alternative 6A would not have any effect on mean
21 monthly flows and would have negligible effects on water temperatures. Overall in the Feather River
22 above Thermalito Afterbay, Alternative 6A would result primarily in negligible effects (<5%) on
23 mean monthly flow or increases in flow (to 40%) that would have a beneficial effect on spawning
24 conditions, with two isolated occurrences of flow reductions (to -24%) that would not have
25 biologically meaningful effects, and negligible effects on water temperatures.

26 **American River**

27 Flows in the American River at the confluence with the Sacramento River were examined for the
28 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
29 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to flows
30 under NAA during the period except in critical years during March and April (23% and 6% lower,
31 respectively) and dry years during April (15% lower) (Appendix 11C, *CALSIM II Model Results*
32 *utilized in the Fish Analysis*).

33 Water temperatures in the American River under Alternative 6A would be the same as those under
34 Alternative 1A, Impact AQUA-94, which indicates that there would be no effects of Alternative 1A
35 relative to NAA on temperatures during the periods evaluated.

36 **Stanislaus River**

37 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
38 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
39 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows under
40 NAA throughout the period.

1 Water temperatures in the American River under Alternative 6A would be the same as those under
2 Alternative 1A, Impact AQUA-94, which indicates that there would be no effects of Alternative 1A
3 relative to NAA on temperatures during the periods evaluated.

4 ***San Joaquin River***

5 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

6 ***Mokelumne River***

7 Flows in the Mokelumne River at the confluence were examined for the January through April
8 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
9 *Fish Analysis*). Flows under A6A_LLT would be the same as flows under NAA throughout the period.

10 Water temperature modeling was not conducted in the Mokelumne River.

11 ***NEPA Effects:*** Collectively, these results indicate that the effect would not be adverse because it
12 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
13 as a result of egg mortality. Effects of Alternative 6A on mean monthly flow consist of negligible
14 effects (<5%), small to moderate increases in flow (up to 40%) that would have beneficial effects on
15 spawning conditions, and isolated occurrence of decreases in flow (up to -24%) that would not have
16 biologically meaningful effects. Meaningful increases in flow that would have beneficial effects
17 during the spawning period would occur in the Feather River below Thermalito Afterbay (increases
18 up to 40%) although these increases would occur primarily in wetter water years when effects of
19 flow alterations are not as critical for spawning conditions. Results of SacEFT and flow reduction
20 analyses indicate no effect (0% change) or small effects (up to 6%) that would not have biologically
21 meaningful effects on spawning and egg incubation habitat, redd dewatering risk, and redd scour
22 risk. Alternative 6A would have negligible effects on water temperatures in all rivers evaluated
23 during the spawning and egg incubation period.

24 ***CEQA Conclusion:*** In general, under Alternative 6A water operations, the quantity and quality of
25 spawning and egg incubation habitat for steelhead would not be affected relative to the CEQA
26 baseline.

27 ***Sacramento River***

28 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
29 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
30 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*
31 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
32 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows
33 under A6A_LLT would generally be similar to or higher than Existing Conditions during January and
34 February (up to 18% higher), similar to Existing Conditions in all water year except below normal
35 (20% lower) during March, and lower than Existing Conditions during April (5% to 11% lower).
36 Upstream of Red Bluff Diversion Dam, A6A_LLT flows would generally be similar to or higher than
37 Existing Conditions throughout the period with lower flows in below normal years during March
38 and April (11% and 7%, respectively).

39 SacEFT predicts no change (0% difference) in spawning habitat, egg incubation, and redd
40 dewatering risk under Alternative 6A, and a small decrease (-7%) in percentage of years considered
41 "good" for redd scour risk (Table 11-6A-29).

1 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
2 under Alternative 1A, Impact AQUA-94. Conclusions for Alternative 1A are that the predicted
3 magnitude and frequency of water temperatures potentially affecting the quantity and quality of
4 spawning and incubation habitat under baseline conditions and Alternative 1A would be
5 comparable.

6 Overall in the Sacramento River, Alternative 6A would have negligible effects (<5%) or cause small
7 increases in mean monthly flow (to 13%), with only two isolated flow reductions (to -11%) that
8 would not affect steelhead spawning conditions in a biologically meaningful way. SacEFT indicates
9 that steelhead egg incubation and redd survival metrics would not be affected by Alternative 6A.
10 Effects of Alternative 6A on water temperature would be negligible.

11 **Clear Creek**

12 No water temperature modeling was conducted in Clear Creek.

13 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
14 (January through April). Flows under A6A_LLT would be similar to or greater than flows (up to 54%
15 higher) under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*
16 *utilized in the Fish Analysis*).

17 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
18 monthly flow reduction would be identical between Existing Conditions and A6A_LLT for all water
19 year types except wet, in which the reduction would be 38% lower (worse) under A6A_LLT than
20 under Existing Conditions (Table 11-6A-30).

21 Overall in Clear Creek, Alternative 6A would have negligible effects (<5%) or contribute to increases
22 in mean monthly flow (to 54%) that would be beneficial for steelhead spawning conditions.

23 **Feather River**

24 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
25 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
26 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
27 Flows in the low-flow channel under A6A_LLT would not differ from Existing Conditions because
28 minimum Feather River flows are included in the FERC settlement agreement and would be met for
29 all model scenarios (California Department of Water Resources 2006). Flows under A6A_LLT at
30 Thermalito Afterbay would be similar Existing Conditions in April except in dry water years (18%
31 higher) and critical water years (7% lower), lower than Existing Condition in all except wet water
32 years during January (up to 43% lower), and mixed during February and March with February
33 having lower flows in below normal and dry water years (up to 46% lower) and higher flows in wet
34 and above normal water years (up to 29% higher) and March having lower flows in below normal
35 and critical water years (up to 39% lower) and higher flows in wet and above normal water years
36 (up to 40% higher).

37 Oroville Reservoir storage volume at the end of September and end of May influences flows
38 downstream of the dam during the steelhead spawning and egg incubation period. Oroville
39 Reservoir storage volume at the end of September would be 1% to 26% lower under A6A_LLT
40 relative to Existing Conditions depending on water year type (Table 11-6A-14). May Oroville storage
41 volume under A6A_LLT would be lower than Existing Conditions by 2% to 9% depending on water
42 year type (Table 11-6A-15).

1 Water temperatures in the Feather River under Alternative 6A would be the same as those under
2 Alternative 1A, which indicates that there would be substantial increases in temperatures under
3 Alternative 1A relative to Existing Conditions during the periods evaluated.

4 Overall in the Feather River, effects of Alternative 6A on mean monthly flow would be negligible (no
5 difference) in the low-flow channel, and negligible (<5% difference) or beneficial in wetter water
6 years (increases to 40%) at Thermalito Afterbay, with small (-8%) to substantial (to -46%)
7 reductions in mean monthly flow in drier water year types for a substantial portion of the spawning
8 period (January through March). Effects of Alternative 6A on water temperature would be
9 negligible.

10 **American River**

11 Flows in the American River at the confluence with the Sacramento River were examined for the
12 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
13 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or
14 greater than flows under Existing Conditions in February and March (up to 27% higher), lower in
15 most water years in April (up to 14% lower) and mixed in January with wet and above normal years
16 having higher flows (27% higher) and below normal, dry and critical water years have lower flows
17 (up to 29% lower). Overall, these results indicate that the effects of Alternative 6A on steelhead
18 spawning and egg incubation habitat in the American River would be minor.

19 Water temperatures in the American River under Alternative 6A would be the same as those under
20 Alternative 1A, which indicates that there would be substantial increases in temperatures under
21 Alternative 1A relative to Existing Conditions during the periods evaluated.

22 **Stanislaus River**

23 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
24 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
25 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be lower than
26 Existing Conditions in all water years, ranging from -6% to -36%. There would be two isolated
27 increases in mean monthly flow, during January in above normal years (14%) and during March in
28 wet years (7%).

29 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
30 Alternative 1A, Impact AQUA-94, which indicates that temperatures under Alternative 1A would be
31 greater during the entire period evaluated relative to Existing Conditions.

32 **San Joaquin River**

33 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

34 **Mokelumne River**

35 Flows in the Mokelumne River were examined for the January through April steelhead spawning
36 and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
37 Flows under A6A_LLT would be similar to or greater than Existing Conditions during January and
38 February (up to 18% greater), similar to or lower during March (8% lower in dry water years) and g
39 lower than Existing Conditions in all water years during April (up to 14% lower).

40 Water temperature modeling was not conducted in the Mokelumne River.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between
 3 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
 4 alternative could substantially reduce suitable spawning habitat and substantially reduce the
 5 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Effects
 6 of Alternative 6A on flow consist of small to substantial decreases in mean monthly flow (up to -
 7 46%) in drier water years for a substantial portion of the spawning period (January through March)
 8 in the Feather River below Thermalito Afterbay, and persistent small to moderate (up to -36%)
 9 reductions in flow throughout the migration period in all water years in the Stanislaus River; in both
 10 locations the flow reductions would result in loss of spawning habitat and an increased potential for
 11 egg mortality. Effects of Alternative 6A on flow in the other locations analyzed include variable
 12 effects, with negligible effects or increases in flow (vto 54%) primarily in wetter water years that
 13 would have beneficial effects on spawning conditions, and small and/or moderate but isolated
 14 decreases in flow (up to -25%) that would not have biologically meaningful negative effects on
 15 spawning conditions. Results of SacEFT and flow reduction analyses indicate negligible effects
 16 (<5%), beneficial effects (reduction in month-over-month flow reductions), or small and/or
 17 infrequent effects (up to 38% change in wetter years when effects of flow reductions would be less
 18 critical for spawning success) that would not have biologically meaningful effects on redd
 19 dewatering risk for all locations analyzed. Water temperatures would increase during the evaluated
 20 periods in the Feather, American, and Stanislaus rivers.

21 These results are primarily caused by four factors: differences in sea level rise, differences in climate
 22 change, future water demands, and implementation of the alternative. The analysis described above
 23 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
 24 the alternative from those of sea level rise, climate change and future water demands using the
 25 model simulation results presented in this chapter. However, the increment of change attributable
 26 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
 27 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
 28 implementation period, which does include future sea level rise, climate change, and water
 29 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
 30 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
 31 effect of the alternative from those of sea level rise, climate change, and water demands.

32 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
 33 term implementation period and Alternative 6A indicates that flows in the locations and during the
 34 months analyzed above would generally be similar between Existing Conditions during the LLT and
 35 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
 36 found above would generally be due to climate change, sea level rise, and future demand, and not
 37 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
 38 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
 39 result in a significant impact on spawning and egg incubation habitat for steelhead. This impact is
 40 found to be less than significant and no mitigation is required.

41 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

42 In general, Alternative 6A would not reduce the quantity and/or quality of steelhead rearing habitat
 43 relative to NAA.

1 **Sacramento River**

2 Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream
3 to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in
4 flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the
5 reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to
6 upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
7 *Analysis*). Flows during January through July and December would be generally similar to NAA, flows
8 in August through November would generally be lower than NAA in most water years (up to 16%)
9 with greater flows in wet years during July (8% higher) and critical years during September (9%
10 greater).

11 SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions
12 under A6A_LLT would be 7% higher than that under NAA (Table 11-6A-29). Also, the percentage of
13 years with good (lower) juvenile stranding risk conditions under A6A_LLT would be the same as
14 under NAA. These results indicate that Alternative 6A would cause a small increase in rearing
15 habitat conditions and no increase in juvenile mortality risk resulting from stranding in the
16 Sacramento River.

17 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
18 under Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A are that the predicted
19 magnitude and frequency of water temperatures potentially affecting the quantity and quality of
20 rearing habitat under relative to NAA and Alternative 1A would be comparable.

21 Overall in the Sacramento River, Alternative 6A would have negligible effects on juvenile steelhead
22 rearing conditions based on negligible effects (<5%) or small negative effects on minimum instream
23 flows (-9% in critical years), and beneficial effects through a small increase (7%) in the number of
24 years classified as “good” rearing habitat, no effect on juvenile stranding risk, and negligible effects
25 on water temperature.

26 **Clear Creek**

27 No water temperature modeling was conducted in Clear Creek.

28 Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under
29 A6A_LLT would generally be similar to flows under NAA except for two total water years with
30 higher flows (up to 15% higher) and two total water years with lower flows (up to 8% lower
31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 It was assumed that habitat for juvenile steelhead rearing would be constrained by the month
33 having the lowest instream flows. Juvenile rearing habitat is assumed to increase as instream flows
34 increase, and therefore the lowest monthly instream flow was used as an index of habitat
35 constraints for juvenile rearing. Results of the analysis indicate that juvenile steelhead rearing
36 habitat, based on minimum instream flows, is comparable for Alternative 6A relative to NAA in all
37 water year types except that it is higher (10%) in critical water year types (Table 11-6A-31).

38 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-
39 1A-4). The current Clear Creek management regime uses flows slightly lower than those
40 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being
41 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We

1 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.
2 No change in effect on steelhead in Clear Creek is anticipated.

3 Overall, these results indicate that Alternative 6A would not affect juvenile rearing conditions in
4 Clear Creek

5 **Table 11-6A-31. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during**
6 **the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	0 (0%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	-7 (-8%)	7 (10%)

Note: Minimum flows occurred between October and March.

7
8 **Feather River**

9 Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay
10 (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing
11 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is
12 the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al.
13 2003). Relatively constant flows in the low flow channel throughout the year under A6A_LLT would
14 not differ from those under NAA. In the high flow channel, flows under A6A_LLT compared to NAA
15 would be mostly equal to or higher during January through June, August and September (up to 40%
16 higher), equal to or lower during October and November (up to 13% lower), and lower in lower July
17 (up to 43% lower).

18 May Oroville storage under A6A_LLT would be similar to or greater than (up to 15% higher) storage
19 under NAA (Table 11-6A-15). September Oroville storage volume would be up to 34% greater than
20 under NAA depending on water year type (Table 11-6A-14).

21 Water temperatures in the Feather River low-flow and high-flow channel under Alternative 6A
22 would be the same as those under Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A
23 are that the predicted magnitude and frequency of water temperatures potentially affecting the
24 quantity and quality of rearing habitat under NAA and Alternative 1A would be comparable.

25 Overall in the Feather River, Alternative 6A would have negligible effects in the low-flow channel and
26 would not have biologically meaningful effects on juvenile rearing conditions at that location.
27 Alternative 6A would have negligible effects on water temperature in the low-flow or the high-flow
28 channel. In the high-flow channel, Alternative 6A would cause variable effects on mean monthly flow
29 with small to substantial increases and decreases depending on specific month and water year type.
30 There would be moderate to substantial (to -43%) decreases in mean monthly flows in drier water
31 years, when effects of flow reductions would be more critical for rearing success, during six months
32 of the year (December–January, April–July) that would have negative effects on juvenile steelhead
33 rearing conditions. These would be offset by increases (to 279%) in drier water years during some
34 months (February, March, June, September, October), such that net effects are not expected to have
35 biologically meaningful negative effects on rearing success in the Feather River.

1 **American River**

2 Flows in the American River at the confluence with the Sacramento River were examined for the
3 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A6A_LLT would generally be similar to or greater than flows under NAA
5 during May, August, October and December, equal to or lower than flows under NAA during March,
6 April, June and November and lower than flows under NAA during July and September.

7 Water temperatures in the American River under Alternative 6A would be the same as those under
8 Alternative 1A, Impact AQUA-95. Conclusions for Alternative 1A are that the predicted magnitude
9 and frequency of water temperatures potentially affecting the quantity and quality of rearing habitat
10 under NAA and Alternative 1A would be comparable.

11 Overall in the American River, Alternative 6A would result in primarily negligible effects (<5%) on
12 mean monthly flow during most of the year. The most critical effect of flow reductions on rearing
13 conditions, reductions in flow below 1,500 cfs in the warmer months, would not occur due to
14 project-related effects under Alternative 6A. Therefore, Alternative 6A would not cause flow
15 reductions that would eliminate riffle habitat, or reductions in mean monthly flow that would
16 increase the potential for loss of juvenile rearing habitat, degradation of habitat conditions, or
17 stranding of juveniles.

18 **Stanislaus River**

19 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
20 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
21 *Analysis*). Flows under A6A_LLT would be similar to flows under NAA for the entire year except for
22 increases in dry and critical water years during June.

23 Water temperatures in the American River under Alternative 6A would be the same as those under
24 Alternative 1A, Impact AQUA-95, which indicates that there would be no effect of Alternative 1A on
25 temperatures during the period evaluated relative to NAA.

26 **San Joaquin River**

27 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing
28 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT
29 would be similar to flows under NAA throughout the period.

30 Water temperature modeling was not conducted in the San Joaquin River.

31 **Mokelumne River**

32 Flows in the Mokelumne River for Alternative 6A were examined for the year-round steelhead
33 rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) and the flows
34 would not be different from those under NAA throughout the period.

35 Water temperature modeling was not conducted in the Mokelumne River.

36 **NEPA Effects:** Collectively these results indicate that the effect would not be adverse because it
37 would not substantially reduce rearing habitat or substantially reduce the number of fish as a result
38 of ammocoete mortality. Alternative 6A would not have project-related effects on water
39 temperatures in any of the locations analyzed, and effects on flow would not be adverse for juvenile

1 rearing conditions at any of the locations analyzed based on primarily negligible project-related
2 effects on mean monthly flow (<5%) with small increases (to 23%) that would have beneficial
3 effects or small (to -10%) and/or isolated decreases (to -32%) throughout the year that would not
4 have biologically meaningful effects on rearing success, and negligible effects (<5%), small-scale
5 negative effects (to -11%), or beneficial effects (10%) on SacEFT rearing conditions metrics and
6 minimum instream flows that indicate stranding potential. The Feather River would experience
7 more variable changes in mean monthly flow, with decreases to -43% and increases to 270%
8 throughout the year depending on specific month and water year type. Flow reductions would not
9 be persistent enough to cause biologically meaningful negative effects in the Feather River.

10 **CEQA Conclusion:** In general, Alternative 6A would not reduce the quantity or quality of steelhead
11 rearing habitat relative to the Existing Conditions.

12 **Sacramento River**

13 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and
14 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM*
15 *II Model Results utilized in the Fish Analysis*). Flows during January, February, June and July under
16 A6A_LLT would generally be similar to or greater than those under Existing Conditions. Flows
17 during March and November would be similar to or lower than those under Existing Conditions.
18 Flows during May, September and October would be mixed with some water years below and some
19 water years above Existing Conditions. Flows during April, August and December would generally
20 be lower under A6A_LLT than under Existing Conditions.

21 SacEFT predicts that there would be a 17% increase in the percentage of years with good rearing
22 availability, measured as weighted usable area, under A6A_LLT relative to Existing Conditions
23 (Table 11-6A-29) and a substantial reduction (-41%) in the number of years with good (lower)
24 juvenile stranding risk under A6A_LLT relative to Existing Conditions.

25 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
26 under Alternative 1A, Impact AQUA-95, which indicates that temperatures would generally not be
27 affected by Alternative 1A relative to Existing Conditions.

28 Overall in the Sacramento River, Alternative 6A would have negligible effects on water temperature,
29 but would result in substantial increased risk of juvenile stranding (-41%) and moderate reductions
30 in minimum flows in drier water years (to -27%) when effects of flow reductions have the greatest
31 potential to affect rearing conditions.

32 **Clear Creek**

33 No water temperature modeling was conducted in Clear Creek.

34 Flows in Clear Creek during the year-round rearing period under A6A_LLT would generally be
35 similar to or greater than flows under Existing Conditions, except for critical years in August
36 through November in which flows would be 6% to 28% lower and in below normal years in October
37 when flows would be 6% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

38 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and
39 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile
40 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream
41 flows affecting juvenile rearing habitat are shown in Table 11-6A-31. Results indicate that

1 Alternative 6A would have no effect on juvenile rearing habitat, based on minimum instream flows,
2 compared to Existing Conditions in all water years except for that they would be 8% lower in critical
3 water years.

4 These results indicate that the effects of Alternative 6A on flows consist primarily of negligible or
5 beneficial effects (increases in mean monthly flow to 54%) with only infrequent, small to moderate
6 flow reductions (-6% to -28%) that would not have biologically meaningful effects on juvenile
7 rearing habitat in Clear Creek.

8 **Feather River**

9 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and
10 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 6A relative to
11 Existing Conditions in the low-flow channel during the year-round steelhead juvenile rearing period
12 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at
13 Thermalito Afterbay), flows under A6A_LLT would be mostly lower (up to 45% lower) during
14 January, July, October, November and December, mostly similar to or higher (up to 161% higher) in
15 August and September, and mixed with some water years higher and some lower in February,
16 March, April, May and June.

17 Water temperatures in the Feather River under Alternative 6A would be the same as those under
18 Alternative 1A, Impact AQUA-95, which indicate that temperatures would increase under
19 Alternative 1A during the year-round period relative to Existing Conditions.

20 Overall in the Feather River, Alternative 6A would have negligible effects on juvenile rearing
21 conditions in the low-flow channel based on results of effects on water temperatures and mean
22 monthly flows. In the high-flow channel, Alternative 6A would have variable effects with
23 occurrences of beneficial effects on rearing conditions through increases in flow in wetter water
24 years during February and March, and drier years during May, and all water year types in August
25 and September (to 161%). However, Alternative 6A would cause persistent, small to substantial
26 decreases in mean monthly flow (to -45%) for nine out of twelve months of the year in drier water
27 years when effects of flow reductions would be most critical for rearing conditions. Alternative 6A
28 would increase water temperatures in the Feather River.

29 **American River**

30 Flows in the American River at the confluence with the Sacramento River were examined for the
31 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
32 Analysis*). Flows under A6A_LLT would be generally lower than flows under Existing Conditions (up
33 to 45% lower) during April through September, November and December, generally higher flows in
34 February and March (up to 27% higher), and mixed higher and lower flows depending on water
35 year in January.

36 Water temperatures in the American River under Alternative 6A would be the same as those under
37 Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under
38 Alternative 1A during the year-round period relative to Existing Conditions.

39 Overall in the American River, Alternative 6A would cause substantial flow reductions (to -57%) for
40 much of the year (depending on water year type), including various months throughout the year in
41 drier water years and the warmer summer months in all water years. Increases in flow (to 27%)
42 during January to March in wetter years and other isolated increases in some drier water years (to

1 32%) would have small beneficial effects but would not offset the prevalence of reductions in flow
2 predicted for other months and water year types. It is also predicted that Alternative 6A would
3 result in flows less than 1,500 cfs when flows would not be that low in Existing Conditions during
4 June in critical years, August in dry years, and September in below normal and dry years, meaning
5 that Alternative 6A would result in reduced availability of riffle habitat for these time-frames.

6 ***Stanislaus River***

7 Flows in the Stanislaus River for Alternative 6A are generally lower than Existing Conditions in most
8 water years in all months except that they are higher in above normal years in January, in wet years
9 in March and June and in below normal years in December (Appendix 11C, *CALSIM II Model Results*
10 *utilized in the Fish Analysis*).

11 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
12 Alternative 1A, Impact AQUA-95, which indicates that temperatures would increase under
13 Alternative 1A relative to Existing Conditions during most of the year-round period.

14 ***San Joaquin River***

15 Flows in the San Joaquin River for Alternative 6A are generally lower than Existing Conditions in
16 most water years in all months except that they are higher in above normal years in January and in
17 wet years in January and February (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
18 *Analysis*).

19 Water temperature modeling was not conducted in the San Joaquin River.

20 ***Mokelumne River***

21 Flows in the Mokelumne River for Alternative 6A are generally lower than Existing Conditions in all
22 months and all water years except that they are generally higher in January and February (up to
23 18% higher depending on water year) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
24 *Analysis*).

25 Water temperature modeling was not conducted in the Mokelumne River.

26 **Summary of CEQA Conclusion**

27 Collectively, the results of the Impact AQUA-95 CEQA analysis indicate that the difference between
28 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
29 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
30 a result of juvenile mortality contrary to the NEPA conclusion set forth above. Effects of Alternative
31 6A on flow would affect juvenile steelhead rearing habitats in the Sacramento River, Feather River
32 below Thermalito Afterbay, American River, and Stanislaus River through persistent reductions in
33 mean monthly flow (to -57%) that would be prevalent for much of the rearing period and
34 particularly during drier water year types and in the warmer summer and early fall months. Effects
35 of Alternative 6A on flows in Clear Creek would not be as substantial. Alternative 6A would also
36 have substantial effects on stranding risk based on SacEFT metrics (decrease in years classified as
37 "good" in terms of stranding risk of -41%) and reduction of minimum instream flows in the
38 Sacramento River. Increased potential for stranding would lead to increased potential for juvenile
39 mortality through desiccation or predation. Effects of Alternative 6A on flow would reduce flows to
40 less than 1,500 cfs in some months and water year types during the summer months in the

1 American River, reducing available riffle habitat and therefore decreasing suitable rearing habitat.
2 Temperatures in the Feather, American, and Stanislaus River would increase under Alternative 6A
3 relative to the CEQA baseline.

4 These results are primarily caused by four factors: differences in sea level rise, differences in climate
5 change, future water demands, and implementation of the alternative. The analysis described above
6 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
7 the alternative from those of sea level rise, climate change and future water demands using the
8 model simulation results presented in this chapter. However, the increment of change attributable
9 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
10 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
11 implementation period, which does include future sea level rise, climate change, and water
12 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
13 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
14 effect of the alternative from those of sea level rise, climate change, and water demands.

15 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
16 term implementation period and Alternative 6A indicates that flows in the locations and during the
17 months analyzed above would generally be similar between Existing Conditions during the LLT and
18 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
19 found above would generally be due to climate change, sea level rise, and future demand, and not
20 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
21 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
22 result in a significant impact on rearing habitat for steelhead. This impact is found to be less than
23 significant and no mitigation is required.

24 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

25 **Upstream of the Delta**

26 In general, Alternative 6A would reduce steelhead migration conditions relative to NAA.

27 ***Sacramento River***

28 *Juveniles*

29 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
30 May juvenile steelhead migration period. Flows under A6A_LLTT would be higher than NAA in some
31 water years in January, February and April (up to 22% higher), similar to NAA flows in March and
32 May, and 6% to 16% lower than flows under NAA during October through December, and generally
33 similar in March and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
35 under Alternative 1A, which indicates that temperatures would not be different under Alternative
36 1A during the periods evaluated relative to NAA.

37 *Adults*

38 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
39 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*
40 *the Fish Analysis*). Flows under A6A_LLTT would be higher than NAA in some water years in January,

1 February and April (up to 22% higher), similar to NAA flows in March, and 6% to 17% lower than
2 flows under NAA during September through December and generally similar in March (Appendix
3 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 *Kelts*

5 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
6 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the
7 Fish Analysis*). Flows during these two months would be minimally different between NAA and
8 A6A_LLТ with lower flows in critical years during April (5% lower) and higher flows in above
9 normal (6%) in April.

10 **Clear Creek**

11 Water temperatures were not modeled in Clear Creek.

12 *Juveniles*

13 Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period
14 under A6A_LLТ would be similar to flows under NAA except in below normal years in March (6%
15 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16 *Adults*

17 Flows in Clear Creek during the September through March adult steelhead migration period under
18 A6A_LLТ would be similar to flows under NAA except in below normal years in March (6% lower)
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 *Kelts*

21 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
22 under A6A_LLТ would be similar to flows under NAA except in below normal years in March (6%
23 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 Overall, these results indicate that juvenile, adult, or kelt steelhead migration conditions in Clear
25 Creek would not be affected by Alternative 6A.

26 **Feather River**

27 Water temperatures in the Feather River under Alternative 6A would be the same as those under
28 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
29 during the periods evaluated relative to NAA.

30 *Juveniles*

31 Flows in the Feather River at the confluence with the Sacramento River were examined during the
32 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results
33 utilized in the Fish Analysis*). Flows under A6A_LLТ would generally be similar to flows under NAA
34 during March and April, similar to or greater than flows under NAA during February (up to 16%
35 higher), less than NAA during October and December (up to 18% lower), similar to or less than
36 during May and November (up to 14% lower), and mixed lower and higher flows depending on
37 water year during January and September.

1 **Adults**

2 Flows in the Feather River at the confluence with the Sacramento River were examined during the
3 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
4 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to flows under
5 NAA during March, similar to or greater than NAA flows during February (up to 16% higher), similar
6 to or lower than NAA lows during November (9% lower), and mixed lower and higher flows
7 depending on water year during January and September.

8 **Kelts**

9 Flows in the Feather River at the confluence with the Sacramento River were examined during the
10 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
11 *Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar to those under NAA
12 during March and April although 10% greater than NAA for above normal years in March.

13 Overall, these results indicate that there would be negligible effects of Alternative 6A on steelhead
14 juvenile, adult, and kelt migration conditions. There would be some flow-based beneficial effects in
15 some months

16 **American River**

17 Water temperatures in the American River under Alternative 6A would be the same as those under
18 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
19 during the periods evaluated relative to NAA.

20 **Juveniles**

21 Flows in the American River at the confluence with the Sacramento River were evaluated during the
22 October through May juvenile steelhead migration period. Flows under A6A_LLT would generally be
23 similar to or greater than flows under NAA during October, December, January, February, and May
24 (up to 17% higher), and similar to or lower than flows under NAA during November, March and
25 April (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 **Adults**

27 Flows in the American River at the confluence with the Sacramento River were evaluated during the
28 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
29 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be similar to or
30 greater than flows under NAA during October, December, January, February, and May (up to 17%
31 higher), and similar to or lower than flows under NAA during September, November and March (up
32 to 32% lower).

33 **Kelts**

34 Flows in the American River at the confluence with the Sacramento River were evaluated for the
35 March and April kelt migration period. Flows under A6A_LLT would generally be similar to or lower
36 than flows under NAA (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
37 *Analysis*).

38 Overall in the American River, Alternative 6A would have negligible effects on water temperatures
39 and effects on flow consist of negligible effects (<5%), increases in flow (to 17%) that would have a

1 beneficial effect on migration conditions, or infrequent, small-magnitude and/or isolated decreases
2 in flow (to -32%) that would not have biologically meaningful effects on juvenile, adult, or kelt
3 steelhead migration in the American River.

4 ***Stanislaus River***

5 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
6 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
7 during the periods evaluated relative to NAA.

8 *Juveniles*

9 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the
10 October through May juvenile steelhead migration period. Flows under A6A_LLT would be similar to
11 flows under NAA during the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
12 *Analysis*).

13 *Adults*

14 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the
15 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
16 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be similar flows under NAA
17 during the entire period.

18 *Kelts*

19 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
20 March and April kelt migration period. Flows under A6A_LLT would be similar to under NAA for
21 both months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 ***San Joaquin River***

23 Water temperature modeling was not conducted in the San Joaquin River.

24 *Juveniles*

25 Flows in the San Joaquin River at Vernalis were evaluated during the October through May juvenile
26 steelhead migration period. Flows under A6A_LLT would be similar to flows under NAA during the
27 entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 *Adults*

29 Flows in the San Joaquin River at Vernalis were evaluated during the September through March
30 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
31 *Fish Analysis*). Flows under A6A_LLT would be similar flows under NAA during the entire period.

32 *Kelts*

33 Flows in the San Joaquin River at Vernalis were evaluated for the March and April kelt migration
34 period. Flows under A6A_LLT would be similar to under NAA for both months (Appendix 11C,
35 *CALSIM II Model Results utilized in the Fish Analysis*).

1 **Mokelumne River**

2 Water temperature modeling was not conducted in the Mokelumne River.

3 *Juveniles*

4 Flows in the Mokelumne River were evaluated during the October through May juvenile steelhead
5 migration period. Flows under A6A_LLT would be similar to flows under NAA during the entire
6 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 *Adults*

8 Flows in the Mokelumne River were evaluated during the September through March steelhead adult
9 upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
10 Flows under A6A_LLT would be similar flows under NAA during the entire period.

11 *Kelts*

12 Flows in the Mokelumne River were evaluated for the March and April kelt migration period. Flows
13 under A6A_LLT would be similar to under NAA for both months (Appendix 11C, *CALSIM II Model*
14 *Results utilized in the Fish Analysis*).

15 **Through-Delta**

16 ***Sacramento River***

17 *Juveniles*

18 During the juvenile steelhead emigration period (October to May), mean monthly flows in the
19 Sacramento River below the north Delta intakes under Alternative 6A averaged across years would
20 be lower (15% to 28% lower) compared to NAA. Flows would be up to 34% lower in April of above
21 normal years. Juvenile steelhead and juvenile winter-run Chinook salmon migrate downstream
22 during the same months and would be exposed to similar conditions. As discussed above in Impact
23 AQUA-42, the five north Delta intakes structures of Alternative 1A would increase potential
24 predation loss of migrating juvenile salmonids and would displace 22 acres of aquatic habitat.
25 Losses of juvenile winter-run Chinook salmon were estimated ranging from 2% up to 18.5% of
26 annual production (Impact AQUA_42). However, juvenile steelhead would be less vulnerable than
27 winter-run Chinook salmon to predation associated with the intake facilities because of their greater
28 size and strong swimming ability.

29 *Adults*

30 Little information apparently currently exists as to the importance of Plan Area flows on the straying
31 of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon
32 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of
33 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including
34 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region
35 steelhead adults as well.

36 The percentage of water at Collinsville that originated from the San Joaquin River during the
37 steelhead migration period (September to March) is small, typically less than 3% under NAA
38 conditions. Alternative 6A operations conditions would increase olfactory cues associated with the

1 San Joaquin River approximately 5% to 10%, which would benefit adult steelhead migrating to the
2 San Joaquin River.

3 ***San Joaquin River***

4 *Juveniles*

5 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of
6 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.
7 There no flow changes associated with the Alternatives. Alternative 6A would have no effect on
8 steelhead migration success through the Delta.

9 *Adults*

10 Alternative 6A would slightly increase the proportion of San Joaquin River water in the Delta in
11 September through December by about 5–10% (compared to NAA) (Table 11-6A-28). The increase
12 in the proportion of San Joaquin River water at Collinsville would be a result of a concomitant
13 reduction in the proportion of Sacramento River flows in the Delta and the elimination of water
14 exports from the south Delta. Therefore migration conditions under Alternative 6A would be similar
15 or slightly improved relative to NAA. Alternative 6A would have no effect to a slight beneficial effect
16 on the adult steelhead and kelt migration.

17 ***NEPA Effects:*** Overall, the results indicate that the effect of Alternative 6A is adverse due to the
18 cumulative effects associated with five north Delta intake facilities, including mortality related to
19 near-field effects (e.g. impingement and predation) and far-field effects (reduced survival due to
20 reduced flows downstream of the intakes) associated with the five NDD intakes.

21 Upstream of the Delta, flow and water temperature conditions under Alternative 6A would generally
22 be similar to those under Existing Conditions in all rivers examined.

23 Adult attraction flows in the Delta under Alternative 6A would be lower than those under NAA, but
24 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

25 Near-field effects of Alternative 6A NDD on steelhead from the Sacramento River and tributaries
26 related to impingement and predation associated with five new intakes could result in substantial
27 effects on juvenile migrating steelhead, although there is high uncertainty regarding the potential
28 effects. Estimates within the effects analysis range from very low levels of effects (~2% mortality) to
29 very significant effects (~ 19% mortality above current baseline levels). CM15 would be
30 implemented with the intent of providing localized and temporary reductions in predation pressure
31 at the NDD. Additionally, several pre-construction surveys to better understand how to minimize
32 losses associated with the five new intake structures will be implemented as part of the final NDD
33 screen design effort. Alternative 6A also includes an Adaptive Management Program and Real-Time
34 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide
35 adequate migration conditions for steelhead. However, at this time, due to the absence of
36 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality
37 expected from near-field effects at the NDD remains highly uncertain.

38 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
39 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
40 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 6A
41 predict improvements in smolt condition and survival associated with increased access to the Yolo

1 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
2 of each of these factors and how they might interact and/or offset each other in affecting salmonid
3 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

4 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
5 all of these elements of BDCP operations and conservation measures to predict smolt migration
6 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
7 migration survival under Alternative 6A would be similar to survival rates estimated for NAA.
8 Further refinement and testing of the DPM, along with several ongoing and planned studies related
9 to salmonid survival at and downstream of the NDD are expected to be completed in the foreseeable
10 future. These efforts are expected to improve our understanding of the relationships and
11 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
12 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
13 Until these efforts are completed and their results are fully analyzed, the overall effect of Alternative
14 6A on steelhead through-Delta survival remains uncertain.

15 Therefore, primarily as a result of unacceptable levels of uncertainty regarding the cumulative
16 impacts of near-field and far-field effects associated with the presence and operation of the five
17 intakes on steelhead, this effect is adverse.

18 While the implementation of the conservation and mitigation measures described below would
19 address these impacts, these measures are not anticipated to reduce the impact to a level considered
20 not adverse.

21 **CEQA Conclusion:** In general, Alternative 6A would have negligible effects on steelhead migration
22 conditions relative to Existing Conditions, upstream of the Delta, through-Delta on the Sacramento
23 River and through-Delta on the San Joaquin River.

24 **Upstream of the Delta**

25 ***Sacramento River***

26 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
27 under Alternative 1A, which indicates that temperatures would not be different under Alternative
28 1A during the periods evaluated relative to Existing Conditions.

29 *Juveniles*

30 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
31 May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
32 *Analysis*). Flows under A6A_LLT would be similar to or lower than Existing Conditions during
33 December, March, April and May (up to 7% lower), similar to or greater than Existing Conditions
34 during October, January and February (up to 13% higher), and mixed in May with higher and lower
35 flows.

36 *Adults*

37 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
38 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*
39 *the Fish Analysis*). Flows under A6A_LLT would be similar to or lower than Existing Conditions
40 during December and March (up to 11% lower), similar to or greater than Existing Conditions

1 during October, January, and February (up to 13% higher) and mixed in September with higher and
2 lower flows.

3 ***Kelts***

4 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
5 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
6 *Fish Analysis*). Flows under A6A_LLT would be similar to or lower flows than under Existing
7 Conditions in March and April (up to 11% lower).

8 Overall in the Sacramento River, these results indicate that there would be no biologically
9 meaningful impacts of Alternative 6A on juvenile, adult, and kelt migration.

10 ***Clear Creek***

11 Water temperatures were not modeled in Clear Creek.

12 ***Juveniles***

13 Flows in Clear Creek during the October through May juvenile steelhead migration period under
14 A6A_LLT would generally be similar to or greater than flows under Existing Conditions (up to 54%
15 greater) during December through May and similar to or lower than Existing Conditions during
16 October and November (up to 6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
17 *Analysis*).

18 ***Adults***

19 Flows in Clear Creek during the September through March adult steelhead migration period under
20 A6A_LLT would generally be similar to or greater than flows under Existing Conditions (up to 54%
21 greater) during December through March and similar to or lower than Existing Conditions during
22 September through November (up to 28% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
23 *the Fish Analysis*).

24 ***Kelt***

25 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
26 under A6A_LLT would be similar to or greater than flows under Existing Conditions (up to 29%
27 higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 ***Feather River***

29 Water temperatures in the Feather River under Alternative 6A would be the same as those under
30 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
31 during the periods evaluated relative to Existing Conditions.

32 ***Juveniles***

33 Flows in the Feather River at the confluence with the Sacramento River were examined during the
34 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
35 *utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under
36 Existing Conditions during October through January and May (up to 36% lower), similar or lower
37 flows during April (up to 6% lower), and mixed flows during March with lower flows in below
38 normal and critical water years (15% and 18%, respectively).

1 **Adults**

2 Flows in the Feather River at the confluence with the Sacramento River were examined during the
3 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
4 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be greater than flows under
5 Existing Conditions during September (up to 63% higher), generally lower than flows under Existing
6 Conditions during October through January (up to 36% lower), and mixed flows during March with
7 lower flows in below normal and critical water years (15% and 18%, respectively).

8 **Kelt**

9 Flows in the Feather River at the confluence with the Sacramento River were examined during the
10 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
11 *Results utilized in the Fish Analysis*). Flows under A6A_LLT compared to Existing Conditions would
12 be mixed during March (up to 19% higher and 15% lower) and similar to lower during April (up to
13 6% lower).

14 Overall, these results indicate that migration conditions for steelhead in the Feather River would be
15 degraded by Alternative 6A. Flows would be lower during a substantial portion of the juvenile and
16 adult migration period, although there would be no other effects in the Feather River.

17 **American River**

18 Water temperatures in the Feather River under Alternative 6A would be the same as those under
19 Alternative 1A, which indicates that temperatures would higher under Alternative 1A during
20 substantial portions of the juvenile and adult migration periods relative to Existing Conditions.

21 **Juveniles**

22 Flows in the American River at the confluence with the Sacramento River were evaluated during the
23 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
24 *utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than flows under
25 Existing Conditions during October through December, April and May (up to 34% lower), similar to
26 or greater than flows under Existing Conditions during October, February and March (up to 27%
27 higher) except in critical years in February and March (8% and 25% lower, respectively).

28 **Adults**

29 Flows in the American River at the confluence with the Sacramento River were evaluated during the
30 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
31 *Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would be generally lower than
32 flows under Existing Conditions during September through December (up to 57% lower), similar to
33 or greater than flows under Existing Conditions during October, February and March (up to 27%
34 higher) except in critical years in February and March (8% and 25% lower, respectively).

35 **Kelt**

36 Flows in the American River at the confluence with the Sacramento River were evaluated for the
37 March and April kelt migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
38 *Analysis*). Flows under A6A_LLT would generally be similar to or higher than Existing Conditions
39 during March (up to 15% higher) except in critical years when they would be lower (25% lower)
40 and less than Existing Conditions in April (up to 14% lower).

1 Overall, these results indicate that Alternative 6A would reduce juvenile and adult migration
2 conditions during a portion of their respective migration periods, but not kelt migration.

3 ***Stanislaus River***

4 Water temperatures in the Stanislaus River under Alternative 6A would be the same as those under
5 Alternative 1A, which indicates that temperatures would not be different under Alternative 1A
6 during substantial portions of the periods evaluated relative to Existing Conditions.

7 Flows in the Stanislaus River for Alternative 6A are substantially below those under Existing
8 Conditions for juveniles, adults or kelts (e.g., 29% lower in critical water years during March).

9 ***San Joaquin River***

10 Flows in the San Joaquin River for Alternative 6A are substantially below those under Existing
11 Conditions for juveniles, adults or kelts (e.g., 16% lower in below normal years during March and
12 38% lower in wet years during May) except for similar or slightly lower flow conditions during
13 November and December and somewhat higher flow conditions in some water years during January
14 (up to 11% higher).

15 Water temperature modeling was not conducted in the San Joaquin River.

16 ***Mokelumne River***

17 Flows in the Mokelumne River for Alternative 6A are substantially below those under Existing
18 Conditions for juveniles, adults or kelts (e.g., 14% lower in dry water years during November)
19 except for somewhat higher flow conditions in some water years during January and February (up
20 to 18% higher) and generally higher flows for all water years in December (up to 15% higher).

21 Water temperature modeling was not conducted in the Mokelumne River.

22 **Through-Delta**

23 ***Sacramento River***

24 *Juveniles*

25 Juveniles migrating down the Sacramento River would generally experience lower flows below the
26 north Delta intakes compared to Existing Conditions. DPM results for Chinook salmon for
27 Alternative 6A indicate juvenile salmonid survival would be reduced by less than 1%. Assuming
28 similar results for steelhead juveniles, Alternative 6A would have a less-than-significant impact on
29 steelhead outmigration through the Delta. No mitigation would be required.

30 *Adults*

31 For Sacramento River steelhead, straying rates of adult hatchery-origin Chinook salmon that were
32 released upstream of the Delta are low (Marston et al. 2012). Although straying rates for hatchery-
33 origin steelhead apparently have not been examined in detail, for this analysis of effects, it was
34 assumed with high certainty (based on Chinook salmon rates), that Plan Area flows in relation to
35 straying have low importance under Existing Conditions for adult Sacramento River region
36 steelhead.

1 As assessed by DSM2 fingerprinting analysis, the average percentage of Sacramento River–origin
2 water at Collinsville was always slightly lower under Alternative 6A than for Existing Conditions
3 during the September-March steelhead upstream migration period. Attraction flow, as estimated by
4 the percentage of Sacramento River water at Collinsville, under Alternative 6A range from an
5 increase of 3% to a decline of 14% during the October to March migration period for steelhead
6 adults (Table 11-6A-9). The reductions in percentage during two of the seven months (February and
7 March) are modest in comparison with the magnitude of change in dilution reported to cause a
8 significant change in migration by Fretwell (1989) and, therefore, are not expected to substantially
9 affect steelhead migration. While the proportion of Sacramento River flows would be reduced under
10 Alternative 6A, the Sacramento River would still represent 63% to 69% of Delta flows and olfactory
11 cues would still be strong for upstream migrating adults. However, uncertainty remains with regard
12 to adult salmon behavioral response to anticipated changes in lower Sacramento River flow
13 percentages. For further discussion of the topic see the analysis for Alternative 1A.

14 ***San Joaquin River***

15 *Juveniles*

16 The only changes on San Joaquin River flows at Vernalis would result from the modeled effects of
17 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.
18 There no flow changes associated with the Alternatives. Alternative 6A would have no effect on
19 steelhead migration success through the Delta.

20 *Adults*

21 Little information apparently currently exists as to the importance of Plan Area flows on the straying
22 of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon
23 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of
24 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including
25 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region
26 steelhead adults as well.

27 The percentage of water at Collinsville that originated from the San Joaquin River during the
28 steelhead migration period (September to March) is small, typically less than 3% under Existing
29 Conditions. Alternative 6A operations conditions would increase olfactory cues associated with the
30 San Joaquin River approximately 5% to 10%, which would benefit adult steelhead migrating to the
31 San Joaquin River.

32 **Summary of CEQA Conclusion**

33 The results of the Impact AQUA-96 analysis indicate generally similar impacts between Alternative
34 6A and Existing Conditions on locations upstream of the Delta, through-Delta conditions on the
35 Sacramento River and through-Delta conditions on the San Joaquin River.

36 Through the Delta, Alternative 6A would result in some effects on flow conditions, during steelhead
37 migration periods (juvenile, adult and kelt), although these effects would not be substantial in both
38 the Sacramento River and San Joaquin River. Similarly, olfactory effects are not expected to be
39 substantial in both locations. Consequently, the through Delta impacts of Alternative 6A in both the
40 Sacramento River and the San Joaquin River would be less than significant and no mitigation is
41 required.

1 Collectively, the analysis indicates that the difference between the CEQA baseline and Alternative 6A
2 upstream of the Delta could be significant because, under the CEQA baseline, the alternative could
3 substantially reduce the amount of suitable habitat and substantially interfere with steelhead
4 migrations. Alternative 6A would negatively affect juvenile and adult migration conditions in the
5 Feather River at Thermalito Afterbay (based on decreases in flow consisting of small to substantial
6 effects, to -46%, including in drier water year types), the American River (based on decreases in
7 flow for September through March, to -57%), and the Stanislaus River (based on persistent
8 decreases in flow to -36%). Alternative 6A would also affect kelt migration in the Stanislaus River
9 (based on persistent flow reductions to -30%), but would not have biologically meaningful effects on
10 kelt migration conditions in the other rivers analyzed. Alternative 6A would not have biologically
11 meaningful effects on juvenile, adult, or kelt migration in the Sacramento River, Clear Creek, or the
12 Feather River at the confluence; despite some variability in effects of Alternative 6A on flow for
13 these locations, flow reductions would not be consistent or of the magnitude expected to result in
14 biologically meaningful negative effects on migration conditions. Temperatures would be higher
15 under Alternative 6A relative to Existing Conditions during the majority of the year in the American
16 and Stanislaus rivers.

17 With respect to the NDD intakes, implementation of CM6 and CM15 and Mitigation Measures AQUA-
18 96a through AQUA-96c would address these impacts, but are not anticipated to reduce them to a
19 level considered less than significant. Although implementation of *CM6 Channel Margin*
20 *Enhancement* would provide habitat similar to that which would be lost, it would not necessarily be
21 located near the intakes and therefore would not fully compensate for the lost habitat. Additionally,
22 implementation of this measure would not fully address predation losses. *CM15 Localized Reduction*
23 *of Predatory Fishes (Predator Control)* has substantial uncertainties associated with its effectiveness
24 such that it is considered to have no demonstrable effect. Conservation measures that address
25 habitat and predation losses, therefore, would potentially minimize impacts to some extent but not
26 to a less than significant level. Consequently, as a result of these changes in migration conditions,
27 this impact is significant and unavoidable.

28 Applicable conservation measures are briefly described below and full descriptions are found in
29 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized
30 Reduction of Predatory Fishes (Predator Control) (CM15).

31 In addition to the conservation measures, the mitigation measures identified below would provide
32 an adaptive management process, that may be conducted as a part of the Adaptive Management and
33 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing
34 impacts and developing appropriate minimization measures. However, this would not necessarily
35 result in a less than significant determination.

36 **Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional**
37 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**
38 **Reduce Impacts to Migration Conditions**

39 Although analysis conducted as part of the EIR/EIS determined that Alternative 6A would have
40 significant and unavoidable adverse effects on migration habitat, this conclusion was based on
41 the best available scientific information at the time and may prove to have been over- or
42 understated. Upon the commencement of operations of CM1 and continuing through the life of
43 the permit, the BDCP proponents will monitor effects on migration habitat in order to determine
44 whether such effects would be as extensive as concluded at the time of preparation of this

1 document and to determine any potentially feasible means of reducing the severity of such
2 effects. This mitigation measure requires a series of actions to accomplish these purposes,
3 consistent with the operational framework for Alternative 6A.

4 The development and implementation of any mitigation actions shall be focused on those
5 incremental effects attributable to implementation of Alternative 6A operations only.
6 Development of mitigation actions for the incremental impact on migration habitat attributable
7 to climate change/sea level rise are not required because these changed conditions would occur
8 with or without implementation of Alternative 6A.

9 **Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts**
10 **on Steelhead Migration Conditions Following Initial Operations of CM1**

11 Following commencement of initial operations of CM1 and continuing through the life of the
12 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
13 modified operations could reduce impacts to migration habitat under Alternative 6A. The
14 analysis required under this measure may be conducted as a part of the Adaptive Management
15 and Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

16 **Mitigation Measure AQUA-96c: Consult with USFWS, and CDFW to Identify and Implement**
17 **Potentially Feasible Means to Minimize Effects on Steelhead Migration Conditions**
18 **Consistent with CM1**

19 In order to determine the feasibility of reducing the effects of CM1 operations on steelhead
20 habitat, the BDCP proponents will consult with FWS and the Department of Fish and Wildlife to
21 identify and implement any feasible operational means to minimize effects on migration habitat.
22 Any such action will be developed in conjunction with the ongoing monitoring and evaluation of
23 habitat conditions required by Mitigation Measure AQUA-96a.

24 If feasible means are identified to reduce impacts on migration habitat consistent with the
25 overall operational framework of Alternative 6A without causing new significant adverse
26 impacts on other covered species, such means shall be implemented. If sufficient operational
27 flexibility to reduce effects on steelhead habitat is not feasible under Alternative 6A operations,
28 achieving further impact reduction pursuant to this mitigation measure would not be feasible
29 under this Alternative, and the impact on steelhead would remain significant and unavoidable.

30 If feasible means are identified to reduce impacts on migration habitat consistent with the overall
31 operational framework of Alternative 6A without causing new significant adverse impacts on other
32 covered species, such means shall be implemented. If sufficient operational flexibility to reduce
33 effects on steelhead habitat is not feasible under Alternative 6A operations, achieving further impact
34 reduction pursuant to this mitigation measure would not be feasible under this alternative, and the
35 impact on steelhead would remain significant and unavoidable.

36 **Restoration and Conservation Measures**

37 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
38 substantial differences in fish effects are anticipated anywhere in the affected environment under
39 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
40 steelhead under Alternative 1A (Impact AQUA-97 through Impact AQUA-108) also appropriately
41 characterize effects under Alternative 6A.

1 The following impacts are those presented under Alternative 1A that are identical for Alternative
2 6A.

3 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

4 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

5 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

6 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

7 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

8 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

9 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

10 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

11 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

12 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

13 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

14 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**
15 **(CM21)**

16 **NEPA Effects:** These restoration and conservation measure impact mechanisms have been
17 determined to range from no effect, not adverse, or beneficial effects on steelhead for NEPA
18 purposes, for the reasons identified for Alternative 1A (Impact AQUA-97 through 108). Specifically
19 for AQUA-98, the effects of contaminants on steelhead with respect to selenium, copper, ammonia
20 and pesticides would not be adverse. The effects of methylmercury on steelhead are uncertain.

21 **CEQA Conclusion:** These restoration and conservation measure impact mechanisms listed above
22 would range from no impact, to less than significant to beneficial, and no mitigation is required.

23 **Sacramento Splittail**

24 **Construction and Maintenance of CM1**

25 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento** 26 **Splittail**

27 The potential effects of construction of water conveyance facilities on Sacramento splittail would be
28 the same as those described for Alternative 1A (see Impact AQUA-109), because the same five
29 intakes would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing
30 shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel
31 reshaping.

1 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-109, environmental commitments and
2 mitigation measures would be available to avoid and minimize potential effects, and the effect would
3 not be adverse for Sacramento splittail.

4 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-109, the impact of the
5 construction of water conveyance facilities on Sacramento splittail would be less than significant
6 except for construction noise associated with pile driving. Implementation of Mitigation Measure
7 AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

8 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
9 **of Pile Driving and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

11 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
12 **and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

14 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**
15 **Splittail**

16 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
17 Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-110),
18 which concluded that the impact would not be adverse for Sacramento splittail.

19 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-110, the impact of the
20 maintenance of water conveyance facilities on Sacramento splittail would be less than significant
21 and no mitigation would be required.

22 **Water Operations of CM1**

23 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

24 **Water Exports from SWP/CVP South Delta Facilities**

25 Entrainment of juvenile and adult splittail would be completely eliminated at the south Delta
26 because there would be no water exports from the south Delta under Alternative 6A.

27 **Water Exports from SWP/CVP North Delta Intake Facilities**

28 The impact from entrainment of splittail to the proposed SWP/CVP north Delta intakes is the same
29 as described under Alternative 1A (Impact AQUA-111) because both Alternative 1A and 6A would
30 have five north Delta intakes. The intakes would be screened to exclude splittail greater than 10 mm
31 length.

32 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

33 The effect of implementing dual conveyance for the NBA with an alternative Sacramento River
34 intake would be the same as described under Alternative 1A (Impact AQUA-111). Reduced pumping
35 from Barker Slough could reduce entrainment losses of larval splittail produced in the Yolo Bypass.

1 There would be potential for increased predation and impingement risk associated with the
2 alternative intake, which would be screened to exclude splittail greater than 10 mm.

3 ***Predation Associated with Entrainment***

4 Splittail predation loss at the south Delta facilities would be eliminated under Alternative 6A
5 because there would be no south Delta entrainment. Predation at the north Delta would be
6 increased due to the installation of the proposed water export facilities on the Sacramento River.
7 The effects of potential predation associated with the five intake structures would be the same as
8 described for Alternative 1A (Impact AQUA-111). These potential predation losses would be offset
9 by the greatly reduced predation loss from eliminating south Delta diversions, and the increased
10 production of juvenile splittail resulting from CM2 actions (Yolo Bypass Fisheries Enhancement).

11 ***NEPA Effects:*** In conclusion, the effect of Alternative 6A on entrainment and predation loss is not
12 adverse and may be beneficial.

13 ***CEQA Conclusion:*** As described above, entrainment of juvenile and adult splittail to the south Delta
14 facilities would be eliminated because there would be no south Delta water exports under
15 Alternative 6A. Entrainment would be reduced at the NBA. At the north Delta intakes, there would
16 be a potential risk of larval entrainment and impingement. The impact and conclusion for predation
17 associated with entrainment would be the same as described above.

18 In conclusion, the impact of entrainment and predation loss from Alternative 6A would be less than
19 significant and may be beneficial due to the overall reduced entrainment and improved juvenile
20 production from implementation of CM2. No mitigation would be required.

21 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
22 **Sacramento Splittail**

23 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream
24 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning
25 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not
26 inundated, spawning in side channels and channel margins is much more important.

27 In general, Alternative 6A would have beneficial effects on splittail spawning habitat relative to NAA
28 by increasing the quantity and quality of spawning habitat in the Yolo Bypass.

29 ***Floodplain Habitat***

30 Effects of Alternative 6A on floodplain spawning habitat were evaluated for Yolo Bypass. Increased
31 flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the
32 Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects
33 in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m
34 threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored
35 because flow velocity was generally very low throughout the modeled area for most conditions, with
36 generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a
37 reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

38 The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo
39 Bypass inundation events compared to NAA, especially for dry and critical year types; the changes
40 are attributable to the influence of the Fremont Weir notch at lower flows. Only the inundation

1 events lasting more than 30 days are considered biologically beneficial to splittail, so are the focus of
 2 the analyses provided here. For below normal, dry, and critical water years, Alternative 6A results in
 3 an increase in frequency of inundation events greater than 30 days compared to NAA (Figure 11-6A-
 4 2, Table 11-6A-32). For below normal years, Alternative 6A would result in the occurrence of five
 5 inundation events of 30-49 days, compared to one such event for NAA, and one inundation event
 6 ≥70 days, compared to no such events for NAA. For critical years, Alternative 6A would result in the
 7 occurrence of one inundation event lasting more than 30 days, compared to no such events for NAA.
 8 The changes are attributable to the influence of the Fremont Weir notch at lower flows. The overall
 9 project-related effects consist of an increase in occurrence of longer-duration inundation events that
 10 would be beneficial for splittail spawning by creating better spawning habitat conditions.

11 **Table 11-6A-32. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**
 12 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**
 13 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
30-49 Days		
Wet	-4	-2
Above Normal	0	0
Below Normal	4	4
Dry	1	1
Critical	1	1
50-69 Days		
Wet	-5	-5
Above Normal	0	0
Below Normal	0	0
Dry	0	0
Critical	0	0
≥70 Days		
Wet	8	7
Above Normal	2	2
Below Normal	1	1
Dry	0	0
Critical	0	0

14
 15 There would be increases in area of suitable splittail habitat in Yolo Bypass under A6A_LLT ranging
 16 from 5 to 962 acres relative to NAA (Table 11-6A-33). Areas under A6A_LLT would be 57%, 64%,
 17 and 188% greater than areas under NAA in wet, above normal, and below normal water years,
 18 respectively. There would be increases in area under A6A_LLT in dry and critical years relative to
 19 NAA, but they would be minimal (6 and 5 acres, respectively). These results indicate that increases
 20 in inundated acreage in each water year type would result in increased habitat and have a beneficial
 21 effect on splittail spawning.

1 **Table 11-6A-33. Increase in Splittail Weighted Habitat Area (acres and percent) in Yolo Bypass**
 2 **from Existing Conditions to Alternative 6A by Water Year Type from 15 2-D and Daily CALSIM II**
 3 **Modeling Runs**

Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet	1,101 (71%)	962 (57%)
Above Normal	752 (66%)	743 (64%)
Below Normal	234 (178%)	238 (188%)
Dry	6 (NA)	6 (NA)
Critical	5 (NA)	5 (NA)

NA = percent differences could not be computed because no splittail weighted habitat occurred in the bypass for NAA and EXISTING CONDITIONS in those years (dividing by 0).

4
 5 A potential adverse effect of Alternative 6A that is not included in the modeling is reduced
 6 inundation of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The
 7 Fremont Weir notch with gates opened would increase the amount Sacramento River flow diverted
 8 from the river into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers.
 9 comm.). As much as about 6,000 cfs more flow would be diverted from the river with the opened
 10 notch than without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir.
 11 A decrease of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont
 12 Weir, could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although
 13 understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In
 14 any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of
 15 inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the
 16 river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass
 17 inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to
 18 reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects
 19 on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the
 20 Yolo Bypass.

21 ***Channel Margin and Side-Channel Habitat***

22 Splittail spawning and larval and juvenile rearing also occurs in channel margin and side-channel
 23 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,
 24 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are
 25 affected by changes in flow because greater flows cause more flooding, thereby increasing
 26 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially
 27 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are
 28 expected to be most important to the splittail population because in years of high-flows, when most
 29 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively
 30 little production.

31 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions
 32 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the
 33 Sacramento River for the time-frame February through June. These are the most important months
 34 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from
 35 the side-channel habitats during May and June if conditions become unfavorable.

1 Differences between model scenarios for monthly average flows during February through June by
2 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather
3 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 For the Sacramento River at Wilkins Slough, effects of Alternative 6A consist primarily of negligible
5 changes in flow (<5%) during February through April, with the exception of a small increase in
6 critical years during February (6%) and small decrease in critical years during April (-8%).
7 Negligible changes (<5%) to small increases in flow are indicated for May and June (to 8%). These
8 results indicate that the effects of Alternative 6A on flow would not have biologically meaningful
9 effects on spawning conditions, and that small increases in flow (to 8%) would have small, beneficial
10 effects on splittail spawning conditions in the Sacramento River.

11 For the Feather River at the confluence, effects consist primarily of negligible effects (<5%) or
12 increases in flow (to 16%) that would have beneficial effects on spawning conditions during
13 February through April, negligible effects (<5%) or decreases in flow (to -14%) in dry and critical
14 years during May (to -14%) and June (to -31%). Project-related effects consist of increases in flow
15 during June in wetter water years (to 14%) that would have beneficial effects. The occurrence of
16 reductions in mean monthly flow in dry and critical years during May and June constitute small to
17 moderate flow reductions that would be relatively infrequent and would occur late in the spawning
18 period. Therefore, they are not considered to cause biologically meaningful negative effects on
19 spawning success.

20 Modeling indicated no differences in project-related effects on water temperature for Alternative 6A
21 relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling results for
22 Alternative 1A show that Sacramento splittail spawning temperature tolerances would not be
23 exceeded in the Sacramento River and would rarely be exceeded in the Feather River. Therefore,
24 effects of water temperature on spawning habitat for Sacramento splittail under Alternative 6A are
25 not biologically meaningful.

26 These results indicate that effects of Alternative 6A on flow consist of both negative and beneficial
27 effects on Feather River splittail spawning conditions through both increases and decreases in flow
28 for the February to June spawning period. The project-related reductions in flow (to -31%) would be
29 infrequent and would occur late in the spawning period and would not contribute to biologically
30 meaningful negative effects on spawning success.

31 ***Stranding Potential***

32 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,
33 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and
34 historical data to evaluate possible stranding effects, the following provides a narrative summary of
35 potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture,
36 which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the
37 bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial
38 ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al.
39 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding
40 by allowing water to inundate certain areas of the bypass to maximize biological benefits, while
41 keeping water away from other areas to reduce stranding in isolated ponds. Actions under
42 Alternative 6A to increase the frequency of Yolo Bypass inundation would increase the frequency of
43 potential stranding events. For splittail, an increase in inundation frequency would also increase the
44 production of Sacramento splittail in the bypass. While total stranding losses may be greater under

1 Alternative 6A than under NAA, the total number of splittail would be expected to be greater under
2 Alternative 6A.

3 In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement
4 in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands
5 desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may
6 decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the
7 potential improvements in habitat capacity outweighed the potential stranding problems that may
8 exist in some years.

9 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
10 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
11 as a result of egg mortality. The effects of Alternative 6A on splittail spawning habitat are largely
12 beneficial. There would be substantial spawning habitat benefits due to increased inundation
13 acreages and an increase in longer duration inundation events in the Yolo Bypass. Effects of
14 Alternative 6A on water temperature would be negligible, and effects on mean monthly flows would
15 consist primarily of negligible effects (<5%), increases in flow (to 8% in the Sacramento River and to
16 16% in the Feather River) that would have beneficial effects on spawning conditions, and small
17 and/or infrequent reductions in flow (to -31% in the Feather River) that would not have biologically
18 meaningful effects on spawning conditions.

19 **CEQA Conclusion:** In general, Alternative 6A would have beneficial effects on splittail spawning
20 habitat relative to Existing Conditions by increasing the quantity and quality of spawning habitat in
21 the Yolo Bypass.

22 **Floodplain Habitat**

23 The proposed changes to the Fremont Weir under Alternative 6A would have minimal effects on the
24 frequency and duration of Yolo Bypass inundation events compared to Existing Conditions, except in
25 wet water year types (Table 11-6A-32). In wet water years, there would be 8 more inundation
26 events of ≥ 70 days, compared to Existing Conditions, but up to 5 fewer inundation events of
27 between 30 and 69 days, compared to Existing Conditions. However, comparisons of splittail
28 weighted habitat area for Alternative 6A to Existing Conditions (Table 11-6A-33) indicate that
29 Alternative 6A would result in increased acreage of suitable spawning habitat compared to Existing
30 Conditions in all water year types, with increases of between 5 and 1,101 acres of suitable spawning
31 habitat depending on water year type. Increased areas for wet, above normal, and below normal
32 water years are predicted to be 71%, 66%, and 178%, respectively, for Alternative 6A. Comparisons
33 for dry and critical water years indicate project-related increases of 6 and 5 acres of suitable
34 spawning habitat, respectively, compared to 0 acres for Existing Conditions. These results indicate
35 that Alternative 6A would have beneficial effects on splittail habitat through increasing spawning
36 habitats in Yolo Bypass by up to 178%.

37 **Channel Margin and Side-Channel Habitat**

38 Modeled flows were in the Sacramento River at Wilkins Slough for the February through June
39 splittail spawning and early life stage rearing (Appendix 11C, *CALSIM II Model Results utilized in the*
40 *Fish Analysis*). Results indicate that Alternative 6A would have primarily negligible effects (<5%)
41 during February through April, with the exception of two small decreases in mean monthly flow (-
42 7%) in below normal years during the months of March and April. Effects of Alternative 6A in May
43 and June consist of small increases in flow (to 17%) in some water years that would have beneficial

1 effects on spawning conditions, with the exception of two small reductions in flow during May in
2 wet years (-14%), when effects of flow reductions on rearing conditions would be less critical, and in
3 below normal years (-13%). These results indicate that effects of Alternative 6A on flows consist
4 primarily of negligible effects (<5%) or increases in flow, with small and/or isolated decreases in
5 flow that would not have biologically meaningful effects on splittail spawning conditions in channel
6 margins and side-channel habitats in the Sacramento River.

7 Results for the Feather River at the confluence show variable effects of Alternative 6A (A6A_LLT
8 compared to Existing Conditions) depending on month and water type. Changes in flow for February
9 and March under Alternative 6A consist of negligible effects (<5%), moderate increases in flow (to
10 20%) in wet and above normal water years, and small to moderate decreases in flow (to -15%)
11 during February in below normal years (-15%), during March in below normal years (-15%) and
12 critical years (-8%). Effects during April consist of negligible effects (<5%) with the exception of one
13 small decrease in critical years (-6%). Effects of Alternative 6A during May and June consist of
14 moderate to substantial decreases in flow for the majority of water year types, including drier years
15 (to -40%). These are relatively prevalent decreases in flow attributable to Alternative 6A relative to
16 Existing Conditions that would occur in drier water years for most of the spawning period and in
17 most water years for the latter portion of the spawning period (May and June) that would have
18 negative effects on spawning success in the Feather River.

19 ***Stranding Potential***

20 As described in the NEPA effects section above, rapid reductions in flow can dewater channel
21 margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a
22 lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects
23 have been evaluated with a narrative summary. Effects for Alternative 6A would be as described for
24 Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to
25 further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to
26 maximize biological benefits, while keeping water away from other areas to reduce stranding in
27 isolated ponds.

28 ***Temperature Effects***

29 Modeling results indicate no differences in project-related effects on water temperature for
30 Alternative 6A relative to Alternative 1A in any of the rivers analyzed for splittail effects. Modeling
31 results for Alternative 1A show that Sacramento splittail spawning temperature tolerances would
32 not be exceeded in the Sacramento River and rarely exceeded in the Feather River. Therefore, effects
33 of Alternative 6A on water temperature would not have biologically meaningful effects on splittail
34 spawning conditions.

35 ***Summary of CEQA Conclusion***

36 Collectively, these results indicate that the impact would not be significant relative to Existing
37 Conditions because it would not substantially reduce suitable spawning habitat or substantially
38 reduce the number of fish as a result of egg mortality. The effects of Alternative 6A on splittail
39 spawning habitat are largely beneficial. There would be substantial spawning habitat benefits due to
40 increased inundation acreages and an increase in longer duration inundation events in the Yolo
41 Bypass. Effects of Alternative 6A on water temperature would be negligible. Effects of Alternative 6A
42 on mean monthly flows in the Sacramento River would consist primarily of negligible effects (<5%),
43 increases in flow (to 17%) that would have beneficial effects, and small and/or isolated decreases in

1 flow (to -14%) that would not have biologically meaningful effects on spawning conditions. Effects
2 of Alternative 6A on flows in the Feather River would consist primarily of negative effects based on a
3 prevalence of flow reductions (to -40%) for most of the spawning period, particularly in drier water
4 years. However, because splittail spawning primarily occurs in Yolo Bypass, which would experience
5 improvements in splittail spawning conditions under Alternative 6A, the negative effects of
6 Alternative 6A based on reductions in mean monthly flow in the Feather River would not have
7 biologically meaningful effects on splittail spawning success.

8 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

9 Floodplains are important rearing habitats for juvenile splittail during periods of high flows when
10 areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated,
11 splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion
12 applies to splittail rearing conditions as well.

13 **NEPA Effects:** Based on the analyses above, the effect of Alternative 6A on splittail rearing habitat is
14 not adverse because it would not substantially reduce rearing habitat or substantially reduce the
15 number of fish as a result of mortality.

16 **CEQA Conclusion:** As described above, upstream splittail rearing habitat under Alternative 6A is
17 expected to be as described for side-channel and channel margin conditions and water temperature
18 effects for spawning. Based on the analyses above, the impact of Alternative 6A on splittail rearing
19 habitat would be less than significant because it would not substantially reduce rearing habitat or
20 substantially reduce the number of fish as a result of mortality. No mitigation would be necessary.

21 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento 22 Splittail**

23 **Upstream of the Delta**

24 In general, effects of Alternative 6A on splittail migration conditions would be negligible relative to
25 NAA based on negligible effects in the Sacramento River, which provides the migration corridor to
26 the most productive splittail spawning area, the Yolo bypass.

27 Effects of Alternative 6A on migration conditions for Sacramento splittail would be the same as
28 described above for channel margin and side-channel environments (Impact AQUA-112). Effects of
29 Alternative 6A on flow in the Sacramento River would consist primarily of negligible effects (<5%),
30 increases in flow (to 17%) that would have beneficial effects, and small and/or isolated decreases in
31 flow (to -14%) that would not have biologically meaningful effects on migration conditions. Effects
32 of Alternative 6A on flows in the Feather River would consist primarily of negative effects based on a
33 prevalence of flow reductions (to -40%) for most of the spawning period, particularly in drier water
34 years. However, as concluded above (Impact AQUA-112), negative effects in the Feather River would
35 be less detrimental based on the fact that the majority of splittail spawning occurs in the Yolo
36 Bypass (accessed via migration in the Sacramento River). Therefore, the effect would not be adverse.

37 **Through-Delta**

38 Alternative 6A would substantially reduce OMR reverse flows during the months of juvenile splittail
39 migration through the Delta compared to baseline conditions (NAA). The improved OMR flow
40 conditions would be a result of the elimination of south Delta exports under Alternative 6A.

1 Therefore the effect on juvenile migration survival would be beneficial, because of the greatly
2 improved OMR flow conditions.

3 **NEPA Effects:** Collectively, the effects of Alternative 6A would not be adverse to migrating adult
4 Sacramento splittail in areas upstream of the Delta, although some negative and beneficial changes
5 would occur. However, through-Delta migration conditions would generally be improved during the
6 juvenile splittail migration period, as a result of improved OMR flow conditions. As a result,
7 Alternative 6A would not be adverse.

8 **CEQA Conclusion:**

9 **Upstream of the Delta**

10 Project impacts on splittail rearing habitat are the same as described for spawning habitat in the
11 previous impact discussion, AQUA-112. As concluded above, the impact would be less than
12 significant and no mitigation would be necessary. Effects of Alternative 6A on flow would not have
13 substantial effects on the availability of channel margin and main-channel habitat. Increased flows
14 into Yolo Bypass may reduce flooding and flooded rearing habitat to some extent in the Sutter
15 Bypass but would create habitat in the Yolo Bypass that would have a beneficial impact on rearing
16 conditions.

17 **Through-Delta**

18 Average OMR flows would increase relative to Existing Conditions during the months of the juvenile
19 splittail migration through the Delta, because of the elimination of south Delta exports. Therefore
20 the impact on splittail migration survival would be beneficial because of the great improvement in
21 OMR flows.

22 Collectively, the effects of Alternative 6A would be less than significant to migrating adult
23 Sacramento splittail in areas upstream of the Delta, although some negative and beneficial changes
24 would occur. However, through-Delta migration conditions would generally be improved during the
25 juvenile splittail migration period, as a result of beneficial OMR flow conditions. As a result,
26 Alternative 6A would be less than significant.

27 **Restoration and Conservation Measures**

28 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
29 substantial differences in fish effects are anticipated anywhere in the affected environment under
30 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
31 Sacramento splittail under Alternative 1A (Impact AQUA-115 through Impact AQUA-126) also
32 appropriately characterize effects under Alternative 6A.

33 The following impacts are those presented under Alternative 1A that are identical for Alternative
34 6A.

35 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

36 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**
37 **Sacramento Splittail**

38 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

1 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

2 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**
3 **Splittail (CM13)**

4 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**
5 **(CM14)**

6 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**
7 **(CM15)**

8 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

9 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

10 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

11 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

12 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**
13 **Splittail (CM21)**

14 *NEPA Effects:* As described in Alternative 1A (Impact AQUA-115 through 126), the effects of these
15 restoration and conservation measure impact mechanisms would range from no effect, not adverse,
16 to beneficial for Sacramento splittail. Specifically for AQUA-116, the effects of contaminants on
17 Sacramento splittail with respect to selenium, copper, ammonia and pesticides would not be
18 adverse. The effects of methylmercury on Sacramento splittail are uncertain.

19 *CEQA Conclusion:* These restoration and conservation measure impact mechanisms listed above
20 would range from no impact, to less than significant to beneficial, and no mitigation is required.

21 **Green Sturgeon**

22 **Construction and Maintenance of CM1**

23 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

24 The potential effects of construction of water conveyance facilities on green sturgeon would be the
25 same as those described for Alternative 1A (see Impact AQUA-127), because the same five intakes
26 would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing
27 shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel
28 reshaping.

29 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and
30 mitigation measures would be available to avoid and minimize potential effects, and the effect would
31 not be adverse for green sturgeon.

32 *CEQA Conclusion:* As described under Alternative 1A, Impact AQUA-127, the impact of the
33 construction of water conveyance facilities on green sturgeon would be less than significant except
34 for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a
35 and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects of Pile Driving and Other Construction-Related Underwater Noise

Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise

Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-128), which concluded that the impact would not be adverse for green sturgeon.

CEQA Conclusion: As described under Alternative 1A, Impact AQUA-128, the impact of the maintenance of water conveyance facilities on green sturgeon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Water Exports

Alternative 6A would eliminate entrainment of juvenile green sturgeon at the SWP/CVP south Delta facilities, because there would be no south Delta exports under this Alternative (Table 11-6A-34). Therefore Alternative 6A would have a beneficial effect on juvenile green sturgeon entrainment because overall entrainment losses would be reduced.

The potential entrainment effects in the north Delta under Alternative 6A would be the same as those under Alternative 1A. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the potential to avoid or reduce entrainment; there would be no adverse effect.

Table 11-6A-34. Juvenile Green Sturgeon Entrainment Index^a at the SWP and CVP Salvage Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 6A

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet and Above Normal	-116 (-100%)	-104 (-100%)
Below Normal, Dry, and Critical	-50 (-100%)	-42 (-100%)
All Years	-166 (-100%)	-146 (-100%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost.

27

1 **Predation Associated with Entrainment**

2 Juvenile green sturgeon predation loss at the south Delta facilities would be eliminated because
3 there would be no south Delta entrainment under Alternative 6A. The impact and conclusion for
4 predation risk associated with NPB structures and the north Delta intakes would be the same as
5 described for Alternative 1A, Impact AQUA-129.

6 **NEPA Effects:** The effect on entrainment and entrainment-related predation loss under Alternative
7 6A would be beneficial to the species, because of the elimination of entrainment and entrainment-
8 related predation loss at the south Delta facilities.

9 **CEQA Conclusion:** The impact and conclusions regarding entrainment are the same as described
10 immediately above. Delta-wide entrainment for green sturgeon would be eliminated at the
11 SWP/CVP south Delta facilities and reduced through decommissioning agricultural diversions in
12 ROAs. Overall, impacts of water operations on entrainment of green sturgeon would be beneficial
13 and no mitigation would be required.

14 The impact and conclusion for predation associated with entrainment would be the same as
15 described above. Overall, the impact would be less than significant and may provide a benefit to the
16 species, particularly because of the elimination in entrainment-related predation loss at the south
17 Delta intakes.

18 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
19 **Green Sturgeon**

20 In general, Alternative 6A would not affect spawning and egg incubation habitat for green sturgeon
21 relative to NAA.

22 **Sacramento River**

23 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
24 Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows
25 can reduce the instream area available for spawning and egg incubation. Flows under A6A_LL
26 would almost always be similar to or greater than flows under NAA, except in critical years during
27 April (6% lower) at Keswick although flows can be lower or higher in individual months of
28 individual years. These results indicate that there would be very few reductions in flows in the
29 Sacramento River under Alternative 6A (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
30 *Analysis*).

31 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
32 under Alternative 1A, Impact AQUA-130, which indicates that there would be no effect of Alternative
33 1A on temperatures during the period evaluated relative to NAA.

34 **Feather River**

35 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
36 the Sacramento River during the February through June green sturgeon spawning and egg
37 incubation period. Flows under A6A_LL would generally be similar to or greater than flows under
38 NAA at Thermalito Afterbay and the confluence with the Sacramento River, except in dry and critical
39 years during May at both locations (9% to 24% lower), critical and dry years during April and June,
40 respectively, at Thermalito (7% and 31% lower, respectively), and dry and critical years during June

1 at the confluence (31% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results*
2 *utilized in the Fish Analysis*). These results indicate that there would be very few reductions in flows
3 in the Feather River under Alternative 6A independent of climate change.

4 Water temperatures in the Feather River under Alternative 6A would be the same as those under
5 Alternative 1A, Impact AQUA-130, which indicates that there would be no effect of Alternative 1A on
6 temperatures during the period evaluated relative to NAA.

7 ***San Joaquin River***

8 Flows were examined in the San Joaquin River at Vernalis during the March to July spawning and
9 egg incubation period. Flows in the San Joaquin River under Alternative 6A would not differ from
10 those under NAA throughout the period.

11 No water temperatures modeling was conducted in the San Joaquin River.

12 ***NEPA Effects:*** Collectively, these results indicate that this effect would not be adverse because it
13 does not have the potential to substantially reduce the amount of suitable habitat. There would be
14 limited project-related effects to flows and water temperatures in the Sacramento and Feather
15 rivers that would not affect spawning and egg incubation conditions for green sturgeon. Further,
16 there would be no effects of Alternative 6A on flows in the San Joaquin River.

17 ***CEQA Conclusion:*** In general, Alternative 6A would not affect spawning and egg incubation habitat
18 for green sturgeon relative to Existing Conditions.

19 ***Sacramento River***

20 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
21 Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under
22 A6A_LLTT at Keswick during April would generally be lower than flows under Existing Conditions by
23 up to 11%, and generally similar to or greater than flows under Existing Conditions during the rest
24 of the period, except in below normal years during March (20% lower) and wet and below normal
25 years during May (19% and 13% lower, respectively). Flows under A6A_LLTT at Red Bluff would
26 generally be similar to or greater than those under Existing Conditions, except in below normal
27 years during March through May (7% to 11% lower) and wet years during (16% lower) (Appendix
28 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Also, flows can be lower or higher in
29 individual months of individual years. These results indicate that there would be few reductions in
30 flows in the Sacramento River under Alternative 6A relative to Existing Conditions.

31 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
32 under Alternative 1A, Impact AQUA-130, which indicates that temperatures would be higher under
33 Alternative 1A during the period evaluated relative to Existing Conditions.

34 ***Feather River***

35 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
36 the Sacramento River during the February through June green sturgeon spawning and egg
37 incubation period. At Thermalito, flows under A6A_LLTT would generally be similar to or greater
38 than those under Existing Conditions, except in below normal and dry years during February (46%
39 and 12% lower, respectively), in below normal and critical years during March (39% and 7% lower,
40 respectively), critical years during April (6% lower), wet and above normal years during May (32%
41 and 8% lower, respectively), and wet and dry years during June (11% and 27% lower, respectively)

1 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At the confluence with the
2 Sacramento River, flows under A6A_LLTT would generally be up to 40% lower during May and June,
3 and generally similar to or greater than flows under Existing Conditions during the rest of the
4 period, except in below normal years during February and March (11% and 15% lower,
5 respectively), and critical years during March and April (8% and 6% lower, respectively). These
6 results indicate that there would be reductions in flows in the Feather River under Alternative 6A
7 relative to Existing Conditions.

8 Water temperatures in the Feather River under Alternative 6A would be the same as those under
9 Alternative 1A, Impact AQUA-130, which indicates that temperatures would be higher under
10 Alternative 1A during the period evaluated relative to Existing Conditions.

11 ***San Joaquin River***

12 Flows in the San Joaquin River at Vernalis under Alternative 6A would be up to 38% lower than
13 flows under Existing Conditions during the March through June spawning and egg incubation period
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 No water temperatures modeling was conducted in the San Joaquin River.

16 **Summary of CEQA Conclusion**

17 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between
18 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
19 alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the
20 NEPA conclusion set forth above. Flows in the Sacramento and Feather rivers would generally be
21 similar between Alternative 6A and the CEQA baseline, but flows would be lower under Alternative
22 6A in the San Joaquin River and temperatures would be greater in the Sacramento and Feather
23 Rivers.

24 These results are primarily caused by four factors: differences in sea level rise, differences in climate
25 change, future water demands, and implementation of the alternative. The analysis described above
26 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
27 the alternative from those of sea level rise, climate change and future water demands using the
28 model simulation results presented in this chapter. However, the increment of change attributable
29 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
30 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
31 implementation period, which does include future sea level rise, climate change, and water
32 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
33 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
34 effect of the alternative from those of sea level rise, climate change, and water demands.

35 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
36 term implementation period and Alternative 1A indicates that flows in the locations and during the
37 months analyzed above would generally be similar between Existing Conditions during the LLT and
38 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
39 found above would generally be due to climate change, sea level rise, and future demand, and not
40 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
41 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

1 result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is
2 found to be less than significant and no mitigation is required.

3 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

4 In general, Alternative 6A would not reduce the quantity and quality of green sturgeon larval and
5 juvenile rearing habitat relative to the NAA.

6 Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon
7 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
8 their habitat is more likely to be limited by changes in water temperature than flow rates.

9 ***Sacramento River***

10 Water temperatures in the Sacramento River for Alternative 6A are not different from those for
11 Alternative 1A, Impact AQUA-131, which indicates that Alternative 1A would not affect
12 temperatures relative to NAA in either river.

13 ***Feather River***

14 Water temperatures in the Feather River for Alternative 6A are not different from those for
15 Alternative 1A, Impact AQUA-131, which indicates that Alternative 1A would not affect
16 temperatures relative to NAA in either river.

17 ***San Joaquin River***

18 Water temperature modeling was not conducted in the San Joaquin River.

19 ***NEPA Effects:*** Collectively, these results indicate that this effect would be not be adverse because it
20 does not have the potential to substantially reduce the amount of suitable rearing habitat.

21 ***CEQA Conclusion:*** In general, Alternative 6A would not reduce the quantity and quality of green
22 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

23 Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon
24 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
25 their habitat is more likely to be limited by changes in water temperature than flow rates.

26 ***Sacramento River***

27 Water temperatures in the Sacramento River for Alternative 6A are not different from those for
28 Alternative 1A, Impact AQUA-131, which indicates that that there would be increase in
29 temperatures under Alternative 1A relative to Existing Conditions.

30 ***Feather River***

31 Water temperatures in the Feather River for Alternative 6A are not different from those for
32 Alternative 1A, Impact AQUA-131, which indicates that that there would be increase in
33 temperatures under Alternative 1A relative to Existing Conditions.

34 ***San Joaquin River***

35 Water temperature modeling was not conducted in the San Joaquin River.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set
5 forth above. Temperatures under Alternative 6A would increase in both the Sacramento and Feather
6 rivers relative to the CEQA baseline.

7 These results are primarily caused by four factors: differences in sea level rise, differences in climate
8 change, future water demands, and implementation of the alternative. The analysis described above
9 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
10 the alternative from those of sea level rise, climate change and future water demands using the
11 model simulation results presented in this chapter. However, the increment of change attributable
12 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
13 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
14 implementation period, which does include future sea level rise, climate change, and water
15 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
16 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
17 effect of the alternative from those of sea level rise, climate change, and water demands.

18 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
19 term implementation period and Alternative 6A indicates that flows in the locations and during the
20 months analyzed above would generally be similar between Existing Conditions during the LLT and
21 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
22 found above would generally be due to climate change, sea level rise, and future demand, and not
23 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
24 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
25 result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than
26 significant and no mitigation is required.

27 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

28 In general, effects of Alternative 6A on green sturgeon migration conditions relative to NAA are
29 uncertain.

30 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
31 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
32 the Sacramento River during the April through October larval migration period, the August through
33 March juvenile migration period, and the November through June adult migration period (Appendix
34 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
35 entire year, flows during all months were compared. Reduced flows could slow or inhibit
36 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
37 cues and pass impediments by adults.

38 Sacramento River flows under A6A_LL1T would nearly always be similar to or greater than flows
39 under NAA in all months, except during August, September, and November, in which flows would be
40 up to 18% lower depending on location, month, and water year type (Appendix 11C, *CALSIM II*
41 *Model Results utilized in the Fish Analysis*).

42 Larval transport flows were also examined by utilizing the positive correlation between white
43 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the

1 assumption that the mechanism responsible for the relationship is that Delta outflow provides
2 improved green sturgeon larval transport that results in improved year class strength. Results for
3 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation
4 between Delta outflow and year class strength, green sturgeon year class strength would be lower
5 under Alternative 6A than those under NAA (up to 67% lower).

6 Relative to NAA, flows in the Feather River at Thermalito under A6A_LLT would generally be similar
7 in all but two months (July and December) (up to 43% lower). Flows at the confluence with the
8 Sacramento River would generally be similar in all but three months (July, August, and December)
9 (up to 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 6A and
11 NAA. However, due to the removal of water at the North Delta intakes, there are substantial
12 differences in through-Delta flows between Alternative 6A and NAA (see Table 11-6A-37 below).
13 Analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green
14 sturgeon, found a positive correlation between year class strength and Delta outflow during April
15 and May. However, this conclusion was reached in the absence of north Delta intakes and the exact
16 mechanism that causes this correlation is not known at this time. One hypothesis suggests that the
17 correlation is caused by high flows in the upper river resulting in improved migration, spawning,
18 and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation
19 is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river
20 to spawn. It is also possible that some combination of these factors are working together to produce
21 the positive correlation between high flows and sturgeon year-class strength.

22 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation
23 between year class strength and river/Delta flow will be addressed through targeted research and
24 monitoring to be conducted in the years leading up to the initiation of north Delta facilities
25 operations. If these targeted investigations determine that the primary mechanisms behind the
26 positive correlation between high flows and sturgeon year-class strength are related to upstream
27 conditions, then Alternative 6A would be deemed Not Adverse due to the similarities in upstream
28 flow conditions between Alternative 6A and NAA. However, if the targeted investigations lead to a
29 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and
30 through-Delta flow conditions, then Alternative 6A would be deemed adverse due to the magnitude
31 of reductions in through-Delta flow conditions in Alternative 6A as compared to NAA.

32 **CEQA Conclusion:** In general, Alternative 6A would not affect green sturgeon migration conditions
33 relative to Existing Conditions.

34 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
35 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
36 the Sacramento River during the April through October larval migration period, the August through
37 March juvenile migration period, and the November through June adult migration period (Appendix
38 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
39 entire year, flows during all months were compared. Reduced flows could slow or inhibit
40 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
41 cues and pass impediments by adults.

42 Sacramento River flows at Keswick under A6A_LLT would generally be similar to or greater than
43 flows under Existing Conditions in all months with some exceptions (up to 20% lower), except April,
44 August, September, and December, during which flows would be up to 23% lower than under

1 Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at
2 Wilkins Slough under A6A_LLТ would generally be similar to or greater than flows under Existing
3 Conditions in all months, except August and September during which flows would be up to 24%
4 lower than under Existing Conditions depending on month and water year type.

5 For Delta outflow, the percent of months exceeding flow thresholds under A6A_LLТ would nearly
6 always be lower than those under Existing Conditions for each flow threshold, water year type, and
7 month (up to 75% lower) with few exceptions (see Table 11-6A-37 below).

8 Flows in the Feather River at Thermalito under A6A_LLТ would generally be up to 45% lower than
9 flows under Existing Conditions during July and October through January and generally similar to or
10 greater than flows under Existing Conditions during the rest of the period, with some exceptions (up
11 to 46% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the
12 Feather River at the confluence under A6A_LLТ would generally be up to 53% lower than flows
13 under Existing Conditions during May through July and October through January, and generally
14 similar to or greater than flows under Existing Conditions during the rest of the period, with some
15 exceptions (up to 34% lower).

16 **Summary of CEQA Conclusion**

17 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between
18 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
19 alternative could substantially reduce migration habitat and substantially interfere with the
20 movement of fish, contrary to the NEPA conclusion set forth above. The reduction in flows in the
21 Sacramento and Feather rivers would reduce the migration periods of larval, juvenile, and adult
22 migration, which would substantially slow or inhibit their downstream migration. Exceedance of
23 Delta outflow thresholds would be lower under Alternative 6A than under Existing Conditions,
24 although there is high uncertainty that year class strength is due to Delta outflow or if both year
25 class strength and Delta outflows are co-variable with another unknown factor.

26 These results are primarily caused by four factors: differences in sea level rise, differences in climate
27 change, future water demands, and implementation of the alternative. The analysis described above
28 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
29 the alternative from those of sea level rise, climate change and future water demands using the
30 model simulation results presented in this chapter. However, the increment of change attributable
31 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
32 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLТ
33 implementation period, which does include future sea level rise, climate change, and water
34 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
35 the LLТ, both of which include sea level rise, climate change, and future water demands, isolates the
36 effect of the alternative from those of sea level rise, climate change, and water demands.

37 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
38 term implementation period and Alternative 6A indicates that flows in the locations and during the
39 months analyzed above would generally be similar between Existing Conditions during the LLТ and
40 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
41 found above would generally be due to climate change, sea level rise, and future demand, and not
42 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
43 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself

1 result in a significant impact on migration habitat for green sturgeon. This impact is found to be less
2 than significant and no mitigation is required.

3 **Restoration and Conservation Measures**

4 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
5 substantial differences in fish effects are anticipated anywhere in the affected environment under
6 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
7 green sturgeon under Alternative 1A (Impact AQUA-133 through Impact AQUA-144) also
8 appropriately characterize effects under Alternative 6A.

9 The following impacts are those presented under Alternative 1A that are identical for Alternative
10 6A.

11 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

12 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green** 13 **Sturgeon**

14 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

15 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

16 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon** 17 **(CM13)**

18 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

19 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon** 20 **(CM15)**

21 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

22 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

23 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

24 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

25 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green** 26 **Sturgeon (CM21)**

27 **NEPA Effects:** These restoration and conservation measure impact mechanisms have been
28 determined to range from no effect, to not adverse, or beneficial effects on green sturgeon for NEPA
29 purposes, for the reasons identified for Alternative 1A (Impact AQUA-133 through 144). Specifically
30 for AQUA-134, the effects of contaminants on green sturgeon with respect to copper, ammonia and
31 pesticides would not be adverse. The effects of methylmercury and selenium on green sturgeon are
32 uncertain.

33 **CEQA Conclusion:** These restoration and conservation measure impact mechanisms would be
34 considered to range from no impact, to less than significant, or beneficial on green sturgeon, for the

1 reasons identified for Alternative 1A (Impact AQUA-133 through 144), and no mitigation is
2 required.

3 **White Sturgeon**

4 **Construction and Maintenance of CM1**

5 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

6 The potential effects of construction of water conveyance facilities on white sturgeon would be the
7 same as those described for Alternative 1A (see Impact AQUA-145), because the same five intakes
8 would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing
9 shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel
10 reshaping.

11 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and
12 mitigation measures would be available to avoid and minimize potential effects, and the effect would
13 not be adverse for white sturgeon.

14 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-145, the impact of the
15 construction of water conveyance facilities on white sturgeon would be less than significant except
16 for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a
17 and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

18 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 19 **of Pile Driving and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

21 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 22 **and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

24 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

25 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
26 Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-146),
27 which concluded that the impact would not be adverse for white sturgeon.

28 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-146, the impact of the
29 maintenance of water conveyance facilities on white sturgeon would be less than significant and no
30 mitigation would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

3 **Water Exports**

4 Alternative 6A would eliminate entrainment of juvenile white sturgeon at the SWP/CVP south Delta
5 facilities because there would be no south Delta exports under this Alternative (Table 11-6A-35).
6 Thus Alternative 6A would have a beneficial effect on juvenile white sturgeon.

7 The potential entrainment effects under Alternative 6A would be the same as those under
8 Alternative 1A. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at the
9 entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the
10 potential to avoid or reduce entrainment; there would be no adverse effect.

11 **Table 11-6A-35. Juvenile White Sturgeon Entrainment Index^a at the SWP and CVP Salvage Facilities**
12 **for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between**
13 **Model Scenarios for Alternative 6A**

Water Year Types	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
Wet and Above Normal	-289 (-100%)	-242 (-100%)
Below Normal, Dry, and Critical	-41 (-100%)	-33 (-100%)
All Years	-330 (-100%)	-275 (-100%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost.

14
15 **Predation Associated with Entrainment**

16 Juvenile white sturgeon predation loss at the south Delta facilities would be eliminated because
17 there would be no south Delta entrainment under Alternative 6A. The impact and conclusion for
18 predation risk associated with NPB structures and the north Delta intakes would be the same as
19 described for Alternative 1A, Impact AQUA-147.

20 **NEPA Effects:** The effect on entrainment and entrainment-related predation under Alternative 6A
21 would be beneficial to the species, because of the elimination of entrainment and entrainment-
22 related predation loss at the south Delta facilities.

23 **CEQA Conclusion:** The impact and conclusion for entrainment are the same as described
24 immediately above. Annual entrainment losses of juvenile white sturgeon would be eliminated at
25 the south Delta diversions. Impacts would be beneficial, and no mitigation would be required.

26 The impact and conclusion for predation associated with entrainment would be the same as
27 described above. Overall, the impact would be less than significant and may provide a benefit to the
28 species, particularly because of the elimination in entrainment-related predation loss at the south
29 Delta intakes under Alternative 6A.

1 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
2 **White Sturgeon**

3 In general, Alternative 6A would not affect spawning and egg incubation habitat for white sturgeon
4 relative to NAA.

5 ***Sacramento River***

6 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
7 May spawning and egg incubation period for white sturgeon. Flows under A6A_LLT at Wilkins
8 Slough from February to May would nearly always be similar to or greater than those under NAA,
9 except in critical years during April (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
10 *the Fish Analysis*). Flows under A6A_LLT at Verona would be lower by up to 7% during March and
11 April and generally similar to or greater than flows under NAA during February and May, except
12 during dry years (5% and 6% lower, respectively).

13 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
14 under Alternative 1A, which indicates that there would be no effect or beneficial effects of
15 Alternative 1A on temperatures relative to NAA.

16 ***Feather River***

17 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
18 River were examined during the February to May spawning and egg incubation period for white
19 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT
20 at Thermalito Afterbay would generally be similar to or greater than flows under NAA, except in
21 critical years during April and May (7% and 11% lower, respectively) and dry years during May
22 (24% lower). Flows under A6A_LLT at the confluence would nearly always be similar to or greater
23 than flows under NAA, except in dry and critical years during May (14% and 9% lower,
24 respectively). These results indicate that there would be very few reductions in flows in the Feather
25 River during the white sturgeon spawning and egg incubation period under Alternative 6A.

26 Water temperatures in the Feather River under Alternative 6A would be the same as those under
27 Alternative 1A, which indicates that there would be no effect or beneficial effects of Alternative 1A
28 on temperatures relative to NAA.

29 ***San Joaquin River***

30 Flows in the San Joaquin River under Alternative 6A would not be different from those under
31 Alternative 1A, which indicates that flows under Alternative 1A would not differ throughout the
32 period evaluated.

33 Temperatures were not modeled for the San Joaquin River.

34 ***NEPA Effects:*** Collectively, these results indicate that the effect would not be adverse because it does
35 not have the potential to substantially reduce the amount of suitable habitat. Reductions in flows
36 under Alternative 6A are small and infrequent relative to NAA and, therefore, would not have a
37 substantial effect on the species. There would be no increases in temperatures in the Sacramento or
38 Feather rivers.

39 ***CEQA Conclusion:*** In general, Alternative 6A would not affect spawning and egg incubation habitat
40 for white sturgeon relative to Existing Conditions.

1 **Sacramento River**

2 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
3 May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results*
4 *utilized in the Fish Analysis*). At Wilkins Slough, flows under A6A_LLT would be similar to or greater
5 than those under Existing Conditions, except in below normal years during March through May (7%
6 to 13% lower) and wet years during May (14% lower). At Verona, flows under A6A_LLT would be
7 generally up to 16% lower than Existing Conditions during March and April, and generally similar
8 during February and May, except in below normal and dry years during February (8% and 7%
9 lower, respectively) and wet and below normal years during May (19% and 8% lower, respectively).
10 These results indicate that there would be small, yet frequent, reductions in flows in the Sacramento
11 River under Alternative 6A relative to Existing Conditions.

12 Water temperatures in the Sacramento River under Alternative 6A would be the same as those
13 under Alternative 1A, Impact AQUA-148, which indicates that there would be no effect of Alternative
14 1A on temperatures.

15 **Feather River**

16 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
17 River were examined during the February to May spawning and egg incubation period for white
18 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito
19 Afterbay from February to May under A6A_LLT would generally be similar to or greater than those
20 under Existing Conditions with some exceptions in which flows would be lower by 46%. Flows at
21 the confluence with the Sacramento River under A6A_LLT would generally be similar to or greater
22 than flows under Existing Conditions during February through April with some exceptions (up to
23 15% lower), and generally lower during May (up to 25% lower). These results indicate that there
24 would be few reductions in flows in the Feather River under Alternative 6A relative to Existing
25 Conditions.

26 Water temperatures in the Feather River under Alternative 6A would be the same as those under
27 Alternative 1A, Impact AQUA-148, which indicates that there would be no effect of Alternative 1A on
28 temperatures.

29 **San Joaquin River**

30 Flows in the San Joaquin River under Alternative 6A would not be different from those under
31 Alternative 1, which indicates that flows would not differ between Existing Conditions and
32 Alternative 1A.

33 Temperatures were not modeled for the San Joaquin River.

34 **Summary of CEQA Conclusion**

35 Collectively, these results indicate that the impact would be less than significant because it does not
36 have the potential to substantially reduce the amount of suitable habitat. No mitigation is necessary.
37 Reductions in flows in all rivers evaluated under Alternative 6A would be small and infrequent
38 relative to Existing Conditions and, therefore, would not have a substantial effect on the species.
39 Further, there would be no effect of Alternative 6A on temperatures in the Sacramento and Feather
40 rivers.

1 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

2 In general, Alternative 6A would not affect the quantity and quality of white sturgeon larval and
3 juvenile rearing habitat relative to NAA.

4 Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon
5 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
6 their habitat is more likely to be limited by changes in water temperature than flow rates.

7 Water temperatures in the Sacramento and Feather rivers under Alternative 6A would not be
8 different from those under Alternative 1A, which indicates that there would be no effect of
9 Alternative 1A on temperatures in either river.

10 Water temperatures were not modeled in the San Joaquin River.

11 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
12 not have the potential to substantially reduce the amount of suitable habitat relative to NAA.

13 **CEQA Conclusion:** In general, Alternative 6A would not affect the quantity and quality of white
14 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

15 Water temperature was used to determine the potential effects of Alternative 6A on green sturgeon
16 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
17 their habitat is more likely to be limited by changes in water temperature than flow rates.

18 Water temperatures in the Sacramento and Feather rivers under Alternative 6A would not be
19 different from those under Alternative 1A, which indicates that there would be no effect of
20 Alternative 1A on temperatures in the Sacramento River, but temperatures would be higher under
21 the majority of months under Alternative 1A in the Feather River.

22 Water temperatures were not modeled in the San Joaquin River.

23 Collectively, the results of the Impact AQUA-149 CEQA analysis indicate that the difference between
24 the Existing Conditions and Alternative 6A could be significant because, under the Existing
25 Conditions, the alternative could substantially reduce the quality of suitable rearing habitat,
26 contrary to the NEPA conclusion set forth above. Water temperatures would be higher in the
27 Feather River during the majority of the white sturgeon rearing period.

28 These results are primarily caused by four factors: differences in sea level rise, differences in climate
29 change, future water demands, and implementation of the alternative. The analysis described above
30 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
31 the alternative from those of sea level rise, climate change and future water demands using the
32 model simulation results presented in this chapter. However, the increment of change attributable
33 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
34 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
35 implementation period, which does include future sea level rise, climate change, and water
36 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
37 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
38 effect of the alternative from those of sea level rise, climate change, and water demands.

39 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
40 term implementation period and Alternative 6A indicates that flows in the locations and during the

1 months analyzed above would generally be similar between Existing Conditions during the LLT and
 2 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
 3 found above would generally be due to climate change, sea level rise, and future demand, and not
 4 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
 5 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
 6 result in a significant impact on rearing habitat of white sturgeon. This impact is found to be less
 7 than significant and no mitigation is required.

8 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

9 In general, effects of Alternative 6A on white sturgeon migration conditions relative to NAA are
 10 uncertain.

11 Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins
 12 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number
 13 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)
 14 (Table 11-6A-36). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A6A_LLТ were
 15 generally similar to those under NAA. The number of months per year above 31,000 cfs at Verona
 16 under A6A_LLТ would be up to 6% higher and up to 50% lower than under NAA. On an absolute
 17 scale, all of these changes would be negligible (up to 0.2 months).

18 **Table 11-6A-36. Difference and Percent Difference in Number of Months in Which Flow Rates**
 19 **Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. A6A_LLТ	NAA vs. A6A_LLТ
Wilkins Slough, 17,700 cfs^a		
Wet	-0.04 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (5%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs^b		
Wet	-0.2 (-3%)	0 (0%)
Above Normal	-0.4 (-6%)	-0.1 (-1%)
Below Normal	-0.1 (-1%)	0.2 (4%)
Dry	0.3 (7%)	0.1 (1%)
Critical	0.1 (2%)	0 (0%)
Verona, 31,000 cfs^a		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.1 (-5%)	0.1 (6%)
Below Normal	-0.2 (-43%)	-0.1 (-33%)
Dry	-0.2 (-60%)	-0.1 (-50%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Months analyzed: February through May.

^b Months analyzed: November through May.

Larval transport flows were also examined by utilizing the positive correlation between year class strength and Delta outflow during April and May (USFWS 1995) under the assumption that the mechanism responsible for the relationship is that Delta outflow provides improved larval transport that results in improved year class strength. The percentage of months exceeding flow thresholds under A6A_LLT would generally be lower than those under NAA (up to 67% lower) with few exceptions (Table 11-6A-37). These results suggest that, using the positive correlation between Delta outflow and year class strength, year class strength would generally be lower under Alternative 6A.

Table 11-6A-37. Difference and Percent Difference in Percentage of Months in Which Average Delta Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in April and May of Wet and Above-Normal Water Years

Flow	Water Year Type	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
April			
15,000 cfs	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
20,000 cfs	Wet	-8 (-9%)	-8 (-9%)
	Above Normal	-17 (-22%)	-8 (-13%)
25,000 cfs	Wet	-15 (-19%)	-12 (-15%)
	Above Normal	-25 (-43%)	-17 (-33%)
May			
15,000 cfs	Wet	-4 (-4%)	4 (5%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-38 (-45%)	-15 (-25%)
	Above Normal	-8 (-20%)	0 (0%)
25,000 cfs	Wet	-27 (-39%)	-15 (-27%)
	Above Normal	-25 (-75%)	-17 (-67%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-25 (-25%)	-17 (-18%)
20,000 cfs	Wet	-19 (-22%)	-15 (-18%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-25 (-50%)	-25 (-50%)

For juveniles, year-round migration flows at Verona would be up to 21% lower under A6A_LLT relative to NAA in most water year types during January, March, April, July, August, November, and December, although differences would rarely exceed ~15% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during other months would generally be similar to flows under NAA with some exceptions.

For adults, the average number of months per year during the November through May adult migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was determined (Table 11-6A-36). The average number of months exceeding 5,300 cfs under A6A_LLT would always be similar to or greater than the number of months under NAA.

1 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 6A and
2 NAA (Table 11-6A-36). However, due to the removal of water at the North Delta intakes, there are
3 substantial differences in through-Delta flows between Alternative 6A and NAA (Table 11-6A-37).
4 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between
5 year class strength and Delta outflow during April and May. However, this conclusion was reached in
6 the absence of north Delta intakes and the exact mechanism that causes this correlation is not
7 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper
8 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another
9 hypothesis suggests that the positive correlation is a result of higher flows through the Delta
10 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some
11 combination of these factors are working together to produce the positive correlation between high
12 flows and sturgeon year-class strength.

13 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation
14 between year class strength and river/Delta flow will be addressed through targeted research and
15 monitoring to be conducted in the years leading up to the initiation of north Delta facilities
16 operations. If these targeted investigations determine that the primary mechanisms behind the
17 positive correlation between high flows and sturgeon year-class strength are related to upstream
18 conditions, then Alternative 6A would be deemed Not Adverse due to the similarities in upstream
19 flow conditions between Alternative 6A and NAA. However, if the targeted investigations lead to a
20 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and
21 through-Delta flow conditions, then Alternative 6A would be deemed adverse due to the magnitude
22 of reductions in through-Delta flow conditions in Alternative 6A as compared to NAA.

23 **CEQA Conclusion:** In general, Alternative 6A would not affect white sturgeon migration conditions
24 relative to Existing Conditions.

25 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough
26 under A6A_LLT would generally be similar to or greater than those under Existing Conditions,
27 except in below normal years (25% lower) (Table 11-6A-36). The number of months per year above
28 31,000 cfs at Verona under A6A_LLT would be up to 60% lower than the number under Existing
29 Conditions in all water year types except critical.

30 For Delta outflow, the percent of months exceeding flow thresholds under A6A_LLT would nearly
31 always be lower than those under Existing Conditions for each flow threshold, water year type, and
32 month (up to 75% lower) with few exceptions (Table 11-6A-37).

33 For juveniles, year-round migration flows at Verona would be up to 21% lower under A6A_LLT
34 relative to Existing Conditions in most water year types in six of 12 months (Appendix 11C, *CALSIM*
35 *II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during other months are
36 generally similar to or greater than flows under Existing Conditions.

37 For adult migration, the average number of months exceeding 5,300 cfs under A6A_LLT would
38 generally be similar to or greater than the number of months under Existing Conditions, except in
39 above normal water years (6% lower) (Table 11-6A-36).

40 **Summary of CEQA Conclusion**

41 Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between
42 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
43 alternative could substantially reduce the quality of suitable rearing habitat, contrary to the NEPA

1 conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for Delta
2 outflow would be lower under Alternative 6A than under the CEQA Existing Conditions. Juvenile
3 migration flows in the Sacramento River at Verona would be up to 21% lower in six of 12 months
4 relative to Existing Conditions. These reduced flows would have a substantial effect on the ability to
5 migrate downstream, delaying or slowing rates of successful migration downstream and increasing
6 the risk of mortality.

7 These results are primarily caused by four factors: differences in sea level rise, differences in climate
8 change, future water demands, and implementation of the alternative. The analysis described above
9 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
10 the alternative from those of sea level rise, climate change and future water demands using the
11 model simulation results presented in this chapter. However, the increment of change attributable
12 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
13 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
14 implementation period, which does include future sea level rise, climate change, and water
15 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
16 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
17 effect of the alternative from those of sea level rise, climate change, and water demands.

18 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
19 term implementation period and Alternative 6A indicates that flows in the locations and during the
20 months analyzed above would generally be similar between Existing Conditions during the LLT and
21 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
22 found above would generally be due to climate change, sea level rise, and future demand, and not
23 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
24 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would
25 not in itself result in a significant impact on migration habitat of white sturgeon. Additionally, as
26 described above in the NEPA Effects statement, further investigation is needed to better understand
27 the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management
28 would be used to make adjustments to meet the biological goals and objectives. This impact is found
29 to be less than significant and no mitigation is required.

30 **Restoration and Conservation Measures**

31 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
32 substantial differences in fish effects are anticipated anywhere in the affected environment under
33 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
34 white sturgeon under Alternative 1A (Impact AQUA-151 through Impact AQUA-162) also
35 appropriately characterize effects under Alternative 6A.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative
37 6A.

38 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

39 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White** 40 **Sturgeon**

41 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

1 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

2 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**
3 **(CM13)**

4 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

5 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**
6 **(CM15)**

7 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

8 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

9 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

10 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

11 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**
12 **Sturgeon (CM21)**

13 **NEPA Effects:** These restoration and conservation measure impact mechanisms have been
14 determined to range from no effect, to not adverse, or beneficial effects on white sturgeon for NEPA
15 purposes, for the reasons identified for Alternative 1A (Impact AQUA-151 through 162). Specifically
16 for AQUA-152, the effects of contaminants on white sturgeon with respect to copper, ammonia and
17 pesticides would not be adverse. The effects of methylmercury and selenium on white sturgeon are
18 uncertain.

19 **CEQA Conclusion:** These restoration and conservation measure impact mechanisms would be
20 considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the
21 reasons identified for Alternative 1A (Impact AQUA-151 through 162), and no mitigation is
22 required.

23 **Pacific Lamprey**

24 **Construction and Maintenance of CM1**

25 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

26 The potential effects of construction of water conveyance facilities on Pacific lamprey would be the
27 same as those described for Alternative 1A (see Impact AQUA-163), because the same five intakes
28 would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing
29 shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel
30 reshaping.

31 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and
32 mitigation measures would be available to avoid and minimize potential effects, and the effect would
33 not be adverse for Pacific lamprey.

34 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-163, the impact of the
35 construction of water conveyance facilities on Pacific lamprey would be less than significant except

1 for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a
2 and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

3 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
4 **of Pile Driving and Other Construction-Related Underwater Noise**

5 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

6 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
7 **and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

9 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

10 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
11 Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-164),
12 which concluded that the impact would not be adverse for Pacific lamprey.

13 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-164, the impact of the
14 maintenance of water conveyance facilities on Pacific lamprey would be less than significant and no
15 mitigation would be required.

16 **Water Operations of CM1**

17 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

18 **Water Exports**

19 Alternative 6A would eliminate entrainment of juvenile lamprey at the SWP/CVP south Delta export
20 facilities, because there would be no south Delta exports under this Alternative (Table 11-6A-38);
21 thus Alternative 6A would have a beneficial effect on juvenile lamprey.

22 The potential entrainment impacts of Alternative 6A on Pacific lamprey and would be the same as
23 described above for Alternative 1A for operating new SWP/CVP North Delta intakes (Impacts AQUA-
24 165), non-physical barriers at the entrances to CCF and the DMC (Impacts AQUA-165), and
25 decommissioning agricultural diversions in ROAs (Impacts AQUA-165). These actions would avoid
26 or reduce potential entrainment and the effect would not be adverse.

27 **Table 11-6A-38. Lamprey Annual Entrainment Indexa at the SWP and CVP Salvage Facilities—for**
28 **Alternative 6A**

Water Year Type	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
All Years	-3,386 (-100%)	-3,280 (-100%)
Shading indicates entrainment increased 10% or more.		
^a Estimated annual number of fish lost, based on non-normalized data.		

29

1 **Predation Associated with Entrainment**

2 Lamprey predation loss at the south Delta facilities would be eliminated because there would be no
3 entrainment loss to the south Delta under Alternative 6A. The impact and conclusion for predation
4 risk associated with NPB would be the same as described for Alternative 1A. Predation at the north
5 Delta would be increased due to the installation of the proposed water export facilities on the
6 Sacramento River. The effect on lamprey from predation loss at the north Delta is unknown because
7 of the lack of knowledge about their distribution and population abundances in the Delta.

8 **NEPA Effects:** The overall effect of Alternative 6A on entrainment and entrainment-related
9 predation on lamprey would not be adverse.

10 **CEQA Conclusion:** As described above, annual entrainment losses of juvenile lamprey would be
11 substantially reduced particularly because of the elimination of entrainment at the SWP/CVP south
12 Delta facilities because there would be no south Delta export under this alternative. The impact and
13 conclusion for predation associated with entrainment would be the same as described above
14 because the additional predation losses associated with the proposed north Delta intakes would be
15 offset by the elimination of entrainment-related predation loss at the south Delta export facilities.
16 The relative impact of predation loss on the lamprey population is unknown since there is little
17 available knowledge on their distribution and abundance in the Delta. Overall, impacts associated
18 with Alternative 6A would be beneficial in the south Delta, because there would be no south Delta
19 water exports; and less than significant at the north Delta intakes because monitoring and adaptive
20 management protocols will be implemented to confirm that fish, including lamprey, are being
21 excluded from entrainment and impingement in the manner that the design specifications suggest.
22 Overall, impacts of water operations on entrainment to Pacific lamprey are expected to be less than
23 significant. No mitigation would be required.

24 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
25 **Pacific Lamprey**

26 In general, Alternative 6A would not affect the quantity and quality of spawning habitat for Pacific
27 lamprey relative to NAA.

28 Flow-related effects on Pacific lamprey spawning habitat were evaluated by estimating effects of
29 flow alterations on redd dewatering risk and effects on water temperature. Dewatering risk was
30 analyzed for the Sacramento River at Keswick, Sacramento River at Red Bluff, Trinity River
31 downstream of Lewiston, Feather River at Thermalito Afterbay, American River at Nimbus Dam and
32 at the confluence with the Sacramento River, and the Stanislaus River at the confluence with the San
33 Joaquin River. Pacific lamprey spawn in these rivers between January and August. Dewatering risk
34 to redd cohorts was characterized by the number of cohorts experiencing a month-over-month
35 reduction in flows (using CALSIM II outputs) of greater than 50%.

36 For evaluation of dewatering risk, comparisons for Alternative 6A to NAA indicate no effect in the
37 Trinity River (0% difference) and decreases in dewatering risk in all other locations analyzed (to -
38 29%), which would have beneficial effects on spawning conditions by increasing suitable spawning
39 habitat area and reducing potential egg mortality (Table 11-6A-39).

1
2

Table 11-6A-39. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd Cohorts^a

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A6A_LL1	NAA vs. A6A_LL1
Sacramento River at Keswick	Difference	16	-6
	Percent Difference	29%	-8%
Sacramento River at Red Bluff	Difference	13	-5
	Percent Difference	24%	-7%
Trinity River downstream of Lewiston	Difference	0	0
	Percent Difference	0%	0%
Feather River at Thermalito Afterbay	Difference	-73	-31
	Percent Difference	-49%	-29%
American River at Nimbus Dam	Difference	28	-9
	Percent Difference	33%	-7%
American River at Sacramento River confluence	Difference	34	-6
	Percent Difference	36%	-4%
Stanislaus River at San Joaquin confluence	Difference	0	-2
	Percent Difference	0%	-3%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 6A than under the baseline (EXISTING CONDITIONS or NAA).

3

4 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
5 results of the analysis on Pacific lamprey egg exposure to elevated temperatures for Alternative 6A
6 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate
7 that egg exposure would be similar to NAA at most locations, although egg exposure would
8 substantially increase in the Feather River below Thermalito Afterbay.

9 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
10 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
11 as a result of egg mortality. Effects of Alternative 6A on flow reductions would have no effect
12 (Trinity River) or beneficial effects (all other locations analyzed) through small to moderate
13 reductions (to -29%) in the number of cohorts predicted to experience month-over-month flow
14 reductions of greater than 50%. Egg exposure to elevated water temperatures under Alternative 6A
15 would not increase in the majority of locations evaluated.

16 **CEQA Conclusion:** In general, under Alternative 6A water operations, the quantity and quality of
17 spawning habitat for Pacific lamprey would not be affected relative to the CEQA baseline.

18 Predicted effects of Alternative 6A in the Sacramento River and American River are for increases in
19 the number of redd cohorts predicted to experience a month-over-month change in flow of greater
20 than 50% relative to Existing Conditions (Table 11-6A-39). Changes would be most substantial for
21 the American River, with increased risk of dewatering exposure to 28 cohorts or 33% at Nimbus
22 Dam, and 34 cohorts or 36% at the confluence. Effects of Alternative 6A consist of no effect (0%

1 difference) for the Trinity River and Stanislaus River, and a substantial decrease in dewatering risk
2 (-49%) in the Feather River.

3 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
4 results of the analysis on egg exposure to elevated temperatures for Alternative 6A would be similar
5 to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-166 indicate that egg exposure
6 would be greater than under Existing Conditions at the Sacramento, Feather, and American rivers.

7 **Summary of CEQA Conclusion**

8 Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between
9 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
10 alternative could substantially, contrary to the NEPA conclusion set forth above reduce suitable
11 spawning habitat and substantially reduce the number of fish as a result of egg mortality. Effects of
12 Alternative 6A on flow would affect Pacific lamprey redd dewatering risk in Sacramento River (29%
13 increase in exposure risk) and the American River (maximum of 36% increase in exposure risk), but
14 would not have biologically meaningful effects on conditions in the Feather River, Trinity River, or
15 Stanislaus River. Egg exposure to elevated water temperatures would substantially increase under
16 Alternative 6A in multiple locations.

17 These results are primarily caused by four factors: differences in sea level rise, differences in climate
18 change, future water demands, and implementation of the alternative. The analysis described above
19 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
20 the alternative from those of sea level rise, climate change and future water demands using the
21 model simulation results presented in this chapter. However, the increment of change attributable
22 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
23 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
24 implementation period, which does include future sea level rise, climate change, and water
25 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
26 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
27 effect of the alternative from those of sea level rise, climate change, and water demands.

28 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
29 term implementation period and Alternative 6A indicates that flows in the locations and during the
30 months analyzed above would generally be similar between Existing Conditions during the LLT and
31 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
32 found above would generally be due to climate change, sea level rise, and future demand, and not
33 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
34 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
35 result in a significant impact on spawning habitat for Pacific lamprey. This impact is found to be less
36 than significant and no mitigation is required.

37 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

38 In general, Alternative 6A would have negligible effects on the quantity and quality of Pacific
39 lamprey rearing habitat relative to NAA. There would be some small to moderate benefits in some
40 locations from decreased stranding risk.

41 Flow-related effects on Pacific lamprey rearing habitat were evaluated by estimating effects of flow
42 alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the

1 Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the
2 Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River. The
3 analysis of ammocoete stranding was conducted by analyzing a range of month-over-month flow
4 reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort was
5 considered stranded if at least one month-over-month flow reduction was greater than the flow
6 reduction at any time during the period.

7 Effects of Alternative 6A on Pacific lamprey ammocoete stranding were analyzed by calculating
8 month-over-month flow reductions for the Sacramento River at Keswick (Table 11-6A-40). Results
9 indicate no effect (0%) or negligible effects (<5%) to ammocoete cohort exposures to all flow
10 reduction categories. These results indicate that project-related effects of Alternative 6A on flow
11 would not affect Pacific lamprey ammocoete stranding conditions in the Sacramento River at
12 Keswick.

13 **Table 11-6A-40. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
14 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
15 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	1	-3
-65%	4	4
-70%	-2	-2
-75%	-2	0
-80%	7	0
-85%	47	0
-90%	NA	NA

NA = all values were 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

16
17 Results of comparisons for the Sacramento River at Red Bluff (Table 11-6A-41) no change (0%),
18 negligible effects (<5%), and a single small decrease in exposure (-7%) of ammocoete cohorts to all
19 flow reductions. These results indicate that Alternative 6A would not affect Pacific lamprey
20 ammocoete stranding conditions in the Sacramento River at Red Bluff.

1 **Table 11-6A-41. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
 3 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	4	0
-60%	6	4
-65%	-2	-3
-70%	9	-2
-75%	10	0
-80%	5	-7
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

4
 5 Comparisons for the Trinity River indicate no effect (0%) or negligible changes (<5%) attributable
 6 to the project in all flow reduction categories (Table 11-6A-42). These results indicate that
 7 Alternative 6A would not affect Pacific lamprey ammocoete stranding conditions in the Trinity
 8 River.

9 **Table 11-6A-42. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	24	0
-80%	30	2
-85%	22	4
-90%	38	2

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

11
 12 Comparisons for the Feather River indicate no effect (0% difference) for flow reductions up to 75%,
 13 and decreases in the percentage of cohorts exposed to the remaining flow reduction categories (to -
 14 28%) that would have beneficial effects on spawning success (Table 11-6A-43). These results
 15 indicate that Alternative 6A would not have biologically meaningful negative effects on Pacific
 16 lamprey ammocoete stranding conditions in the Feather River.

1 **Table 11-6A-43. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
 3 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-8	-6
-85%	-5	-27
-90%	-64	-28

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

4
 5 Comparisons for the American River at Nimbus Dam (Table 11-6A-44) indicate no effect (0%
 6 difference) for the lower flow reduction categories, and negligible (<5%) to moderate (to -33%)
 7 reductions in cohorts exposed to 65% through 90% flow reductions, which would have beneficial
 8 effects on spawning success. These results indicate that Alternative 6A would not have biologically
 9 meaningful negative effects on Pacific lamprey ammocoete stranding conditions in the American
 10 River at Nimbus Dam.

11 Comparisons for the American River at the confluence with the Sacramento River (Table 11-6A-45)
 12 indicate no effect (0% difference) on cohort exposure for the lower flow reduction categories and
 13 negligible (<5%) to moderate (to -35%) decreases in exposure to 70% through 90% flow
 14 reductions, which would have beneficial effects on cohort survival. These results indicate that
 15 project-related effects of Alternative 6A would not have biologically meaningful negative effects on
 16 spawning success in the American River at the confluence with the Sacramento River.

1 **Table 11-6A-44. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 3 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	-1
-70%	33	-5
-75%	69	-12
-80%	156	-32
-85%	336	-14
-90%	100	-33

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

4

5 **Table 11-6A-45. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 7 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	7	-1
-75%	36	-1
-80%	129	-23
-85%	128	-35
-90%	248	-17

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

8

9 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-46)
 10 no effect (0% difference) or negligible effects (<5%) on cohort exposure for the lower flow
 11 reduction categories and moderate (-56 cohorts or -100%) decreases in exposure to 80% through
 12 90% flow reductions, which would have beneficial effects on cohort survival. These results indicate
 13 that project-related effects of Alternative 6A would not have biologically meaningful negative effects
 14 on spawning success in the Stanislaus River at the confluence with the San Joaquin River.

1 **Table 11-6A-46. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the**
 3 **Confluence with the San Joaquin River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-8	0
-70%	5	1
-75%	52	1
-80%	-100	-100
-85%	-100	-100
-90%	-100	-100

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

4
 5 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
 6 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would
 7 be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that
 8 there would be small to moderate increases and decreases in exposure under Alternative 1A relative
 9 to NAA that will balance out within rivers such that there would be no overall effect on Pacific
 10 lamprey ammocoetes.

11 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
 12 would not substantially reduce rearing habitat or substantially reduce the number of fish as a result
 13 of ammocoete mortality in any of the locations analyzed. While the effects of climate change would
 14 increase stranding risk during A6A_LLT for some locations, project-related effects would primarily
 15 consist of no effect (0%), negligible effects (<5%), or small to moderate decreases in stranding risk
 16 that would have beneficial effects on rearing success. There would be no overall effects to
 17 ammocoete exposure to elevated temperatures.

18 **CEQA Conclusion:** In general, under Alternative 6A water operations, the quantity and quality of
 19 rearing habitat for Pacific lamprey would not be affected relative to Existing Conditions.

20 Flow-related impacts on Pacific lamprey rearing habitat were evaluated by estimating effects of flow
 21 alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the
 22 Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the
 23 Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River. As
 24 described for operations-related impacts of Alternative 6A on spawning habitat for Pacific lamprey
 25 above, it was determined that the impacts of Alternative 6A on water temperatures for all locations
 26 analyzed would be the same as described for Alternative 1A. Conclusions for Alternative 1A are that
 27 impacts of water temperature during Pacific lamprey ammocoete rearing would be less than
 28 significant relative to Existing Conditions.

29 Comparisons of month-over-month flow reductions under Alternative 6A relative to Existing
 30 Conditions for the Sacramento River at Keswick indicate negligible effects (<5%) or small changes
 31 (to 7%) in occurrence of cohort exposure for all flow reduction categories with the exception of a

1 substantial increase in exposure (47%) to 85% flow reductions (Table 11-6A-40). With primarily
2 negligible to small effects and a more substantial effect on a single flow reduction category, these
3 results indicate that effects of Alternative 6A on flow would not result in biologically meaningful
4 effects on Pacific lamprey ammocoete stranding risk in the Sacramento River at Keswick.

5 Comparisons of Alternative 6A to Existing Conditions for the Sacramento River at Red Bluff indicate
6 negligible changes (<5%) to small increases (to 10%) in occurrence of cohort exposure for all flow
7 reduction categories up to 80%, and an increases of 56 cohorts or 100% exposed to 85% flow
8 reduction events (Table 11-6A-41). These results indicate that effects of Alternative 6A on flow
9 would cause increase risk of Pacific lamprey ammocoete stranding in the Sacramento River at Red
10 Bluff but not to the extent that would be considered a biologically meaningful effect on rearing
11 success.

12 Comparisons of Alternative 6A to Existing Conditions for the Trinity River indicate no effect (0%
13 difference) in ammocoete cohort exposure for the lower flow reduction categories, and moderate
14 increases in cohort exposure (to 38%) for flow reductions from 75% to 90% (Table 11-6A-42). The
15 effects of Alternative 6A on flow reduction exposures are consistent for the higher flow reduction
16 categories which would contribute incrementally to increased stranding risk and therefore would
17 have a negative effect on rearing conditions in the Trinity River.

18 Comparisons of Alternative 6A to Existing Conditions for Feather River indicate no effect (0%
19 difference) on ammocoete cohort exposures for the lower flow reduction categories, and small (-
20 5%) to substantial (-64%) decreases in exposures to flow reductions from 80% to 90% (Table 11-
21 6A-43). The decreases in exposure to the highest flow reduction categories would have beneficial
22 effects on lamprey rearing by reducing stranding risk. These results indicate that effects of
23 Alternative 6A on flow would not cause biologically meaningful negative effects on rearing success
24 in the Feather River.

25 Comparisons for the American River at Nimbus Dam (Table 11-6A-44) and at the confluence with
26 the Sacramento River (Table 11-6A-45) indicate negligible effects (<5%) on ammocoete cohort
27 exposures under A6A_LLT relative to Existing Conditions for 50% through 65% flow reduction
28 events, and small (7%), moderate (33%) and substantial increases (increase of 188 cohorts or 336%
29 at Nimbus Dam, 139 cohorts or 248% at the confluence) in exposures for the larger flow reduction
30 categories. These are substantial increases in cohort stranding exposure and would have negative
31 effects on spawning success at both locations.

32 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-46)
33 indicate negligible effects (<5%) and small increases (5%) and decreases (-8%) in ammocoete cohort
34 exposures under A6A_LLT relative to Existing Conditions for 50% through 70% flow reduction
35 events, a moderate increase (52%) for 75% flow reductions, and substantial decreases (56 cohorts
36 or 100%) in exposures for the larger flow reduction categories. These substantial decreases in
37 cohort stranding exposure for higher flow reduction events would have beneficial effects on
38 spawning success and would outweigh the negative effects of the increase (52%) in 75% flow
39 reductions.

40 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
41 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would
42 be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-167 indicate that
43 there would be substantial increases in ammocoete exposure in all rivers relative to Existing
44 Conditions.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
5 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of
6 Alternative 6A on flow would affect ammocoete stranding risk in the Trinity River and the American
7 River at Nimbus Dam and at the confluence with the Sacramento River based on substantial
8 increases in the number of cohorts exposed to stranding risk in the larger flow reduction categories
9 (to 38% in the Trinity River and to 336% in the American River). Alternative 6A would not have
10 biologically meaningful effects on stranding risk in the Sacramento River, Feather River, and
11 Stanislaus River, where it would increase stranding risk for some flow reduction categories but not
12 to the extent that would be expected to substantially reduce rearing habitat or substantially reduce
13 the number of fish as a result of ammocoete mortality. There would be substantial increases in
14 ammocoete exposure to increased temperatures in all rivers evaluated.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate
16 change, future water demands, and implementation of the alternative. The analysis described above
17 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
18 the alternative from those of sea level rise, climate change and future water demands using the
19 model simulation results presented in this chapter. However, the increment of change attributable
20 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
21 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
22 implementation period, which does include future sea level rise, climate change, and water
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
27 term implementation period and Alternative 6A indicates that flows in the locations and during the
28 months analyzed above would generally be similar between Existing Conditions during the LLT and
29 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
30 found above would generally be due to climate change, sea level rise, and future demand, and not
31 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
32 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
33 result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less
34 than significant and no mitigation is required.

35 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

36 **Upstream of the Delta**

37 In general, Alternative 6A would not affect the quantity or quality of migration habitat for Pacific
38 lamprey relative to NAA based on primarily negligible effects on mean monthly flow or a mix of
39 relatively small increases (beneficial effect) and decreases (negative effect) in mean monthly flow
40 throughout the migration period with a net result of negligible effects for the locations analyzed.

1 **Macrophthalmia**

2 After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macrophthalmia once
3 they reach the Delta. Migration generally is associated with large flow pulses in winter months
4 (December through March) (USFWS unpublished data) meaning alterations in flow have the
5 potential to affect downstream migration conditions. The effects of Alternative 6A on seasonal
6 migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow output. Flow
7 rates along the migration pathways of Pacific lamprey during the likely migration period (December
8 through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River
9 at the confluence with the Sacramento River, the American River at the confluence with the
10 Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River.

11 *Sacramento River*

12 Effects of Alternative 6A on mean monthly flow rates for the Sacramento River at Rio Vista
13 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for December to May compared
14 to NAA indicate reductions in mean monthly flow (to -31%) for all water year types and only the
15 occasional occurrence of negligible effects (<5%). Based on the persistent small to substantial
16 reductions in mean monthly flow during all months of the migration period in all water year types,
17 effects of Alternative 6A on flow would affect macrophthalmia migration conditions in the
18 Sacramento River at Rio Vista.

19 For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
20 *Analysis*]), the difference in mean monthly flow rate for Alternative 6A compared to indicates
21 primarily negligible project-related effects on flow (<5%) with infrequent, small increases (to 10%)
22 and a single decrease (-11%) that would not have biologically meaningful effects on migration
23 conditions. These results indicate that effects of Alternative 6A on flow would not have biologically
24 meaningful effects on outmigrating macrophthalmia in the Sacramento River at Red Bluff.

25 *Feather River*

26 For the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model*
27 *Results utilized in the Fish Analysis*) for December to May for Alternative 6A compared to NAA
28 indicates primarily negligible project-related effects (<5%), with small (5% to 10%) to moderate
29 (18%) increases in flow that would have beneficial effects on migration, and moderate project-
30 related decreases in flow during December in all but wet years (to -18%), a small decrease during
31 January in critical years (-10%), and small decreases during May in dry (-14%) and critical years (-
32 9%). The persistent, moderate decreases in mean monthly flow during December would occur early
33 in the migration period, and the small decreases during May in drier years would occur infrequently
34 at the very end of the migration period. Based on negligible effects or small increases in flow for the
35 remainder of the migration period, these effects of Alternative 6A on flow reductions are not
36 expected to have biologically meaningful negative effects on macrophthalmia migration in the
37 Feather River at the confluence.

38 *American River*

39 For the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II*
40 *Model Results utilized in the Fish Analysis*) for December through May, comparisons of Alternative 6A
41 to indicates project-related effects consist primarily of negligible effects (<5%), with infrequent,
42 small increases in flow (to 12%) during some months/water years that would be beneficial for

1 migration, a single, moderate decrease in flow (-23%) during March in critical years, and decreases
2 during April in dry (-15%) and critical years (-6%), which would be offset somewhat by increases in
3 drier water years (to 11%) during May. Project-related decreases in flow are isolated and/or of
4 relatively small magnitude and therefore effects of Alternative 6A on flow would not have
5 biologically meaningful negative effects on migration conditions in the American River.

6 *Stanislaus River*

7 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C,
8 *CALSIM II Model Results utilized in the Fish Analysis*) for December through May indicates project-
9 related effects consist entirely of negligible effects (<5%) throughout the migration period. These
10 results indicate that project-related effects of Alternative 6A on flow would not have biologically
11 meaningful effects on macrophthalmia migration in the Stanislaus River.

12 Overall, project-related effects of Alternative 6A on outmigrating macrophthalmia for all locations
13 analyzed, except Rio Vista, consist of negligible effects on flow (<5% difference), small to moderate
14 increases in flow (to 18%) that would have a beneficial effect on migration conditions, or infrequent
15 (to -23%) and/or relatively small decreases in flow (to -15%) which would not have biologically
16 meaningful effects on Pacific lamprey macrophthalmia migration. Effects of Alternative 6A for the
17 Sacramento River at Rio Vista consist of persistent small to moderate reductions in mean monthly
18 flow (to -31%) that would affect macrophthalmia migration conditions in the Sacramento River at Rio
19 Vista.

20 **Adults**

21 *Sacramento River*

22 For the Sacramento River at Red Bluff for the time-frame January to June (Appendix 11C, *CALSIM II*
23 *Model Results utilized in the Fish Analysis*), effects of Alternative 6A on mean monthly flow consist
24 primarily of negligible effects (<5%) for the entire migration period, with infrequent, small increases
25 in mean monthly flow (to 10%) and a single occurrence of a small decrease in flow (-11%) during
26 January in critical years. These results indicate that project-related effects of Alternative 6A on flow
27 would not have biologically meaningful effects on adult migration in the Sacramento River.

28 *Feather River*

29 For the Feather River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model*
30 *Results utilized in the Fish Analysis*) during January to June, mean monthly flows under Alternative
31 6A consist primarily of negligible changes (<5%) throughout the migration period, with occasional
32 increases in flow (to 16%) for some months/water years that would have beneficial effects on
33 migration conditions, and infrequent/isolated decreases in flow during January in critical years (-
34 10%), during May in dry (-14%) and critical years (-9%), and during June in dry (-31%) and critical
35 years (-10%). The small to moderate decreases in flow during May and June in dry and critical years
36 consist primarily of small flow reductions that would occur late in the migration period and are
37 therefore not expected to have biologically meaningful negative effects on migration conditions.
38 These results indicate that project-related effects of Alternative 6A on flow would not affect adult
39 migration conditions in the Feather River.

1 *American River*

2 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
3 River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)
4 predominantly negligible effects (<5%) throughout the migration period, with occasional, small
5 increases in flow (to 12%) that would have beneficial effects on migration conditions, and isolated
6 decreases in flow during March in critical years (-23%), during April in dry (-15%) and critical years
7 (-6%), and during June in dry years (-8%). The project-related decreases in flow are infrequent
8 and/or of small magnitude and would not have biologically meaningful negative effects on migration
9 conditions. These results indicate that effects of Alternative 6A on flow would not affect adult
10 migration conditions in the American River.

11 *Stanislaus River*

12 Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin
13 River for January to June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)
14 indicate effects of Alternative 6A compared to NAA consist predominantly of negligible effects
15 (<5%) throughout the migration period with the exception of moderate increases in flow during
16 June in dry (19%) and critical years (16%) that would have beneficial effects on migration
17 conditions. These results indicate that effects of Alternative 6A on flow would not affect adult
18 migration conditions in the Stanislaus River.

19 Overall, project-related effects of Alternative 6A on flow for all locations analyzed consist of
20 negligible effects on flow (<5% difference), small to substantial increases in flow (to 19%) that
21 would have a beneficial effect on migration conditions, or infrequent (to -31%) and/or small
22 decreases in flow (to -15%) that would not have biologically meaningful effects on Pacific lamprey
23 adult migration conditions.

24 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
25 would not substantially reduce the amount of suitable habitat or substantially interfere with the
26 movement of fish. Project-related effects of Alternative 6A on mean monthly flows during the Pacific
27 lamprey macrophthalmia outmigration period and the adult migration period consist of negligible
28 effects (<5%) or increases in flow (to 19%) that would have beneficial effects on migration
29 conditions, with highly infrequent small (to -15%) to moderate (to -31%) reductions in flow that
30 would not have biologically meaningful effects on migration conditions. Effects of Alternative 6A on
31 flow in the Sacramento River at Rio Vista would have localized effects on macrophthalmia migration
32 conditions through persistent small to moderate reductions in mean monthly flow (to -31%), but
33 based on the limited geographic extent of these persistent flow reductions, as well as the moderate
34 magnitude, they are not expected to have biologically meaningful effects on regional migration
35 conditions.

36 **CEQA Conclusion:** In general, under Alternative 6A water operations, the quantity and quality of
37 Pacific lamprey macrophthalmia and adult migration habitat would be reduced relative to the CEQA
38 baseline. Differences between the anticipated future conditions under this alternative and Existing
39 Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change, and not
40 to the operational scenarios. As a result, the differences between Alternative 6A (which is under LLT
41 conditions that include future sea level rise and climate change) and the CEQA baseline (Existing

1 Conditions) may therefore either overstate the effects of Alternative 6A or suggest significant effects
2 that are largely attributable to sea level rise and climate change, and not to Alternative 6A.

3 ***Macrophthalmia***

4 *Sacramento River*

5 Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista (Appendix 11C,
6 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 6A relative
7 to Existing Conditions indicate primarily decreases in mean monthly flow (to -60%) throughout the
8 migration period and in all water year types. Effects in drier water year types when flow reductions
9 would be most critical for migration conditions would be considered moderate, to -16% in dry years
10 and to -19% in critical years. The larger magnitude reductions would occur in wetter years when
11 effects of flow reductions would be less critical for migration conditions. Based on the prevalence of
12 moderate to substantial reductions in mean monthly flow during all months and most water year
13 types for the migration period, including moderate reductions in drier water years, effects of
14 Alternative 6A on flow would affect macrophthalmia migration in the Sacramento River at Rio Vista.

15 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*
16 *in the Fish Analysis*) for December to May for Alternative 6A relative to Existing Conditions indicate
17 primarily negligible (<5%) effects, with occasional small decreases (to -16%) or increases in flow (to
18 13%) for all months and water years. Increases would have beneficial effects on migration
19 conditions, and the decreases in flow would be infrequent and of greatest magnitude in wetter years
20 when effects of flow reductions would be less critical. Flow reductions in drier water years would
21 not be greater than -11%. These results indicate that effects of Alternative 6A on flow would not
22 have biologically meaningful negative effects on outmigrating macrophthalmia at this location.

23 *Feather River*

24 Comparisons for the Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized*
25 *in the Fish Analysis*) for December to May indicate effects of Alternative 6A compared to Existing
26 Conditions are somewhat variable depending on month and water year. Effects for December
27 through April consist primarily of negligible effects (<5%), small to moderate increases (to 20%) or
28 decreases in flow (-15%), with a more substantial decrease in flow predicted during December in
29 critical years (-36%). Effects during May consist of decreases in flow for most water year types, to -
30 25%. These reductions for most water years would occur during the last month of the 6 month
31 migration period, with small reductions in drier years during May (to -12%). These would
32 contribute to incremental effects on migration conditions; however, overall effects of Alternative 6A
33 on flow for the entire migration period and all water years consists predominantly of negligible
34 effects, increases in flow, and smaller decreases in flow. These results indicate that the effects of
35 Alternative 6A on flow would not have biologically meaningful effects on outmigrating
36 macrophthalmia in the Feather River.

37 *American River*

38 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
39 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate variable results
40 depending on the specific month and water year, with negligible effects (<5%) or decreases in flow
41 (to -22%) during December (including in drier water years), increases in wetter water years (to
42 27%) and decreases in drier water years (to -29%) during January through March, negligible effects

1 (<5)% and small-scale decreases (to -14%) during April, and reductions in flow (to -34%) during
2 May in all but dry years (<5% difference). Based on small to moderate reductions in flow in drier
3 water years during most of the migration period (December through March and May), these results
4 indicate that effects of Alternative 6A on flow would have negative effects on outmigrating
5 macrophthalmia in the American River at the confluence.

6 *Stanislaus River*

7 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C,
8 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate primarily
9 decreases in flow (to -30%) for all months of the migration period and most water year types, with
10 only infrequent occurrence of negligible effects (<5% difference) or small increases in flow (to
11 14%). Based on persistent, small to moderate reductions in flow, including in drier water years,
12 throughout the migration period, these results indicate that effects of Alternative 6A on flow would
13 have negative effects on outmigrating macrophthalmia in the Stanislaus River at the confluence.

14 Overall, these results indicate that the effects of Alternative 6A on mean monthly flows would affect
15 outmigrating macrophthalmia in the Sacramento River at Rio Vista, and the American River and the
16 Stanislaus River, based on a prevalence of flow reductions throughout the migration period (to -
17 60%, -34% and -30% for these locations, respectively), and particularly in drier water years. Effects
18 of Alternative 6A on flow would not have biologically meaningful negative effects on migration
19 conditions in the Sacramento River at Red Bluff and in the Feather River, based on a prevalence of
20 negligible effects (<5%), increases in flow that would be beneficial for migration conditions (to
21 20%), and infrequent, small decreases in flow (to -15%), and occasional, more substantial decreases
22 in wetter water years (to -34%) that would not affect migration conditions.

23 **Adults**

24 *Sacramento River*

25 Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II*
26 *Model Results utilized in the Fish Analysis*) during the Pacific lamprey adult migration period from
27 January through June indicate primarily negligible effects (<5%), with small increases (to 13%) in
28 flow that would have beneficial effects on migration conditions, and infrequent, isolated decreases
29 (to -16%) in flow that would not have biologically meaningful effects on migration conditions. These
30 results indicate that effects of Alternative 6A on flow would not have biologically meaningful
31 negative effects on adult migration conditions in the Sacramento River.

32 *Feather River*

33 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento
34 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
35 indicate variable effects of Alternative 6A by month and water year type. Effects during January
36 through March consist primarily of increases in flow (to 20%) in wetter years, and decreases (to -
37 15%) in drier years. Effects during April consist primarily of negligible effects (<5%), with the
38 exception of small decrease (-6%) in critical years. Effects during May and June consist primarily of
39 reductions in flow (to -40%) that include small (-11%) to substantial (-40%) reductions in drier
40 water years. Flow reductions in drier water years would contribute incrementally to effects on
41 migration, and would occur in January and March through June, which would affect migration
42 conditions in the Feather River.

1 *American River*

2 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
3 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
4 indicate variable effects of Alternative 6A depending on the month and water year type, with
5 negligible effects (<5%) or increases in flow (to 27%) in wetter water years and decreases (to -29%)
6 in drier water years for January through March, negligible effects or small decreases in flow (to -
7 14%) during April, and reductions in flow (to -52%) in all but dry years (<5% difference) during
8 May and in all but below normal years (<5% difference) in June. The prevalence of moderate to
9 substantial flow reductions in some of the drier water years for most months in the migration
10 period would have negative effects on adult migration in the American River.

11 *Stanislaus River*

12 Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin
13 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
14 indicate primarily decreases (to -21%) in mean monthly flow for all months and most water year
15 types, with only occasional occurrences of negligible effects (<5%) or increases in flow (to 14%).
16 Reductions in flow range up to -36% and include substantial reductions (to -36%) in drier water
17 years. The persistent moderate to substantial flow reductions would have negative effects on adult
18 migration in the Stanislaus River.

19 Overall, these results indicate that effects of Alternative 6A on flow during the January to June adult
20 Pacific lamprey migration period in the Sacramento River consist predominantly of negligible effects
21 (<5% difference), increases in flow that would have beneficial effects, or small, isolated occurrences
22 of decreases in flow (to -18%) for some water year types, or infrequent, more substantial decreases
23 in wetter water years (to -28%) that would not have biologically meaningful effects. There would be
24 greater prevalence of moderate to substantial flow reductions during some water year types and
25 most or all months of the adult migration period in the Feather River (to -40%), American River (to -
26 52%), and the Stanislaus River (-36%) that would have negative effects on migration conditions.

27 **Summary of CEQA Conclusion**

28 Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between
29 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
30 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
31 the movement of fish, contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on
32 flow would affect Pacific lamprey macropthalmia migration in the Sacramento River at Rio Vista
33 (based on prevalent flow reductions of up to -60%), both macropthalmia and adult migration
34 conditions in the American River (based on flow reductions to -34% for macropthalmia migration
35 and to -52% for adults) and the Stanislaus River (based on prevalent flow reductions to -30% for
36 macropthalmia migration and -36% for adults), and adult migration conditions only in the Feather
37 River (based on prevalent flow reductions to -40%).

38 These results are primarily caused by four factors: differences in sea level rise, differences in climate
39 change, future water demands, and implementation of the alternative. The analysis described above
40 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
41 the alternative from those of sea level rise, climate change and future water demands using the
42 model simulation results presented in this chapter. However, the increment of change attributable
43 to the alternative is well informed by the results from the NEPA analysis, which found this effect to

1 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
2 implementation period, which does include future sea level rise, climate change, and water
3 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
4 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
5 effect of the alternative from those of sea level rise, climate change, and water demands.

6 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
7 term implementation period and Alternative 6A indicates that flows in the locations and during the
8 months analyzed above would generally be similar between Existing Conditions during the LLT and
9 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
10 found above would generally be due to climate change, sea level rise, and future demand, and not
11 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
12 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
13 result in a significant impact on Pacific lamprey macrophthalmia and adult migration habitat. This
14 impact is found to be less than significant and no mitigation is required.

15 **Restoration and Conservation Measures**

16 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
17 substantial differences in fish effects are anticipated anywhere in the affected environment under
18 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
19 Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact AQUA-180) also
20 appropriately characterize effects under Alternative 6A.

21 The following impacts are those presented under Alternative 1A that are identical for Alternative
22 6A.

23 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

24 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific 25 Lamprey**

26 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

27 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

28 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey 29 (CM13)**

30 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

31 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey 32 (CM15)**

33 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

34 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

35 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

1 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

2 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**
3 **Lamprey (CM21)**

4 *NEPA Effects:* These restoration and conservation measure impact mechanisms have been
5 determined to range from no effect, to not adverse, or beneficial effects on Pacific lamprey for NEPA
6 purposes, for the reasons identified for Alternative 1A (Impact AQUA-169 through 180).

7 *CEQA Conclusion:* These impact mechanisms would be considered to range from no impact, to less
8 than significant, or beneficial on Pacific lamprey, for the reasons identified for Alternative 1A
9 (Impact AQUA-169 through 180), and no mitigation is required.

10 **River Lamprey**

11 **Construction and Maintenance of CM1**

12 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

13 The potential effects of construction of water conveyance facilities on river lamprey would be the
14 same as those described for Alternative 1A (see Impact AQUA-181), because the same five intakes
15 would be constructed. As in Alternative 1A, this would convert 11,900 lineal feet of existing
16 shoreline habitat into intake facilities and would require 27.3 acres of dredge and channel
17 reshaping.

18 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and
19 mitigation measures would be available to avoid and minimize potential effects, and the effect would
20 not be adverse for river lamprey.

21 *CEQA Conclusion:* As described under Alternative 1A, Impact AQUA-181, the impact of the
22 construction of water conveyance facilities on river lamprey would be less than significant except
23 for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a
24 and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

25 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
26 **of Pile Driving and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

28 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
29 **and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

31 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

32 *NEPA Effects:* The potential effects of the maintenance of water conveyance facilities under
33 Alternative 6A would be the same as those described for Alternative 1A (see Impact AQUA-182),
34 which concluded that the impact would not be adverse for river lamprey.

1 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-182, the impact of the
2 maintenance of water conveyance facilities on river lamprey would be less than significant and no
3 mitigation would be required.

4 **Water Operations of CM1**

5 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

6 **NEPA Effects:** The impact discussion is the same as discussed under Pacific lamprey. Please see
7 Impact AQUA-165 above.

8 **CEQA Conclusion:** The conclusion is the same as discussed under Pacific lamprey. Please see Impact
9 AQUA-165 above.

10 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 11 **River Lamprey**

12 In general, Alternative 6A would have negligible effects on river lamprey spawning habitat relative
13 to NAA.

14 Flow-related effects on river lamprey spawning habitat were evaluated by estimating effects of flow
15 alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames
16 for river lamprey incorporated into the analysis. The same locations were analyzed as for Pacific
17 lamprey: the Sacramento River at Keswick and Red Bluff, Trinity River downstream of Lewiston,
18 Feather River at Thermalito Afterbay, and American River at Nimbus Dam and at the confluence
19 with the Sacramento River. River lamprey spawn in these rivers between February and June so flow
20 reductions during those months have the potential to dewater redds, which could result in
21 incomplete development of the eggs to ammocoetes (the larval stage).

22 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-
23 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Results were
24 expressed as the number of cohorts exposed to dewatering risk and as a percentage of the total
25 number of cohorts anticipated in the river based on the applicable time-frame, February to June.

26 Results indicate negligible effects (<5%) under Alternative 6A relative to NAA for most locations,
27 including the Sacramento River at Red Bluff, Trinity River, Feather River, and American River at
28 Nimbus Dam (Table 11-6A-47). Project-related effects consist of no change (0% difference) in the
29 Sacramento River, Trinity River, and the Feather River, with negligible (<5%) to small decreases in
30 dewatering risk (to -8%) in the American River and Stanislaus River. Decreases in dewatering risk
31 would be beneficial for spawning success.

1
2

Table 11-6A-47. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd Cohorts^a

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A6A_LLТ	NAA vs. A6A_LLТ
Sacramento River at Keswick	Difference	3	0
	Percent Difference	9%	0%
Sacramento River at Red Bluff	Difference	2	0
	Percent Difference	5%	0%
Trinity River downstream of Lewiston	Difference	-2	0
	Percent Difference	-3%	0%
Feather River at Thermalito Afterbay	Difference	-10	0
	Percent Difference	-15%	0%
American River at Nimbus Dam	Difference	4	-5
	Percent Difference	7%	-8%
American River at Sacramento River confluence	Difference	13	-4
	Percent Difference	22%	-5%
Stanislaus River at San Joaquin River confluence	Difference	-9	-4
	Percent Difference	-16%	-8%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 6A than under the baseline (EXISTING CONDITIONS or NAA).

3

4 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
5 results of the analysis on river lamprey egg exposure to elevated temperatures for Alternative 6A
6 would be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate
7 that egg exposure would be similar to NAA at most locations, although egg exposure would
8 moderately increase in the Feather River below Thermalito Afterbay. Because this is isolated to a
9 single location in the Feather River, it is not expected to cause a population level effect on river
10 lamprey.

11 **NEPA Effects:** These results indicate that the effect would not be adverse because it would not
12 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result
13 of egg mortality. Effects of Alternative 6A on water temperature would be negligible, and project-
14 related effects on flow reductions that could negatively affect spawning and egg incubation
15 conditions consist of no effect (0% difference) or small decreases in dewatering risk (to -8%) that
16 would be beneficial for spawning conditions. Egg exposure to elevated water temperatures under
17 Alternative 6A would not increase in the majority of location evaluated.

18 **CEQA Conclusion:** In general, Alternative 6A would not reduce the quantity and quality of river
19 lamprey spawning conditions relative to Existing Conditions.

20 Effects of Alternative 6A on flow reductions during the river lamprey spawning period from
21 February to June consist of negligible (<5%) to small (5%) effects on dewatering risk in the
22 Sacramento River at Red Bluff and the Trinity River (Table 11-6A-47). There would be increases in
23 river lamprey redd cohort dewatering risk relative to Existing Conditions for the Sacramento River

1 at Keswick (9%), and the American River at Nimbus Dam (7%) and at the confluence (22%). There
2 would be decreased dewatering risk in the Feather River (-15%) and the Stanislaus River (-16%).
3 Decreases in dewatering risk would have a beneficial effect on spawning success.

4 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
5 results of the analysis on egg exposure to elevated temperatures for Alternative 6A would be similar
6 to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-184 indicate that egg exposure
7 would be greater than under Existing Conditions at the Sacramento, Feather, American, and
8 Stanislaus rivers.

9 Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between
10 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
11 alternative could substantially, contrary to the NEPA conclusion set forth above reduce suitable
12 spawning habitat and substantially reduce the number of fish as a result of egg mortality. The risk of
13 egg exposure to increased temperatures would be higher under Alternative 6A in multiple rivers.
14 There would be negligible effects of Alternative 6A on redd dewatering risk.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate
16 change, future water demands, and implementation of the alternative. The analysis described above
17 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
18 the alternative from those of sea level rise, climate change and future water demands using the
19 model simulation results presented in this chapter. However, the increment of change attributable
20 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
21 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
22 implementation period, which does include future sea level rise, climate change, and water
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
27 term implementation period and Alternative 6A indicates that flows in the locations and during the
28 months analyzed above would generally be similar between Existing Conditions during the LLT and
29 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
30 found above would generally be due to climate change, sea level rise, and future demand, and not
31 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
32 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
33 result in a significant impact on spawning habitat for river lamprey. This impact is found to be less
34 than significant and no mitigation is required.

35 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

36 In general, Alternative 6A would have negligible effects on river lamprey rearing habitat relative to
37 NAA. In most locations, there would be small to substantial decreases in exposure to the higher flow
38 reduction categories that would have beneficial effects on rearing success.

39 Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow
40 alterations on ammocoete exposure, or stranding risk, as described for Pacific lamprey, and effects
41 of water temperatures. As described for river lamprey spawning effects above, water temperature
42 results from the SRWQM and the Reclamation Temperature Model were used to assess the
43 exceedances of water temperatures under Alternative 6A in the upper Sacramento, Trinity, Feather,

American, and Stanislaus rivers for river lamprey ammocoete rearing. It was determined that the effects of Alternative 6A on water temperatures for all locations were the same as described for Alternative 1A. Conclusions for Alternative 1A are that effects of water temperature during river lamprey ammocoete rearing are not adverse relative to NAA.

For ammocoete stranding risk, the effects of Alternative 6A on flow were evaluated in the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus Dam and at the confluence with the Sacramento River. As for Pacific lamprey, the analysis of river lamprey ammocoete stranding was conducted by analyzing a range of month-over-month flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of ammocoetes was assumed to be born every month during their spawning period (February through June) and spend 5 years rearing upstream. Therefore, a cohort was considered stranded if at least one month-over-month flow reduction was greater than the flow reduction at any time during the period.

Comparisons of Alternative 6A to NAA for the Sacramento River at Keswick (Table 11-6A-48) indicated no effect (0%), negligible effects (<5%), and small increases (up to 5%) for all flow reduction categories attributable to the project. These results indicate that effects of Alternative 6A on flow would not affect ammocoete rearing success in the Sacramento River at Keswick.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-6A-49) indicate negligible effects (<5%) attributable to the project for all flow reduction categories. These results indicate that effects of Alternative 6A on flow reductions would not affect river lamprey ammocoete stranding in the Sacramento River at Red Bluff.

Table 11-6A-48. Percent Difference between Model Scenarios in the Number of River Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Keswick

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LL1	NAA vs. A6A_LL1
-50%	0	0
-55%	2	0
-60%	1	-3
-65%	4	4
-70%	-3	-3
-75%	-2	4
-80%	17	5
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

25

1 **Table 11-6A-49. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
 3 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	6	3
-60%	11	4
-65%	-3	-4
-70%	10	1
-75%	26	3
-80%	6	-4
-85%	[25-50] 100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

4
 5 Comparisons for the Trinity River indicate no effect (0% difference) or negligible effects (<5%) for
 6 all flow reduction categories (Table 11-6A-50). These results indicate that project-related effects of
 7 Alternative 6A on flow would not affect river lamprey ammocoete stranding in the Trinity River.

8 **Table 11-6A-50. Percent Difference between Model Scenarios in the Number of River Lamprey**
 9 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	32	0
-80%	40	1
-85%	32	1
-90%	52	0

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

10
 11 Comparisons for the Feather River indicate no effect (0% difference) in ammocoete cohort to flow
 12 events up to 70%, and small to moderate (to -33%) decreases in exposure to all higher flow
 13 reduction events that would have beneficial effects on rearing success (Table 11-6A-51). These
 14 results indicate that project-related effects of Alternative 6A on flow would not have negative effects
 15 on river lamprey ammocoete stranding in the Feather River.

1 **Table 11-6A-51. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
 3 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	-4	-4
-80%	-14	-8
-85%	-12	-33
-90%	-62	-32

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

4
 5 Comparisons for the American River at Nimbus Dam (Table 11-6A-52) and at the confluence with
 6 the Sacramento River (Table 11-6A-53) indicate negligible effects (<5%) or decreases (to -40%) in
 7 cohort exposure to all flow reduction categories that would have beneficial effects on rearing
 8 success for both locations. These results indicate that project-related effects of Alternative 6A on
 9 flow would not have biologically meaningful effects on river lamprey ammocoete stranding in the
 10 American River.

11 **Table 11-6A-52. Percent Difference between Model Scenarios in the Number of River Lamprey**
 12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 13 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	3	-1
-65%	3	-4
-70%	39	-12
-75%	88	-17
-80%	[50-150] 200	-37
-85%	[25-115] 360	-18
-90%	[25-50] 100	-33

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

14

1 **Table 11-6A-53. Relative Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	4	-1
-70%	17	-5
-75%	40	-9
-80%	[71-176] 148	-27
-85%	[50-129] 158	-40
-90%	[25-91] 264	-22

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

4
 5 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-54)
 6 indicate no effect (0%) or negligible effects (<5%) for exposure to 50% through 75% flow reduction
 7 events, and decreases from 25 cohorts to 0 cohorts (-100%) for the higher flow reduction categories
 8 which would have beneficial effects on rearing success. These results indicate that project-related
 9 effects of Alternative 6A on flow would not have negative effects on river lamprey ammocoete
 10 stranding in the Stanislaus River.

11 **Table 11-6A-54. Relative Difference between Model Scenarios in the Number of River Lamprey**
 12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the**
 13 **Confluence with the San Joaquin River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A6A_LLT	NAA vs. A6A_LLT
-50%	0	0
-55%	0	0
-60%	-3	0
-65%	-9	-2
-70%	3	3
-75%	67	0
-80%	[25-0] -100	[25-0] -100
-85%	[25-0] -100	[25-0] -100
-90%	[25-0] -100	[25-0] -100

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 6A.

14
 15 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
 16 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would
 17 be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that

1 there would be small to moderate increases and decreases in exposure relative to NAA that will
2 balance out within rivers such that there would be no overall effect on river lamprey ammocoetes.

3 **NEPA Effects:** Overall, these results indicate that the effect would not be adverse because it would
4 not substantially reduce rearing habitat or substantially reduce the number of fish as a result of
5 ammocoete mortality. Results indicate that project-related effects of Alternative 6A on flow would
6 not affect river lamprey ammocoete stranding at any of the locations analyzed based on results
7 indicating no change (0%), negligible effects (<5%), or small-scale effects (to 6%) in ammocoete
8 cohort exposure to flow reduction events. In most locations, there would be small to substantial
9 decreases in exposure to the higher flow reduction categories that would have beneficial effects on
10 rearing success. There would be small to moderate increases and decreases in ammocoete exposure
11 to elevated temperatures will balance out within rivers such that there would be no overall effect.

12 **CEQA Conclusion:** In general, under Alternative 6A water operations, the quantity and quality of
13 rearing habitat for river lamprey would not be affected relative to the CEQA baseline.

14 Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow
15 alterations on ammocoete exposure, or stranding risk, as described for Pacific lamprey, and effects
16 on water temperatures. As described for river lamprey spawning effects above, water temperature
17 results from the SRWQM and the Reclamation Temperature Model were used to assess the
18 exceedances of water temperatures under Alternative 6A in the upper Sacramento, Trinity, Feather,
19 American, and Stanislaus rivers for river lamprey ammocoete rearing. It was determined that the
20 effects of Alternative 6A on water temperatures for all locations analyzed were the same as
21 described for Alternative 1A. Conclusions for Alternative 1A are that effects of water temperature
22 during river lamprey ammocoete rearing would be less than significant relative to Existing
23 Conditions.

24 Flow reductions were evaluated to determine the effects of Alternative 6A on ammocoete stranding
25 risk. Comparisons of Alternative 6A to Existing Conditions for the Sacramento River at Keswick
26 indicate negligible effects (<5%) on the number of ammocoete cohorts exposed to flow reductions
27 flow reduction categories from 50% to 75%, with a moderate increase (17%) in exposure to 80%
28 flow reductions and a more substantial increase (44%) in exposure to 85% flow reductions (Table
29 11-6A-48). All values for 90% flow reduction events are zero. Comparisons for the Sacramento River
30 at Red Bluff indicate slightly more variable results with negligible effects (<5%) or small-scale
31 increases (to 11%) for all flow reduction categories except for a moderate increase (26%) to 75%
32 flow reductions, and a more substantial increase in exposure to 85% flow reduction events
33 (increase from 25 to 50 cohorts or 100%) (Table 11-6A-49). While there would be fairly substantial
34 increases in the number of cohorts exposed to the 85% reduction category at both locations, effects
35 would be negligible or small in all other flow reduction categories and therefore, results indicate
36 that effects of Alternative 6A on flow reductions would not have biologically meaningful effects on
37 river lamprey ammocoete stranding in the Sacramento River at Keswick and at Red Bluff.

38 Comparisons for the Trinity River indicated no effect (0%) for flow reduction categories from 50%
39 to 70%, and increases ranging from 32% to 52% for the higher flow reduction categories (Table 11-
40 6A-50). These consistent and more substantial increases in ammocoete cohort exposures to larger
41 flow reductions would affect ammocoete stranding risk and therefore rearing success in the Trinity
42 River.

43 Comparisons for the Feather River indicated no effect or reductions in frequency of occurrence for
44 all flow reduction categories, with reductions ranging from -4% to -62% in the higher flow reduction

1 categories (Table 11-6A-51). Decreased exposure to flow reduction events would have beneficial
2 effects on rearing success. These results indicate that effects of Alternative 6A on flow would not
3 have negative effects on river lamprey ammocoete stranding in the Feather River.

4 Comparisons for the American River at Nimbus Dam (Table 11-6A-52) and at the confluence with
5 the Sacramento River (Table 11-6A-53) indicate small (5%) to substantial (360%) increased
6 ammocoete cohort exposures to flow reductions between 70 and 90% for Alternative 6A compared
7 to Existing Conditions; substantial increases are from 39 to 360% (increase in cohorts exposed from
8 25 to 115) for Nimbus Dam and from 40% to 264% (increase in cohorts exposed from 25 to 91) for
9 the confluence. These consistent and substantial increases in ammocoete cohorts exposed to flow
10 reductions would affect ammocoete stranding risk and therefore rearing success in the American
11 River.

12 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Table 11-6A-54)
13 indicate negligible effects (<5%) and small reductions in exposure (to -9%) for flow reduction
14 events between 50% and 70%, a substantial increase (67%) in ammocoete cohort exposure to 75%
15 flow reductions, and decreases in exposure risk (from 25 to 0 cohorts or -100%) for the higher flow
16 reduction categories. These consistent and substantial decreases in ammocoete cohorts exposed to
17 the higher flow reduction events would have beneficial effects on rearing success.

18 Because water temperatures under Alternative 6A would be similar to those under Alternative 1A,
19 results of the analysis on ammocoete exposure to elevated temperatures for Alternative 6A would
20 be similar to that for Alternative 1A. Results from Alternative 1A, Impact AQUA-185 indicate that
21 there would be moderate to large increases in ammocoete exposure under Alternative 1A relative to
22 Existing Conditions in all rivers evaluated that would substantially reduce rearing habitat
23 conditions.

24 **Summary of CEQA Conclusion**

25 Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between
26 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
27 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
28 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of
29 Alternative 6A on flow reductions would affect ammocoete stranding risk in the Trinity River (based
30 on increases to 52% for the larger flow reduction categories) and the American River (based on
31 increases to 360% for the larger flow reduction categories), and would not have biologically
32 meaningful effects in the Sacramento River, the Feather River, and the Stanislaus River (based on
33 negligible effects, reductions in stranding risk, or small and/or inconsistent increases in stranding
34 risk). Further, there would be moderate to large increases in ammocoete exposure under
35 Alternative 6A in all rivers evaluated that would substantially reduce rearing habitat conditions.

36 These results are primarily caused by four factors: differences in sea level rise, differences in climate
37 change, future water demands, and implementation of the alternative. The analysis described above
38 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
39 the alternative from those of sea level rise, climate change and future water demands using the
40 model simulation results presented in this chapter. However, the increment of change attributable
41 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
42 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
43 implementation period, which does include future sea level rise, climate change, and water
44 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
4 term implementation period and Alternative 6A indicates that flows in the locations and during the
5 months analyzed above would generally be similar between Existing Conditions during the LLT and
6 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
7 found above would generally be due to climate change, sea level rise, and future demand, and not
8 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
9 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
10 result in a significant impact on rearing habitat for river lamprey. This impact is found to be less
11 than significant and no mitigation is required.

12 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

13 ***Macrophthalmia***

14 In general, Alternative 6A would have negligible effects on river lamprey migration conditions
15 compared to NAA for all locations analyzed, with beneficial effects due to substantial increases in
16 mean monthly flow during drier water years in the Feather River.

17 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once
18 they reach the Delta. River lamprey migration generally occurs September through November
19 (USFWS unpublished data). The effects of water operations on seasonal migration flows for river
20 lamprey macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely
21 migration pathways of river lamprey during the likely migration period (September through
22 November) were examined to predict how Alternative 6A may affect migration flows for
23 outmigrating macrophthalmia. Analyses were conducted for the Sacramento River at Red Bluff,
24 Feather River at the confluence with the Sacramento River, the American River at the confluence
25 with the Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River.

26 *Sacramento River*

27 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*
28 *in the Fish Analysis*) for September through November indicate decreases in flow (to -17%) in wetter
29 years during September and October, when effects of flow reductions would be less critical for
30 migration conditions, a small increase during September in critical years (10%) that would have a
31 small beneficial effect, and negligible effects (<5%) or small decreases in flow (to -11%) during
32 October. Despite a prevalence of negligible effects or reductions in flow attributable to the project,
33 decreases in mean monthly flow would be of small magnitude in drier water years (to -14%) when
34 effects on migration would be more critical. Therefore, effects of Alternative 6A on flow would not
35 have biologically meaningful negative effects on migration conditions.

36 *Feather River*

37 Comparisons for the Feather River at the confluence with the Sacramento River flow comparisons
38 Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)
39 for September through November indicate project-related effects would cause decreases in mean
40 monthly flow during September in wetter years (to -23%) when effects on migration would be less
41 critical, and increases in drier years (to 95%) that would have beneficial effects on migration

1 conditions. Project-related effects during October and November consist of negligible effects (<5%)
2 or small increases (9%) or decreases in flow (to -8%) that would not have biologically meaningful
3 negative effects for river lamprey macrophthalmia migration in the Feather River.

4 *American River*

5 Comparisons for the American River at the confluence with the Sacramento River flow comparisons
6 Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)
7 for September through November indicate an increased prevalence of negligible (<5%) or small-
8 scale effects on mean monthly flow, with decreases (to -32%) during September in wet and above
9 normal years when effects on migration would be less critical, increases (to 17%) during October,
10 and negligible effects with a single, small decrease in flow (-7%) during November in below normal
11 years. These results indicate that project-related effects of Alternative 6A on flows would not have
12 biologically meaningful negative effects on river lamprey macrophthalmia migration in the American
13 River.

14 *Stanislaus River*

15 Comparisons for the American River at the confluence with the Sacramento River flow comparisons
16 Feather River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)
17 for September through November indicate no effect (0% difference) or negligible (<5%) for all
18 months and water year types. These results indicate that project-related effects of Alternative 6A on
19 flows would not affect river lamprey macrophthalmia migration in the Stanislaus River.

20 Overall, these results indicate that, despite some variation in results by location, month, and water
21 year type, effects of Alternative 6A on flow would generally not have biologically meaningful effects
22 on river lamprey macrophthalmia migration in the Sacramento River, Feather River, American River,
23 and Stanislaus River.

24 **Adults**

25 Effects of Alternative 6A on flow during the adult migration period, September through November,
26 would be the same as described for the macrophthalmia migration period, September through
27 November, above. Results are the same; Alternative 6A would not have biologically meaningful
28 negative effects on adult river lamprey migration in the Sacramento River, Feather River, American
29 River, and Stanislaus River.

30 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
31 would not substantially reduce the amount of suitable habitat or substantially interfere with the
32 movement of fish. Project-related effects consist primarily of negligible effects (<5%), increases in
33 flow (to 95%) that would have a beneficial effect, infrequent small decreases (to -11%) in drier
34 water years that would not have biologically meaningful effects, and more substantial decreases (to
35 -32%) in wetter years when effects on migration would not be critical.

36 **CEQA Conclusion:** In general, under Alternative 6A water operations, the quantity and quality of
37 river lamprey juvenile and adult migration habitat would not be reduced relative to the CEQA
38 baseline.

1 **Macrophthalmia**

2 *Sacramento River*

3 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*
4 *in the Fish Analysis*) for September through November indicate variable effects of Alternative 6A
5 during September, with increases in mean monthly flow (to 38%) in wetter years and decreases (to
6 -21%) in drier years, small-scale increases and decreases in flow (to 9%) during October that would
7 not be expected to have biologically meaningful effects, and negligible effects (<5%) during
8 November for all water year types. Flow reductions during September (to -21%) in dry years, and
9 another small reduction during October in critical years (-9%) would have incremental effects on
10 migration conditions but would not be substantial enough to cause biologically meaningful negative
11 effects on migration conditions.

12 *Feather River*

13 Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C,
14 *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate
15 variable results by month and water year type, with consistent increases in flow (to 83%) during
16 September in all water years that would have beneficial effects on migration conditions, and
17 negligible effects (<5%) or decreases during October and November (to -21%). Decreases in drier
18 water years when effects of flow reductions would be more critical for migration conditions would
19 be small (to -10%). These results indicate that the effects of Alternative 6A on flow would not have
20 biologically meaningful negative effects on migration conditions in the Feather River.

21 *American River*

22 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
23 *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate
24 moderate to substantial reductions in flow (to -57%) during September through November in all
25 water year types, and negligible effects (<5%) or small (9%) to moderate (30%) increases in flow
26 during October. The substantial decrease during September in critical years (-57%) would be
27 partially offset by an increase during October (30%), but would be followed by another decrease
28 during November (-23%). Based on the prevalence of moderate to substantial reductions in flow
29 during 2 out of the 3 months of the migration period and in all water year types, effects of
30 Alternative 6A on flow are expected to have negative effects on migration conditions in the
31 American River.

32 *Stanislaus River*

33 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C,
34 *CALSIM II Model Results utilized in the Fish Analysis*) for September through November indicate
35 negligible effects (<5%) or reductions in flow during September through November in all water year
36 types, with reductions ranging from -5 to -17%. Reductions in drier water years when effects on
37 migration conditions would be more critical would be limited to small-scale effects (-10%).
38 Therefore, despite a predominance of decreases in mean monthly flows under Alternative 6A
39 throughout the migration period, based on the relatively small magnitude, particularly in drier
40 water years, effects are not expected to have biologically meaningful negative effects on river
41 lamprey macrophthalmia migration in the Stanislaus River.

1 Overall, these results indicate that effects of Alternative 6A on flow from September through
2 November would not have biologically meaningful negative effects on river lamprey macrophthalmia
3 migration in the Sacramento River, Feather River, and Stanislaus River, but would affect migration
4 conditions in the American River.

5 **Adults**

6 Effects of Alternative 6A on flow during the adult migration period, September through November,
7 would be the same as described for the macrophthalmia migration period, September through
8 November, above. These results indicate that Alternative 6A would affect adult migration conditions
9 in the American River, and would not have biologically meaningful negative effects in the
10 Sacramento River, Feather River, and Stanislaus River.

11 **Summary of CEQA Conclusion**

12 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between
13 the CEQA baseline and Alternative 6A could be significant because, under the CEQA baseline, the
14 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
15 the movement of fish, contrary to the NEPA conclusion set forth above. Effects of Alternative 6A on
16 flow would affect river lamprey macrophthalmia and adult migration conditions in the American
17 River based on persistent and substantial decreases in mean monthly flow (to -57% in all water year
18 types for September and November), and would not have biologically meaningful effects in the
19 Sacramento River, Feather River, and Stanislaus River (based on primarily negligible effects,
20 increases in flow to 38% that would have beneficial effects, and/or isolated decreases to -21% or
21 more prevalent but small-magnitude decreases, to -10%, that would not have biologically
22 meaningful negative effects).

23 These results are primarily caused by four factors: differences in sea level rise, differences in climate
24 change, future water demands, and implementation of the alternative. The analysis described above
25 comparing Existing Conditions to Alternative 6A does not partition the effect of implementation of
26 the alternative from those of sea level rise, climate change and future water demands using the
27 model simulation results presented in this chapter. However, the increment of change attributable
28 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
29 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
30 implementation period, which does include future sea level rise, climate change, and water
31 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
32 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
33 effect of the alternative from those of sea level rise, climate change, and water demands.

34 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
35 term implementation period and Alternative 6A indicates that flows in the locations and during the
36 months analyzed above would generally be similar between Existing Conditions during the LLT and
37 Alternative 6A. This indicates that the differences between Existing Conditions and Alternative 6A
38 found above would generally be due to climate change, sea level rise, and future demand, and not
39 the alternative. As a result, the CEQA conclusion regarding Alternative 6A, if adjusted to exclude sea
40 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
41 result in a significant impact on migration habitat for juvenile and adult river lamprey. This impact is
42 found to be less than significant and no mitigation is required.

1 **Restoration and Conservation Measures**

2 Alternative 6A has the same restoration and conservation measures as Alternative 1A. Because no
3 substantial differences in fish effects are anticipated anywhere in the affected environment under
4 Alternative 6A compared to those described in detail for Alternative 1A, the effects described for
5 river lamprey under Alternative 1A (Impact AQUA-187 through Impact AQUA-198) also
6 appropriately characterize effects under Alternative 6A.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative
8 6A.

9 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

10 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**
11 **Lamprey**

12 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

13 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

14 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**
15 **(CM13)**

16 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

17 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

18 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

19 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

20 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

21 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

22 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**
23 **(CM21)**

24 **NEPA Effects:** These restoration and conservation measure impact mechanisms have been
25 determined to range from no effect, to not adverse, or beneficial effects on river lamprey for NEPA
26 purposes, for the reasons identified for Alternative 1A (Impact AQUA-187 through 198).

27 **CEQA Conclusion:** These impact mechanisms would be considered to range from no impact, to less
28 than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A (Impact
29 AQUA-187 through 198), and no mitigation is required.

1 **Non-Covered Aquatic Species of Primary Management Concern**

2 **Construction and Maintenance of CM1**

3 The effects of construction and maintenance of CM1 under Alternative 6A would be similar for all
4 non-covered species; therefore, the analysis below is combined for all non-covered species instead
5 of analyzed by individual species.

6 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered** 7 **Aquatic Species of Primary Management Concern**

8 Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water
9 conveyance facilities on non-covered species of primary management concern. That discussion
10 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
11 to the aquatic environment and aquatic species. The potential effects of the construction of water
12 conveyance facilities under Alternative 6A would be similar to those described for Alternative 1A
13 (see Alternative 1A, Impact AQUA-199), because the same five intakes would be constructed. As in
14 Alternative 1A, this would convert 11,900 lineal feet of existing shoreline habitat into intake
15 facilities and would require 27.3 acres of dredge and channel reshaping. Additionally, California bay
16 shrimp would not be affected because they do not occur in the vicinity and Sacramento-San Joaquin
17 roach and hardhead are unlikely to be affected because their primary distributions are upstream.

18 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-199, environmental commitments and
19 mitigation measures would be available to avoid and minimize potential effects, and the effect would
20 not be adverse for non-covered aquatic species of primary management concern.

21 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact
22 of the construction of water conveyance facilities on non-covered aquatic species of primary
23 management concern would not be significant except potentially for construction noise associated
24 with pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b
25 would reduce that noise impact to less than significant.

26 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 27 **of Pile Driving and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

29 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 30 **and Other Construction-Related Underwater Noise**

31 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

32 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered** 33 **Aquatic Species of Primary Management Concern**

34 Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water
35 conveyance facilities on non-covered species of primary management concern. That discussion
36 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
37 to the aquatic environment and aquatic species. Also, California bay shrimp would not be affected
38 because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are
39 unlikely to be affected because their primary distributions are upstream.

1 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
2 Alternative 6A would be similar to those described for Alternative 1A (see Alternative 1A, Impact
3 AQUA-200). Consequently, the effects would not be adverse.

4 **CEQA Conclusion:** As described above, these impacts would be less than significant.

5 **Water Operations of CM1**

6 The effects of water operations of CM1 under Alternative 6A include a detailed analysis of the
7 following species:

- 8 • Striped Bass
- 9 • American Shad
- 10 • Threadfin Shad
- 11 • Largemouth Bass
- 12 • Sacramento tule perch
- 13 • Sacramento-San Joaquin roach – California species of special concern
- 14 • Hardhead – California species of special concern
- 15 • California bay shrimp

16 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic** 17 **Species of Primary Management Concern**

18 Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-
19 covered species of primary management concern.

20 ***Striped Bass***

21 Striped bass eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP
22 Delta diversions and the alternate NBA intake as these life stages are passively transported
23 downstream to the north Delta. Entrainment risk for egg and larval striped bass would be high since
24 pumping rates at the north Delta intakes would be high given the elimination of exports from the
25 south Delta facilities under Alternative 6A. State of the art fish screens on these north Delta intakes
26 though would exclude juvenile and adult striped bass.

27 Entrainment losses under Alternative 6A to the SWP/CVP south delta intakes would be eliminated
28 since there would be no south delta exports under this Alternative.

29 Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile
30 striped bass (Nobriga et al. 2004). Reduction or consolidation of diversions from the ROAs
31 (approximately 4–12% of diversions) would not increase entrainment and may provide a minor
32 benefit.

33 Variations in striped bass survival rates during the first few months of life are moderated by a
34 population bottleneck between YOY striped bass and three-year-old individuals (Kimmerer et al.
35 2000). Therefore it would be expected that elimination of entrainment of juveniles and adults at the
36 south Delta intakes would have a greater population impact than increases in entrainment of striped
37 bass larvae and eggs at the proposed SWP/CVP north Delta intakes and the NBA intake.

1 Furthermore, decommissioning of agricultural diversions may also reduce entrainment of striped
2 bass. Also, restoration activities as part of the conservation measures should increase the amount of
3 habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The
4 expectation is that these habitat changes would result in at least a minor improvement in production
5 of juvenile striped bass.

6 **NEPA Effects:** Overall, the effect on striped bass entrainment would not be adverse.

7 **CEQA Conclusion:** The impact of water operations on entrainment of striped bass would be the
8 same as described immediately above. The changes in entrainment under Alternative 6A would not
9 substantially reduce the striped bass population when other conservation measures are taken into
10 consideration. The impact would be less than significant and no mitigation would be required.

11 **American Shad**

12 American shad eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP
13 Delta diversions and the alternate NBA intake as these life stages are passively transported
14 downstream to the north Delta. The majority of spawning takes place upstream of the Delta, so only
15 limited numbers of American shad eggs and larvae would be exposed to entrainment risk at the
16 north Delta intakes. State of the art fish screens on these north Delta intakes though would exclude
17 juvenile and adult American shad.

18 American shad entrainment losses to the south Delta would be eliminated because there would not
19 be any south Delta exports under Alternative 6A. Reduction or consolidation of agricultural
20 diversions in ROAs would not increase entrainment of American shad, and may provide a modest
21 benefit to the species.

22 **NEPA Effects:** Overall, the effect on American shad would not be adverse, and would be slightly
23 beneficial to the species.

24 **CEQA Conclusion:** The impact of water operations on entrainment of American shad would be the
25 same as described immediately above. The changes in entrainment under Alternative 6A would not
26 substantially reduce the American shad population. The impact would be less than significant and
27 no mitigation would be required.

28 **Threadfin Shad**

29 Entrainment at the south Delta would be eliminated since there would be no water exports from the
30 south delta under Alternative 6A. Decommissioning agricultural diversions in Delta ROAs would
31 potentially reduce threadfin shad entrainment. There would be entrainment of threadfin shad eggs
32 and larvae to the north Delta intakes. However, overall threadfin shad entrainment would be
33 reduced because they are most abundant in the southwestern portion of the Delta and would
34 particularly benefit from the elimination of south Delta pumping.

35 **NEPA Effects:** The effect would not be adverse.

36 **CEQA Conclusion:** The impact of water operations on entrainment of threadfin shad would be the
37 same as described immediately above. The changes in entrainment under Alternative 6A would not
38 substantially reduce and may benefit the threadfin shad population. The impact would be less than
39 significant and no mitigation would be required.

1 **Largemouth Bass**

2 Since largemouth bass are predominantly found in the south and central portions of the Delta,
3 largemouth bass would be most vulnerable to entrainment to south Delta facilities. Entrainment to
4 the south Delta facilities would be effectively eliminated because there would be no water exports
5 from the south Delta under Alternative 6A. As discussed for Alternative 1A (Impact AQUA-201) few
6 larval largemouth bass would be vulnerable to entrainment at the five north Delta intakes and the
7 alternative NBA intake since the majority of the population in the Delta would not encounter the
8 intake structures and don't occur in the vicinity. Decommissioning agricultural diversions could
9 reduce entrainment of largemouth bass since they hold in shallow water habitats where most
10 agricultural diversions are sited.

11 **NEPA Effects:** Overall entrainment would be reduced under Alternative 6A and there would be a
12 benefit for the species.

13 **CEQA Conclusion:** The impact of water operation on largemouth bass would be as described
14 immediately above. The changes in entrainment under Alternative 6A could benefit the largemouth
15 bass population. The impact would be less than significant and no mitigation would be required.

16 **Sacramento Tule Perch**

17 The effects and conclusion for this impact would be the same as Alternative 1A (Impact AQUA-201).
18 Entrainment of Sacramento tule perch to the SWP/CVP south Delta facilities would be effectively
19 eliminated because there would be no south delta exports under Alternative 6A. Because
20 Sacramento tule perch are viviparous, newly born Sacramento tule perch would be large enough to
21 be effectively screened at the proposed north Delta facilities. Reduction or consolidation of these
22 agricultural diversions under the Plan would decrease entrainment of Sacramento tule perch into
23 these agricultural intakes.

24 **NEPA Effects:** Overall the reduction in entrainment of Sacramento tule perch under Alternative 6A
25 would not be adverse, and would provide a benefit for the species.

26 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would
27 be the same as described immediately above. The changes in entrainment under Alternative 6A
28 would be slightly beneficial to the Sacramento tule perch. The impact would be less than significant
29 and no mitigation would be required.

30 **Sacramento-San Joaquin Roach**

31 **NEPA Effects:** The effect of water operations on entrainment of Sacramento-San Joaquin roach
32 under Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A,
33 Impact AQUA-201). For a detailed discussion, please see Alternative 1A, Impact AQUA-201. The
34 effects would not be adverse.

35 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento-San Joaquin roach
36 would be the same as described immediately above and would be less than significant.

37 **Hardhead**

38 **NEPA Effects:** The effect of water operations on entrainment of hardhead under Alternative 6A
39 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a
40 detailed discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

1 **CEQA Conclusion:** The impact of water operations on entrainment of hardhead would be the same
2 as described immediately above and would be less than significant.

3 **California Bay Shrimp**

4 **NEPA Effects:** California bay shrimp do not occur in the vicinity of the intakes so there would be no
5 entrainment effect on them.

6 **CEQA Conclusion:** California bay shrimp do not occur in the vicinity of the intakes so there would be
7 no entrainment impact on them.

8 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
9 **Non-Covered Aquatic Species of Primary Management Concern**

10 Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-
11 covered species of primary management concern.

12 **Striped Bass**

13 In general, Alternative 6A would slightly improve the quality and quantity of upstream habitat
14 conditions for striped bass relative to NAA.

15 **Flows**

16 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
17 Clear Creek were examined during the April through June striped bass spawning, embryo
18 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
19 habitat available for spawning, egg incubation, and rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
21 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
22 *utilized in the Fish Analysis*).

23 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
24 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
25 *utilized in the Fish Analysis*).

26 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to flows under NAA
27 during April through June, regardless of water year, except in critical years during June (8% lower)
28 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
30 greater than flows under NAA during April through June, except in critical years during April (7%
31 lower), dry and critical years during May (24% and 11% lower, respectively), and dry years during
32 June (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or
34 greater than flows under NAA except in dry and critical years during April (13% and 5% lower,
35 respectively) and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized*
36 *in the Fish Analysis*).

1 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
2 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
3 flows relative to the NAA.

4 *Water Temperature*

5 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
6 bass spawning, embryo incubation, and initial rearing during April through June was examined in
7 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
8 range could lead to reduced spawning success and increased egg and larval stress and mortality.
9 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
11 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
12 indicates that there would be no temperature related effects in these rivers during the April through
13 June period.

14 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
15 Alternative 6A would not cause a substantial reduction in striped bass spawning, incubation, or
16 initial rearing habitat relative to NAA. Flows in all rivers examined during the April through June
17 spawning, incubation, and initial rearing period under Alternative 6A would generally be similar to
18 or greater than flows under NAA, with relatively infrequent, small magnitude reductions in flow that
19 would not have biologically meaningful negative effects. There would be small (7% lower) to
20 moderate (31% lower) flow reductions in the Feather River below Thermalito Afterbay in drier
21 water year types throughout the spawning, incubation, and rearing period. Considered collectively
22 with the results for the other locations analyzed, this would not have biologically meaningful
23 negative effects on striped bass spawning and rearing success. There would be no temperature
24 related effects of Alternative 6A on striped bass.

25 **CEQA Conclusion:** In general, Alternative 6A would not affect the quality and quantity of upstream
26 habitat conditions for striped bass relative to Existing Conditions.

27 *Flows*

28 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
29 Clear Creek were examined during the April through June striped bass spawning, embryo
30 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
31 habitat available for spawning, egg incubation, and rearing.

32 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
33 or greater than flows under Existing Conditions during April through June, except in below normal
34 years during April (7% lower), and wet and below normal years during May (16% and 10% lower,
35 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
37 or greater than flows under Existing Conditions during April through June, except in critical years
38 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

39 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows
40 under Existing Conditions during April through June regardless of water year type (Appendix 11C,
41 *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
2 substantially greater than flows under Existing Conditions during April through June, except in wet
3 and above normal years during May (32% and 8% lower, respectively) and in wet and dry years
4 during June (11% and 27% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
5 *the Fish Analysis*).

6 In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or less than flows
7 under Existing Conditions during April through June in all water year types with flows ranging from
8 6% to 45% lower in both wetter (to 34% lower) and drier (to 45% lower) water year types
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
11 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
12 moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus
13 River at the confluence with the San Joaquin River, flows under A6A_LLT would be from 11% to
14 27% lower in both wetter (to 14% lower) and drier (to 27% lower) water year types, except in wet
15 years during June (10% greater), compared to Existing Conditions (Appendix 11C, *CALSIM II Model*
16 *Results utilized in the Fish Analysis*).

17 *Water Temperature*

18 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
19 bass spawning, embryo incubation, and initial rearing during April through June was examined in
20 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
21 range could lead to reduced spawning success and increased egg and larval stress and mortality.
22 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

23 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
24 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
25 indicates that there would be no temperature related effects in these rivers during the April through
26 June period.

27 **Summary of CEQA Conclusions**

28 Collectively, these results indicate that the effect would not be significant because Alternative 6A
29 would not cause a substantial reduction in striped bass spawning, incubation, and initial rearing
30 habitat relative to CEQA Existing Conditions. Therefore, no mitigation is necessary. Flows in all
31 rivers except the American and Stanislaus rivers during the April through June period under
32 Alternative 6A would generally be similar to or greater than flows under CEQA Existing Conditions;
33 there would be an infrequent occurrence of flow reductions for some locations that would be of
34 small magnitude and/or would occur in wetter water year types when effects of flow reductions are
35 less critical. There would be more persistent, moderate flow reductions in the American River and
36 the Stanislaus River, including in drier water year types (to 45% lower in the American River and to
37 27% lower in the Stanislaus River). However, considered collectively with the results for the other
38 locations analyzed, these reductions would not have biologically meaningful negative effects on
39 striped bass spawning and rearing success. The percentage of months outside the 59°F to 68°F
40 water temperature range under Alternative 6A would be similar to or lower than under CEQA
41 Existing Conditions.

1 **American Shad**

2 In general, Alternative 6A would slightly improve the quality and quantity of upstream habitat
3 conditions for American shad relative to NAA.

4 **Flows**

5 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
6 Clear Creek were examined during the April through June American shad adult migration and
7 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
8 quality for spawning.

9 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
10 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
11 *utilized in the Fish Analysis*).

12 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
13 or greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
14 *utilized in the Fish Analysis*).

15 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to flows under NAA
16 during April through June, regardless of water year, except in critical years during June (8% lower)
17 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
19 greater than flows under NAA during April through June, except in critical years during April (7%
20 lower), dry and critical years during May (24% and 11% lower, respectively), and dry years during
21 June (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or
23 greater than flows under NAA except in dry and critical years during April (13% and 5% lower,
24 respectively) and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized*
25 *in the Fish Analysis*).

26 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
27 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
28 flows relative to the NAA.

29 **Water Temperature**

30 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
31 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
32 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
33 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
34 were not modeled in the San Joaquin River or Clear Creek.

35 Water temperatures in the Sacramento, Trinity, Feather American, and Stanislaus rivers under
36 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
37 indicates that there would be no temperature related effects in these rivers during the April through
38 June period.

39 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
40 Alternative 6A would not cause a substantial reduction in American shad adult migration and

1 spawning habitat. Flows in all rivers examined during the April through June adult migration and
2 spawning period under Alternative 6A would generally be similar to or greater than flows under
3 NAA, with relatively infrequent, small magnitude reductions in flow that would not have biologically
4 meaningful negative effects. There would be small (7% lower) to moderate (31% lower) flow
5 reductions in the Feather River below Thermalito Afterbay in drier water year types throughout the
6 adult migration and spawning period. Considered collectively with the results for the other locations
7 analyzed, this flow reduction would not have biologically meaningful negative effects on American
8 shad adult migration and spawning success. There would be no temperature related effects of
9 Alternative 6A on American shad.

10 **CEQA Conclusion:** In general, Alternative 6A would not affect the quality and quantity of upstream
11 habitat conditions for American shad relative to Existing Conditions.

12 *Flows*

13 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
14 Clear Creek were examined during the April through June American shad adult migration and
15 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
16 quality for spawning.

17 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
18 or greater than flows under Existing Conditions during April through June, except in below normal
19 years during April (7% lower), and wet and below normal years during May (16% and 10% lower,
20 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
22 or greater than flows under Existing Conditions during April through June, except in critical years
23 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows
25 under Existing Conditions during April through June regardless of water year type (Appendix 11C,
26 *CALSIM II Model Results utilized in the Fish Analysis*).

27 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
28 substantially greater than flows under Existing Conditions during April through June, except in wet
29 and above normal years during May (32% and 8% lower, respectively) and in wet and dry years
30 during June (11% and 27% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
31 *the Fish Analysis*).

32 In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or less than flows
33 under Existing Conditions during April through June in all water year types with flows ranging from
34 6% to 45% lower in both wetter (to 34% lower) and drier (to 45% lower) water year types
35 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
37 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
38 moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus
39 River at the confluence with the San Joaquin River, flows under A6A_LLT would be similar to or less
40 than flows under Existing Conditions during April through June in all water year types with flows
41 ranging from 11% to 27% lower in both wetter (to 14% lower) and drier (to 27% lower) water year

1 types, except in wet years during June (10% greater) (Appendix 11C, *CALSIM II Model Results*
2 *utilized in the Fish Analysis*).

3 *Water Temperature*

4 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
5 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
6 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
7 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
8 were not modeled in the San Joaquin River or Clear Creek.

9 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
10 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
11 indicates that there would be no temperature related effects in these rivers during the April through
12 June period.

13 **Summary of CEQA Conclusions**

14 Collectively, these results indicate that the impact would not be significant because Alternative 6A
15 would not cause a substantial reduction in American shad adult migration and spawning habitat,
16 and no mitigation is necessary. Flows in all rivers except the American and Stanislaus rivers during
17 the April through June adult migration and spawning period under Alternative 6A would generally
18 be similar to or greater than flows under CEQA Existing Conditions; there would be an infrequent
19 occurrence of flow reductions for some locations that would be of small magnitude and/or would
20 occur in wetter water year types when effects of flow reductions are less critical. There would be
21 more persistent, moderate flow reductions in the American River and the Stanislaus River, including
22 in drier water year types (to 45% lower in the American River and to 27% lower in the Stanislaus
23 River). However, considered collectively with the results for the other locations analyzed, these
24 reductions would not have biologically meaningful negative effects on American shad adult
25 migration and spawning success. The percentage of months outside the 60°F to 70°F water
26 temperature range under Alternative 6A would be similar to or lower than under the CEQA Existing
27 Conditions.

28 ***Threadfin Shad***

29 In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions
30 for threadfin shad relative to NAA.

31 *Flows*

32 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
33 Clear Creek were examined during April through August threadfin shad spawning period. Lower
34 flows could reduce the quantity and quality of instream habitat available for spawning.

35 In the Sacramento River upstream of Red Bluff, flows under A6A_LL1T would generally be similar to
36 or greater than flows under NAA during April through August except in drier water year types
37 during August relative to NAA (7% to 10% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
38 *the Fish Analysis*). These are relatively small flow reductions that would not have biologically
39 meaningful negative effects.

1 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would be similar to or greater
2 than flows under NAA during April through August in all water year types (Appendix 11C, *CALSIM II*
3 *Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to flows under NAA
5 during April through August, regardless of water year, except in critical years during June (8%
6 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would be similar to or greater
8 than flows under NAA except in critical years during April (7% lower), dry and critical years during
9 May (24% and 11% lower, respectively), dry years during June (31% lower), all water years during
10 July (to 43% lower), and in wet and above normal years during August (to 14% lower) (Appendix
11 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water year types,
12 when effects on habitat conditions would be most critical, consist of small to moderate reductions in
13 dry (to 43% lower) and/or critical years (to 22% lower) for most of the spawning period.

14 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows
15 under NAA during April through August with the exception of relatively small increases (to 14%
16 greater) or decreases (to 13% lower) that would not have biologically meaningful effects (Appendix
17 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
19 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
20 flows relative to the NAA.

21 *Water Temperature*

22 The percentage of months below 68°F water temperature threshold for the April through August
23 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
24 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
25 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
26 Creek.

27 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
28 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
29 indicates that there would be no temperature-related effects in these rivers throughout the year.

30 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
31 Alternative 6A would not cause a substantial reduction in threadfin shad spawning habitat relative
32 to NAA. Flows in all rivers examined during the April through August spawning period under
33 Alternative 6A would generally be similar to or greater than flows under NAA, with relatively
34 infrequent, small magnitude reductions in flow that would not have biologically meaningful negative
35 effects. There would be moderate to substantial (to 43% lower) flow reductions in the Feather River
36 below Thermalito Afterbay in drier water year types throughout the spawning period. Considered
37 collectively with the results for the other locations analyzed, this would not have biologically
38 meaningful negative effects on threadfin shad spawning success. The percentage of months below
39 the spawning temperature threshold would be similar under Alternative 6A relative to NAA.

40 **CEQA Conclusion:** In general, Alternative 6A would not affect the quality and quantity of upstream
41 habitat conditions for threadfin shad relative to CEQA Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
3 Clear Creek were examined during April through August spawning period. Lower flows could reduce
4 the quantity and quality of instream habitat available for spawning.

5 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
6 or greater than flows under Existing Conditions during April through August, except in below
7 normal years during April (7% lower), wet and below normal years during May (16% and 10%
8 lower, respectively), and dry and critical years during August (7% and 20% lower, respectively)
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively small,
10 isolated flow reductions that would not have biologically meaningful negative effects.

11 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
12 or greater than flows under Existing Conditions during April through June, except in critical years
13 during May (6% lower), in wet years during July (14% lower), and in critical years during August
14 (25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow
15 reductions are of small magnitude and/or isolated and would not have biologically meaningful
16 negative effects.

17 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows
18 under Existing Conditions during April through August regardless of water year type, except in
19 critical years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
20 Analysis*). This isolated flow reduction would not have biologically meaningful negative effects.

21 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
22 substantially greater than flows under Existing Conditions during April through June, except in wet
23 and above normal years during May (32% and 8% lower, respectively), in wet and dry years during
24 June (11% and 27% lower, respectively), in all water year types during July (to 45% lower), and in
25 dry years during August (31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
26 Analysis*). Persistent, moderate flow reductions would occur in dry years (to 45% lower) relative to
27 Existing Conditions and would have a localized effect on spawning conditions for that particular
28 type of water year.

29 In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or less than flows
30 under Existing Conditions during April through August in all water year types with flows ranging
31 from 6% to 45% lower in both wetter (to 34% lower) and drier (to 45% lower) water year types,
32 with the single exception of greater flows relative to Existing Conditions in critical years during July
33 (30% greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These persistent,
34 substantial flow reductions would affect spawning conditions for this location.

35 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
36 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
37 moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus
38 River at the confluence with the San Joaquin River, flows under A6A_LLT would be similar to or less
39 than flows under Existing Conditions during April through August in all water year types with flows
40 ranging from 11% to 27% lower in both wetter (to 23% lower) and drier (to 27% lower) water year
41 types, except in wet years during June (10% greater) (Appendix 11C, *CALSIM II Model Results
42 utilized in the Fish Analysis*). These persistent, substantial flow reductions would affect spawning
43 conditions for this location, particularly in drier water year types.

1 *Water Temperature*

2 The percentage of months below 68°F water temperature threshold for the April through August
3 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
4 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
5 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
6 Creek.

7 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
8 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
9 indicates that there would be no temperature-related effects in these rivers during the April through
10 November period.

11 **Summary of CEQA Conclusions**

12 Collectively, these results indicate that the effect would be significant because Alternative 6A would
13 cause a substantial reduction in threadfin shad spawning habitat relative to CEQA Existing
14 Conditions. Flows in all rivers except the Feather, American and Stanislaus rivers during the April
15 through August spawning period under Alternative 6A would generally be similar to or greater than
16 flows under CEQA Existing Conditions; with infrequent occurrence of relatively small flow
17 reductions for some locations that would be of small magnitude and/or would occur in wetter water
18 year types when effects of flow reductions are less critical. Conversely, there would be more
19 persistent, moderate to substantial flow reductions in the Feather River (to 45% lower), the
20 American River (to 45% lower), and the Stanislaus River (to 27% lower), including in drier water
21 year types when effects on spawning conditions would be more critical. The percentage of months
22 outside all temperature thresholds is similar under Alternative 6A to CEQA Existing Conditions. This
23 impact is a result of the specific reservoir operations and resulting flows associated with this
24 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
25 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
26 change the alternative, thereby making it a different alternative than that which has been modeled
27 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
28 mitigation available.

29 The NEPA and CEQA conclusions differ for this impact statement because they were determined
30 using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LL1 with
31 NAA and the CEQA conclusion was based on the comparison of A6A_LL1 with Existing Conditions.
32 These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
33 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
34 NEPA point of comparison is assumed to occur during the late long-term implementation period
35 whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore,
36 differences in model outputs between the CEQA baseline and the Alternative 6A are due primarily to
37 both the alternative and future climate change.

38 ***Largemouth Bass***

39 In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions
40 for largemouth bass relative to NAA.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
3 Clear Creek were examined during the March through June largemouth bass spawning period.
4 Lower flows could reduce the quantity and quality of instream spawning habitat.

5 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
6 or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*
7 *utilized in the Fish Analysis*).

8 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
9 or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*
10 *utilized in the Fish Analysis*).

11 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows
12 under NAA during March through June in all water year types except in below normal years during
13 March (6% lower) and in critical years during June (8% lower) (Appendix 11C, *CALSIM II Model*
14 *Results utilized in the Fish Analysis*).

15 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would be the same or greater
16 than flows under NAA (up to 26% greater) during March through June except infrequently (to 31%
17 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions under
18 A6A_LLT would not be consistent month to month in any specific water year type and would not
19 have biologically meaningful negative effects.

20 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or
21 greater than flows under NAA with a few isolated, small to moderate flow reductions, including in
22 critical years during March (21% lower), dry and critical years during April (13% and 5% lower,
23 respectively), and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized*
24 *in the Fish Analysis*). The flow reductions are infrequent and relatively small and would not have
25 biologically meaningful negative effects.

26 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
27 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
28 flows relative to the NAA.

29 *Water Temperature*

30 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
31 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
32 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
33 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
34 Creek.

35 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
36 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
37 indicates that there would be no temperature-related effects in these rivers during the March
38 through June period.

39 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse.

1 **CEQA Conclusion:** In general, Alternative 6A would reduce the quality and quantity of upstream
2 habitat conditions for largemouth bass relative to CEQA Existing Conditions.

3 *Flows*

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
5 Clear Creek were examined during the March through June largemouth bass spawning period.
6 Lower flows could reduce the quantity and quality of instream spawning habitat.

7 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
8 or greater than flows under Existing Conditions during March through June, except in below normal
9 years during March and April (11% and 7% lower, respectively), and wet and below normal years
10 during May (16% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
11 *the Fish Analysis*).

12 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
13 or greater than flows under Existing Conditions during March through June, except in below normal
14 years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*).

16 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always be similar to or greater
17 than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model*
18 *Results utilized in the Fish Analysis*).

19 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable effects
20 relative to flows under Existing Conditions, with flows under A6A_LLT greater than flows under
21 Existing Conditions in wetter years during March, dry years during April, drier water year types
22 during May, and above and below normal water years during June. Flows under A6A_LLT would be
23 lower relative to flows under Existing Conditions in drier water year types during March (to 40%
24 lower), in critical years during April (6% lower), in wetter water year types during May (to 32%
25 lower), and in wet (11% lower) and dry (27% lower) years during June (Appendix 11C, *CALSIM II*
26 *Model Results utilized in the Fish Analysis*). This consists of relatively inconsistent effects during
27 March through June for any specific water year type (i.e., increases in flow in some months would
28 generally offset the decreases in other months) and would not have biologically meaningful negative
29 effects.

30 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or
31 greater than flows under Existing Conditions during March except in critical years (21% lower), and
32 similar to or lower than flows under Existing Conditions during April through June (to 45% lower)
33 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to
34 moderate flow reductions in dry (to 11% lower) or critical (to 45% lower) years in each month that
35 would affect habitat conditions primarily in critical years.

36 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
37 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
38 moderate reductions in flows during the period relative to Existing Conditions. Flow reductions in
39 drier water years, when effects would be most critical for spawning conditions, consist of persistent,
40 moderate reductions (14% to 30% lower) for March through May (Appendix 11C, *CALSIM II Model*
41 *Results utilized in the Fish Analysis*).

1 *Water Temperature*

2 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
3 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
4 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
5 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
6 Creek.

7 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
8 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
9 indicates that there would be no temperature-related effects in these rivers during the March
10 through June period.

11 ***Sacramento Tule Perch***

12 ***NEPA Effects:*** The effects of water operations on spawning habitat for Sacramento tule perch under
13 Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact
14 AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects
15 would not be adverse.

16 ***CEQA Conclusion:*** As described above the impacts on Sacramento tule perch spawning habitat
17 would not be significant.

18 ***Sacramento-San Joaquin Roach – California Species of Special Concern***

19 In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions
20 for Sacramento-San Joaquin Roach relative to NAA.

21 *Flows*

22 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
23 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
24 period. Lower flows could reduce the quantity and quality of instream habitat available for
25 spawning.

26 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
27 or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*
28 *utilized in the Fish Analysis*).

29 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
30 or greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*
31 *utilized in the Fish Analysis*).

32 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would be similar to or greater than flows
33 under NAA during March through June in all water year types except in critical years during June
34 (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would be the same or greater
36 than flows under NAA (up to 26% greater) during March through June except infrequently (to 31%
37 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions under
38 A6A_LLT would not be consistent month to month in any specific water year type and would not
39 have biologically meaningful negative effects.

1 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or
2 greater than flows under NAA with a few isolated, small to moderate flow reductions, including in
3 critical years during March (21% lower), dry and critical years during April (13% and 5% lower,
4 respectively), and dry years during June (7% lower) (Appendix 11C, *CALSIM II Model Results utilized*
5 *in the Fish Analysis*). The flow reductions are infrequent and relatively small and would not have
6 biologically meaningful negative effects.

7 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
8 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
9 flows relative to the NAA.

10 *Water Temperature*

11 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
12 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
13 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
14 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
15 River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
17 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
18 indicates that there would be no temperature-related effects in these rivers during the March
19 through June period.

20 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse.

21 **CEQA Conclusion:** In general, Alternative 6A would affect the quality and quantity of upstream
22 habitat conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

23 *Flows*

24 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
25 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
26 period. Lower flows could reduce the quantity and quality of instream habitat available for
27 spawning.

28 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
29 or greater than flows under Existing Conditions during March through June, except in below normal
30 years during March and April (11% and 7% lower, respectively), and wet and below normal years
31 during May (16% and 10% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
32 *the Fish Analysis*).

33 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
34 or greater than flows under Existing Conditions during March through June, except in below normal
35 years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*
36 *Model Results utilized in the Fish Analysis*).

37 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always be similar to or greater
38 than flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model*
39 *Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable effects
2 relative to flows under Existing Conditions, with flows under A6A_LLT greater than flows under
3 Existing Conditions in wetter years during March, dry years during April, drier water year types
4 during May, and above and below normal water years during June. Flows under A6A_LLT would be
5 lower relative to flows under Existing Conditions in drier water year types during March (to 40%
6 lower), in critical years during April (6% lower), in wetter water year types during May (to 32%
7 lower), and in wet (11% lower) and dry (27% lower) years during June (Appendix 11C, *CALSIM II*
8 *Model Results utilized in the Fish Analysis*). This consists of relatively inconsistent effects during
9 March through June for any specific water year type (i.e., increases in flow in some months would
10 generally offset the decreases in other months) and would not have biologically meaningful negative
11 effects.

12 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or
13 greater than flows under Existing Conditions during March except in critical years (21% lower), and
14 similar to or lower than flows under Existing Conditions during April through June (to 45% lower)
15 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to
16 moderate flow reductions in dry (to 11% lower) or critical (to 45% lower) years in each month that
17 would affect habitat conditions primarily in critical years.

18 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
19 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
20 moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the
21 Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years,
22 when effects would be most critical for spawning conditions, consist of persistent, moderate
23 reductions (14% to 30% lower) for March through May.

24 *Water Temperature*

25 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
26 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
27 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
28 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
29 River or Clear Creek.

30 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
31 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
32 indicates that there would be no temperature-related effects in these rivers during the March
33 through June period.

34 ***Hardhead – California Species of Special Concern***

35 In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions
36 for hardhead relative to NAA.

37 *Flows*

38 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
39 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
40 could reduce the quantity and quality of instream habitat available for spawning.

1 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would be similar to or greater
2 than flows under NAA during April and May in all water year types (Appendix 11C, *CALSIM II Model*
3 *Results utilized in the Fish Analysis*).

4 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
5 or greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*
6 *utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always to be similar to flows
8 under NAA throughout the period regardless of water year type (Appendix 11C, *CALSIM II Model*
9 *Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
11 greater than flows under NAA except in critical years during April (7% lower) and in dry (24%
12 lower) and critical years (11% lower) during May (Appendix 11C, *CALSIM II Model Results utilized in*
13 *the Fish Analysis*). These are relatively isolated, moderate magnitude flow reductions that are not
14 expected to cause biologically meaningful negative effects.

15 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or
16 greater than flows under NAA during April and May except in dry (13% lower) and critical (5%
17 lower) years during April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These
18 are small flow reductions that would not have biologically meaningful negative effects.

19 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
20 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
21 flows relative to NAA.

22 *Water Temperature*

23 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
24 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
25 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
26 spawning success and increased egg and larval stress and mortality. Water temperatures were not
27 modeled in the San Joaquin River or Clear Creek.

28 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
29 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
30 indicates that there would be no temperature-related effects in these rivers throughout the year.

31 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse.

32 **CEQA Conclusion:** In general, Alternative 6A would not affect the quality and quantity of upstream
33 spawning habitat conditions for hardhead relative to CEQA Existing Conditions.

34 *Flows*

35 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
36 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
37 could reduce the quantity and quality of instream habitat available for spawning.

38 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
39 or greater than flows under Existing Conditions throughout the period, except in below normal

1 years during April (7% lower) and in wet and below normal years during May (16% and 10% lower,
2 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are
3 relatively small reductions in flow that would not have biologically meaningful negative effects.

4 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would be similar to or greater
5 than flows under Existing Conditions throughout the period, except in critical years during May (6%
6 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would always be similar to or greater
8 than flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*
9 *utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
11 greater than flows under Existing Conditions throughout the period, except in critical years during
12 April (6% lower), and in wet and above normal years during May (32% and 8% lower, respectively)
13 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of
14 small magnitude and/or occur in wetter water year types when effects of flow reductions would be
15 less critical for effects on habitat conditions.

16 In the American River at Nimbus Dam, flows under A6A_LLT would be similar to or lower than flows
17 under Existing Conditions during April and May, ranging from 7% to 32% lower (Appendix 11C,
18 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when
19 effects would be more critical for habitat conditions, would consist of negligible effects or relatively
20 small flow reductions (7% and 26% in below normal years, negligible or to 14% lower in dry and
21 critical years) that would not be expected to have biologically meaningful negative effects.

22 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
23 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
24 moderate reductions in flows during the period relative to Existing Conditions. In the Stanislaus
25 River at the confluence with the San Joaquin River, flows under A6A_LLT in drier water years, when
26 effects would be more critical for habitat conditions, would consist of moderate flow reductions (to
27 19% lower in below normal years, 17% to 19% lower in dry and critical years). While persistent
28 throughout the relatively short spawning period, the overall magnitude of these flow reductions is
29 relatively small and would not have biologically meaningful negative effects on the hardhead
30 population.

31 *Water Temperature*

32 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
33 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
34 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
35 spawning success and increased egg and larval stress and mortality. Water temperatures were not
36 modeled in the San Joaquin River or Clear Creek.

37 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
38 Alternative 6A would be the same as those under Alternative 1A.

39 *California Bay Shrimp*

40 **NEPA Effects:** The effect of water operations on spawning habitat of California bay shrimp under
41 Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact

1 AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects
2 would not be adverse.

3 **CEQA Conclusion:** As described above the impacts on California bay shrimp rearing would be less
4 than significant.

5 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**
6 **Species of Primary Management Concern**

7 Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-
8 covered species of primary management concern.

9 ***Striped Bass***

10 The discussion under Alternative 6A, Impact AQUA-202 for striped bass also addresses the embryo
11 incubation and initial rearing period. That analysis indicates that there is no adverse effect on
12 striped bass rearing during that period. Other effects of water operations on rearing habitat for
13 striped bass under Alternative 6A would be similar to that described for Alternative 1A (see
14 Alternative 1A, Impact AQUA-203).

15 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

16 **CEQA Conclusion:** As described above the impacts on striped bass rearing habitat would be less
17 than significant.

18 ***American Shad***

19 The effects of water operations on rearing habitat for American shad under Alternative 6A would be
20 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

21 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

22 **CEQA Conclusion:** As described above the impacts on American shad rearing habitat would be less
23 than significant.

24 ***Threadfin Shad***

25 The effects of water operations on rearing habitat for threadfin shad under Alternative 6A would be
26 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

27 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

28 **CEQA Conclusion:** As described above the impacts on threadfin shad rearing habitat would be less
29 than significant.

30 ***Largemouth Bass***

31 ***Juveniles***

32 ***Flows***

33 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
34 Clear Creek were examined during the April through November juvenile largemouth bass rearing

1 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
2 rearing.

3 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
4 or greater than flows under NAA during all months but August, September, and November with
5 infrequent exceptions (up to 9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
6 *Analysis*). Flows under A6A_LLT during August, September, and November would generally be lower
7 by up to 16% depending on month, water year type, and time period. Flow reductions under
8 A6A_LLT relative to NAA would be no greater than 13% lower in drier water years when effects of
9 flow reductions would be more critical for habitat conditions and would therefore not have
10 biologically meaningful negative effects.

11 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally similar to or
12 greater than flows under NAA in August through November except in critical years during October
13 (10% lower) and wet years during November (7% lower) (Appendix 11C, *CALSIM II Model Results*
14 *utilized in the Fish Analysis*). These isolated, small flow reductions relative to NAA would not have
15 biologically meaningful effects.

16 In Clear Creek at Whiskeytown Dam, April through November flows under A6A_LLT would generally
17 be similar to or greater than flows under NAA except in critical years during June (8% lower)
18 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
20 greater than flows under NAA during June and September, and similar to or lower than flows under
21 NAA during April, May, July, August, October, and November (up to 43% lower) (Appendix 11C,
22 *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in flow (to 43% lower)
23 would be prevalent in drier water year types for May, June, and July.

24 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or lower
25 than flows under NAA in April (to 13% lower), July (to 13% lower), and September (to 30% lower),
26 and similar to or greater than flows under NAA in the remaining months with isolated occurrences
27 of small flow reductions (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
28 *Analysis*). Based on the relatively small magnitude and infrequent occurrence of flow reductions,
29 effects would not be biologically meaningful.

30 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
31 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
32 flows relative to the NAA.

33 *Water Temperature*

34 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
35 rearing during April through November was examined in the Sacramento, Trinity, Feather,
36 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
37 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
38 temperatures were not modeled in the San Joaquin River or Clear Creek.

39 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
40 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
41 indicates that there would be no temperature-related effects in these rivers during the April through
42 November period.

1 *Adults*

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
4 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows
5 could reduce the quantity and quality of instream habitat available for adult rearing.

6 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
7 or greater than flows under NAA during all months but August, September, and November with
8 some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
9 *Analysis*). Flows under A6A_LLT during August, September, and November would be lower than
10 flows under NAA (up to 16% lower depending on month, water year type, and time period). Flow
11 reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when
12 effects of flow reductions would be more critical for habitat conditions. These are relatively small
13 flow reductions that are not expected to have biologically meaningful negative effects on adult
14 rearing conditions.

15 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT generally be similar to or
16 greater than flows under NAA with two, isolated, small exceptions, in critical years during October
17 (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II Model Results*
18 *utilized in the Fish Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
20 than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C,
21 *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful
22 effects.

23 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
24 greater than flows under NAA from January through April, June, and September, with some
25 exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows
27 under NAA, with flows generally similar to or greater than flows under NAA in January through June,
28 August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix
29 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be
30 similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and
31 September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the*
32 *Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on
33 habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year
34 types) and would be intermittent by month and water year type and would be offset by increases in
35 flow in other months and therefore are not expected to have biologically meaningful negative
36 effects.

37 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
38 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
39 flows relative to the NAA.

40 *Water Temperature*

41 The percentage of months above the 86°F water temperature threshold for year-round adult
42 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and

1 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
2 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
3 modeled in the San Joaquin River or Clear Creek.

4 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
5 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
6 indicates that there would be no temperature-related effects in these rivers during the year-round
7 period.

8 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
9 Alternative 6A would not cause a substantial reduction in spawning habitat or juvenile and adult
10 rearing habitat. Flows in all rivers examined during the year under Alternative 6A are generally
11 similar to or greater than flows under NAA in most months, with only infrequent, isolated
12 reductions in flow. Flows from May through July (affecting juvenile and adult rearing) and December
13 (affecting adult rearing) are generally lower in the Feather River high-flow channel in drier water
14 year types (to 43% lower), although these reductions would not be biologically meaningful to the
15 largemouth bass population. Also, there are no temperature-related effects in any of the rivers
16 examined.

17 **CEQA Conclusion:** In general, Alternative 6A would reduce the quality and quantity of upstream
18 habitat conditions for largemouth bass relative to CEQA Existing Conditions.

19 *Juveniles*

20 *Flows*

21 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
22 Clear Creek were examined during the April through November juvenile largemouth bass rearing
23 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
24 rearing.

25 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
26 or greater than flows under Existing Conditions in all months but August, September, and October
27 with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
28 *Analysis*). Flows during August, September, and October under A6A_LLT would be as much as 21%
29 lower than flows under Existing Conditions depending on the month and water year type, with fairly
30 persistent, small to moderate flow reductions in dry and critical years for these months. Based on
31 the relatively small magnitude, this effect is not expected to have biologically meaningful negative
32 effects on rearing conditions.

33 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT during April through July
34 would generally be similar to or greater than flows under Existing Conditions throughout the year
35 with a few, isolated exceptions (up to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
36 *the Fish Analysis*). Flows under A6A_LLT during August through November would be similar to or
37 lower than flows under Existing Conditions (to 37% lower) with the largest flow reductions in
38 critical years.

39 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
40 than flows under Existing Conditions throughout the April through November period, except in
41 critical years during August through November (ranging from 6% to 28% lower) and in below

1 normal years during October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
2 *Analysis*).

3 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally have variable
4 effects by water year type during April, May, and June, with increases in flow to 48% and decreases
5 in flow to 32% lower; would generally be similar to or greater than flows under Existing Conditions
6 during August and September, and would generally be similar to or less than flows under Existing
7 Conditions during July, October, and November (to 44% lower) (Appendix 11C, *CALSIM II Model*
8 *Results utilized in the Fish Analysis*). Occurrence of moderate flow reductions in drier water years
9 would be infrequent and would be offset by increases in other months. The most persistent,
10 moderate reductions would be in dry years during June (27% lower), July (45% lower), and August
11 (31% lower).

12 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to or lower
13 than flows under Existing Conditions for all months (to 48% lower) except during October, for
14 which flows would be similar to or greater than flows under Existing Conditions (Appendix 11C,
15 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT during April through
16 November in drier water years, when effects on habitat conditions would be most critical, include
17 small to substantial (48% lower) flow reductions for most months.

18 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
19 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
20 moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the
21 Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years,
22 when effects would be most critical for rearing conditions, consist of persistent, small to moderate
23 reductions (6% to 27% lower) for April, May, July, October, and November (Appendix 11C, *CALSIM II*
24 *Model Results utilized in the Fish Analysis*).

25 *Water Temperature*

26 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
27 rearing during April through November was examined in the Sacramento, Trinity, Feather,
28 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
29 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
30 temperatures were not modeled in the San Joaquin River or Clear Creek.

31 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
32 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
33 indicates that there would be no temperature-related effects in these rivers during the April through
34 November period.

35 *Adults*

36 *Flows*

37 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
38 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower
39 flows could reduce the quantity and quality of instream habitat available for adult rearing.

40 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
41 or greater than flows under Existing Conditions during all months but August, September, and

1 October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
2 *the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows
3 under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow
4 reductions in dry and critical years. Based on the relatively small magnitude, this effect is not
5 expected to have biologically meaningful negative effects on adult rearing conditions.

6 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
7 or greater than flows under Existing Conditions during January through July, with a few, isolated
8 exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally
9 be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial
10 flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
11 *Analysis*).

12 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
13 than flows under Existing Conditions throughout the year, except in critical years during August
14 through November (ranging from 6% and 28% lower) and in below normal years during October
15 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results
17 relative to flows under Existing Conditions from February through June, with decreases to 46%
18 lower than under Existing Conditions, and would generally be lower than flows under Existing
19 Conditions during January (to 43% lower), July (to 45% lower), and October through December (to
20 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under
21 Existing Conditions for August and September, with one exception (31% lower in dry years during
22 August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in
23 flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46%
24 lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and
25 December (to 41% lower).

26 In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January
27 (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to
28 or greater than flows under Existing Conditions in February, March, and October with the exception
29 of in critical years (6% lower during February and 21% lower during March), and would be similar
30 to or lower than flows under Existing Conditions for the remaining months of the year (to 48%
31 lower). Flows under A6A_LLT during January and April through December in drier water years,
32 when effects on habitat conditions would be most critical, include small to substantial (48% lower)
33 flow reductions for most months.

34 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
35 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
36 moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the
37 Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years,
38 when effects would be most critical for rearing conditions, consist of persistent, small to moderate
39 reductions (6% to 36% lower) for January through May, July, and October through December
40 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

41 *Water Temperature*

42 The percentage of months above the 86°F water temperature threshold for year-round adult
43 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and

1 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
2 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
3 modeled in the San Joaquin River or Clear Creek.

4 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
5 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
6 indicates that there would be no temperature-related effects in these rivers during the April through
7 November period.

8 **Summary of CEQA Conclusions**

9 Collectively, these results indicate that the impact would be significant because Alternative 6A
10 would cause a substantial reduction in largemouth bass habitat. Flows would be substantially lower
11 during portions of the spawning period in two rivers, and much of the rearing periods in most of the
12 locations analyzed, particularly in drier water year types, for most locations analyzed. There would
13 be moderate to substantial reductions in flows in the American River and the Stanislaus River
14 during the spawning period, particularly in critical water years (to 48% lower in the American
15 River, to 36% lower in the Stanislaus River). For the juvenile and adult rearing periods, there would
16 be moderate to substantial flow reductions in the Trinity River with the largest flow reductions in
17 critical years (August through December, to 37% lower), in Clear Creek in critical water years
18 (August through November, to 28% lower), in the Feather River in dry years (June through August,
19 to 45% lower for juvenile rearing, with the addition of January and December, to 46% lower for
20 adult rearing), in the American River in drier water years (April through November, to 48% lower
21 for juvenile rearing and January and December, to 48% lower, for adult rearing), and in the
22 Stanislaus River for much of the rearing periods in drier water years (to 36% lower). Combined,
23 these flow reductions would substantially reduce or degrade upstream habitat for largemouth bass.
24 The percentages of months outside all temperature thresholds are generally lower under
25 Alternative 6A than under CEQA Existing Conditions. This impact is a result of the specific reservoir
26 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
27 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
28 less-than-significant level would fundamentally change the alternative, thereby making it a different
29 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
30 unavoidable because there is no feasible mitigation available.

31 The NEPA and CEQA conclusions differ for this impact statement because they were determined
32 using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with
33 NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions.
34 These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
35 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
36 NEPA point of comparison is assumed to occur during the late long-term implementation period
37 whereas the CEQA baseline (Existing Conditions) is assumed to occur during existing climate
38 conditions. Therefore, differences in model outputs between the CEQA baseline and the Alternative
39 6A are due primarily to both the alternative and future climate change.

40 ***Sacramento Tule Perch***

41 In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions
42 for Sacramento tule perch relative to NAA.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
3 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
4 reduce the quantity and quality of instream habitat available for rearing.

5 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
6 or greater than flows under NAA during all months but August, September, and November with
7 some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
8 *Analysis*). Flows under A6A_LLT during August, September, and November would be lower than
9 flows under NAA (up to 16% lower, depending on month, water year type, and time period). Flow
10 reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when
11 effects of flow reductions would be more critical for habitat conditions. These are relatively small
12 flow reductions that are not expected to have biologically meaningful negative effects on habitat
13 conditions.

14 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
15 or greater than flows under NAA with two, isolated, small exceptions, in critical years during
16 October (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II*
17 *Model Results utilized in the Fish Analysis*).

18 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
19 than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C,
20 *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful
21 effects.

22 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
23 greater than flows under NAA from January through April, June, and September, with some
24 exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows
26 under NAA, with flows generally similar to or greater than flows under NAA in January through June,
27 August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix
28 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be
29 similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and
30 September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the*
31 *Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on
32 habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year
33 types) and would be intermittent by month and water year type and would be offset by increases in
34 flow in other months and therefore are not expected to have biologically meaningful negative
35 effects.

36 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
37 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
38 flows relative to the NAA.

39 *Water Temperature*

40 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-
41 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,
42 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds

1 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water
2 temperatures were not modeled in the San Joaquin River or Clear Creek.

3 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
4 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
5 indicates that there would be no temperature-related effects in these rivers throughout the year.

6 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
7 Alternative 6A would not cause a substantial reduction in Sacramento tule perch habitat. Flows in all
8 rivers examined during the year under Alternative 6A are generally similar to or greater than flows
9 under NAA in most months, with only infrequent, isolated reductions in flow. Flows from May
10 through July (affecting juvenile and adult rearing) and December (affecting adult rearing) are
11 generally lower in the Feather River high-flow channel in drier water year types (to 43% lower),
12 although these reductions would not be biologically meaningful to the Sacramento tule perch
13 population. Also, there are no temperature-related effects in any of the rivers examined.

14 **CEQA Conclusion:** In general, Alternative 6A would not affect the quality and quantity of upstream
15 habitat conditions for Sacramento tule perch relative to CEQA Existing Conditions.

16 *Flows*

17 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
18 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
19 reduce the quantity and quality of instream habitat available for rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
21 or greater than flows under Existing Conditions during all months but August, September, and
22 October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
23 *the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows
24 under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow
25 reductions in dry and critical years. Based on the relatively small magnitude, this effect is not
26 expected to have biologically meaningful negative effects on rearing conditions.

27 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
28 or greater than flows under Existing Conditions during January through July, with a few, isolated
29 exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally
30 be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial
31 flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
32 *Analysis*).

33 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
34 than flows under Existing Conditions throughout the year, except in critical years during August
35 through November (ranging from 6% and 28% lower) and in below normal years during October
36 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

37 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results
38 relative to flows under Existing Conditions from February through June, with decreases to 46%
39 lower than under Existing Conditions, and would generally be lower than flows under Existing
40 Conditions during January (to 43% lower), July (to 45% lower), and October through December (to
41 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under
42 Existing Conditions for August and September, with one exception (31% lower in dry years during

1 August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in
2 flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46%
3 lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and
4 December (to 41% lower).

5 In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January
6 (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to
7 or greater than flows under Existing Conditions in February, March, and October with the exception
8 of in critical years (6% lower during February and 21% lower during March), and would be similar
9 to or lower than flows under Existing Conditions for the remaining months of the year (to 48%
10 lower). Flows under A6A_LLT during January and April through December in drier water years,
11 when effects on habitat conditions would be most critical, include small to substantial (48% lower)
12 flow reductions for most months.

13 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
14 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
15 moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the
16 Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years,
17 when effects would be most critical for rearing conditions, consist of persistent, small to moderate
18 reductions (6% to 36% lower) for January through May, July, and October through December
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 *Water Temperature*

21 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round
22 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,
23 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead
24 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not
25 modeled in the San Joaquin River or Clear Creek.

26 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
27 Alternative 6A would be the same as those under Alternative 1A which indicates generally higher
28 temperatures.

29 **Summary of CEQA Conclusions**

30 Collectively, these results indicate that the impact would be significant because Alternative 6A
31 would cause a substantial reduction in Sacramento tule perch habitat. Flows would be substantially
32 lower during much of the rearing periods, particularly in drier water year types, for most locations
33 analyzed. There would be moderate to substantial flow reductions in the Trinity River with the
34 largest flow reductions in critical years (August through December, to 37% lower), in Clear Creek in
35 critical water years (August through November, to 28% lower), in the Feather River in dry years
36 (June through August, January and December, to 46% lower), in the American River in drier water
37 years (April through January, to 48% lower), and in the Stanislaus River for much of the year in drier
38 water years (to 36% lower). The percentages of months outside both temperature thresholds are
39 generally higher under Alternative 6A than under CEQA Existing Conditions. This impact is a result
40 of the specific reservoir operations and resulting flows associated with this alternative. Applying
41 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to
42 reduce this impact to a less-than-significant level would fundamentally change the alternative,

1 thereby making it a different alternative than that which has been modeled and analyzed. As a
2 result, this impact is significant and unavoidable because there is no feasible mitigation available.

3 The NEPA and CEQA conclusions differ for this impact statement because they were determined
4 using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with
5 NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions.
6 These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
7 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
8 NEPA point of comparison (NAA) is assumed to occur during the late long-term implementation
9 period whereas CEQA Existing Conditions are assumed to occur during existing climate conditions.
10 Therefore, differences in model outputs between CEQA Existing Conditions and the Alternative 6A
11 are due primarily to both the alternative and future climate change.

12 ***Sacramento-San Joaquin Roach***

13 In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions
14 for Sacramento-San Joaquin roach relative to NAA.

15 *Flows*

16 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
17 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
18 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
19 rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
21 or greater than flows under NAA during all months but August, September, and November with
22 some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
23 *Analysis*). Flows under A6A_LLT during August, September, and November would be lower than
24 flows under NAA (up to 16% lower depending on month, water year type, and time period). Flow
25 reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when
26 effects of flow reductions would be more critical for habitat conditions. These are relatively small
27 flow reductions that are not expected to have biologically meaningful negative effects on juvenile
28 and adult rearing conditions.

29 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
30 or greater than flows under NAA with two, isolated, small exceptions, in critical years during
31 October (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II*
32 *Model Results utilized in the Fish Analysis*).

33 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
34 than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C,
35 *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful
36 effects.

37 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
38 greater than flows under NAA from January through April, June, and September, with some
39 exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

40 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows
41 under NAA, with flows generally similar to or greater than flows under NAA in January through June,

1 August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix
2 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be
3 similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and
4 September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the*
5 *Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on
6 habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year
7 types) and would be intermittent by month and water year type and would be offset by increases in
8 flow in other months and therefore are not expected to have biologically meaningful negative
9 effects.

10 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
11 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
12 flows relative to the NAA.

13 *Water Temperature*

14 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
15 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
16 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing
17 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San
18 Joaquin River or Clear Creek.

19 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
20 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
21 indicates that there would be no temperature-related effects in these rivers throughout the year.

22 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
23 Alternative 6A would not cause a substantial reduction in spawning habitat or juvenile and adult
24 rearing habitat. Flows in all rivers examined during the year under Alternative 6A are generally
25 similar to or greater than flows under NAA in most months, with only infrequent, isolated
26 reductions in flow. Flows from May through July and December are generally lower in the Feather
27 River high-flow channel in drier water year types (to 43% lower), although these reductions would
28 not be biologically meaningful to the Sacramento-San Joaquin roach population. Also, there are no
29 temperature-related effects in any of the rivers examined.

30 **CEQA Conclusion:** In general, Alternative 6A would not affect the quality and quantity of upstream
31 habitat conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

32 *Flows*

33 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
34 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
35 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
36 rearing.

37 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
38 or greater than flows under Existing Conditions during all months but August, September, and
39 October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
40 *the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows
41 under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow

1 reductions in dry and critical years. Based on the relatively small magnitude, this effect is not
2 expected to have biologically meaningful negative effects on juvenile and adult rearing conditions.

3 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
4 or greater than flows under Existing Conditions during January through July, with a few, isolated
5 exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally
6 be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial
7 flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
8 *Analysis*).

9 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
10 than flows under Existing Conditions throughout the year, except in critical years during August
11 through November (ranging from 6% and 28% lower) and in below normal years during October
12 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results
14 relative to flows under Existing Conditions from February through June, with decreases to 46%
15 lower than under Existing Conditions, and would generally be lower than flows under Existing
16 Conditions during January (to 43% lower), July (to 45% lower), and October through December (to
17 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under
18 Existing Conditions for August and September, with one exception (31% lower in dry years during
19 August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in
20 flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46%
21 lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and
22 December (to 41% lower).

23 In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January
24 (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to
25 or greater than flows under Existing Conditions in February, March, and October with the exception
26 of in critical years (6% lower during February and 21% lower during March), and would be similar
27 to or lower than flows under Existing Conditions for the remaining months of the year (to 48%
28 lower). Flows under A6A_LLT during January and April through December in drier water years,
29 when effects on habitat conditions would be most critical, include small to substantial (48% lower)
30 flow reductions for most months.

31 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
32 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
33 moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the
34 Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years,
35 when effects would be most critical for rearing conditions, consist of persistent, small to moderate
36 reductions (6% to 36% lower) for January through May, July, and October through December
37 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

38 *Water Temperature*

39 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
40 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
41 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced
42 quantity and quality of rearing habitat and increased stress and mortality of rearing juveniles and
43 adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

1 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
2 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
3 indicates that there would be no temperature-related effects in these rivers during the April through
4 November period.

5 **Summary of CEQA Conclusions**

6 Collectively, these results indicate that the impact would be significant because Alternative 6A
7 would cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be
8 substantially lower during portions of the spawning period in two rivers, and much of the rearing
9 periods in most of the locations analyzed, particularly in drier water year types, for most locations
10 analyzed. There would be moderate to substantial reductions in flows in the American River and the
11 Stanislaus River during the spawning period, particularly in critical water years (to 45% lower in
12 the American River, to 30% lower in the Stanislaus River). For the juvenile and adult rearing
13 periods, there would be moderate to substantial flow reductions in the Trinity River with the largest
14 flow reductions in critical years (August through December, to 37% lower), in Clear Creek in critical
15 water years (August through November, to 28% lower), in the Feather River in dry years (June
16 through August, January and December, to 45% lower), in the American River in drier water years
17 (April through January, to 48% lower), and in the Stanislaus River for much of the year in drier
18 water years (to 36% lower). Combined, these flow reductions would substantially reduce or
19 degrade upstream habitat for roach. The percentages of months outside all temperature thresholds
20 are generally higher under Alternative 6A than under Existing Conditions. This impact is a result of
21 the specific reservoir operations and resulting flows associated with this alternative. Applying
22 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to
23 reduce this impact to a less-than-significant level would fundamentally change the alternative,
24 thereby making it a different alternative than that which has been modeled and analyzed. As a
25 result, this impact is significant and unavoidable because there is no feasible mitigation available.

26 The NEPA and CEQA conclusions differ for this impact statement because they were determined
27 using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with
28 NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions.
29 These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
30 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
31 NEPA point of comparison is assumed to occur during the late long-term implementation period
32 whereas CEQA Existing Conditions are assumed to occur during existing climate conditions.
33 Therefore, differences in model outputs between CEQA Existing Conditions and Alternative 6A are
34 due primarily to both the alternative and future climate change.

35 ***Hardhead***

36 In general, Alternative 6A would not affect the quality and quantity of upstream habitat conditions
37 for hardhead relative to NAA.

38 ***Flows***

39 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
40 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
41 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
42 adult rearing.

1 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
2 or greater than flows under NAA during all months but August, September, and November with
3 some exceptions (up to 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A6A_LLT during August, September, and November would be lower than
5 flows under NAA (up to 16% lower depending on month, water year type, and time period). Flow
6 reductions under A6A_LLT relative to NAA would be no greater than 13% in drier water years when
7 effects of flow reductions would be more critical for habitat conditions. These are relatively small
8 flow reductions that are not expected to have biologically meaningful negative effects on juvenile
9 and adult rearing conditions.

10 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
11 or greater than flows under NAA with two, isolated, small exceptions, in critical years during
12 October (10% lower) and in wet years during November (7% lower) (Appendix 11C, *CALSIM II*
13 *Model Results utilized in the Fish Analysis*).

14 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
15 than NAA throughout the year, with two isolated exceptions (up to 8% lower) (Appendix 11C,
16 *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically meaningful
17 effects.

18 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would generally be similar to or
19 greater than flows under NAA from January through April, June, and September, with some
20 exceptions (up to 31% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the American River at Nimbus Dam, flows under A6A_LLT would generally be similar to flows
22 under NAA with flows generally similar to or greater than flows under NAA in January through June,
23 August, and October through December, with a few isolated exceptions (to 21% lower) (Appendix
24 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A6A_LLT would generally be
25 similar to or lower than flows under NAA in the remaining months, July (to 13% lower) and
26 September (to 30% lower in wet water years) (Appendix 11C, *CALSIM II Model Results utilized in the*
27 *Fish Analysis*). Flow reductions in drier water year types would have the most critical effects on
28 habitat conditions; these would be of relatively small magnitude (to 21% lower in drier water year
29 types) and would be intermittent by month and water year type and would be offset by increases in
30 flow in other months and therefore are not expected to have biologically meaningful negative
31 effects.

32 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
33 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
34 flows relative to the NAA.

35 *Water Temperature*

36 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for year-
37 round juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather,
38 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
39 rearing habitat quality and increased stress and mortality. Water temperatures were not modeled in
40 the San Joaquin River or Clear Creek.

41 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
42 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
43 indicates that there would be no temperature-related effects in these rivers throughout the year.

1 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
2 Alternative 6A would not cause a substantial reduction in spawning habitat or juvenile and adult
3 rearing habitat. Flows in all rivers examined during the year under Alternative 6A are generally
4 similar to or greater than flows under NAA in most months, with only infrequent, isolated
5 reductions in flow. Flows during May, July, August, and October through December are generally
6 lower in the Feather River high-flow channel in drier water year types (to 43% lower). Based on the
7 fact that these fairly persistent, moderate flow reductions would only occur in one of the locations
8 analyzed, they are not expected to have biologically meaningful negative effects on the hardhead
9 population. Also, there are no temperature-related effects in any of the rivers examined.

10 **CEQA Conclusion:** In general, Alternative 6A would reduce the quality and quantity of upstream
11 habitat conditions for hardhead relative to CEQA Existing Conditions, based on reductions in flow
12 that would affect juvenile and adult rearing conditions.

13 *Flows*

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin and Stanislaus rivers and in
15 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
16 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
17 adult rearing.

18 In the Sacramento River upstream of Red Bluff, flows under A6A_LLT would generally be similar to
19 or greater than flows under Existing Conditions during all months but August, September, and
20 October, with some exceptions (up to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
21 *the Fish Analysis*). Flows under A6A_LLT during August through October would be lower than flows
22 under Existing Conditions (up to 21% lower) including fairly persistent, small to moderate flow
23 reductions in dry and critical years. Based on the relatively small magnitude, this effect is not
24 expected to have biologically meaningful negative effects on juvenile and adult rearing conditions.

25 In the Trinity River below Lewiston Reservoir, flows under A6A_LLT would generally be similar to
26 or greater than flows under Existing Conditions during January through July, with a few, isolated
27 exceptions (up to 16% lower). Flows under A6A_LLT for August through December would generally
28 be similar to or lower than flows under Existing Conditions (by up to 37% with the most substantial
29 flow reductions in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
30 *Analysis*).

31 In Clear Creek at Whiskeytown Dam, flows under A6A_LLT would generally be similar to or greater
32 than flows under Existing Conditions throughout the year, except in critical years during August
33 through November (ranging from 6% and 28% lower) and in below normal years during October
34 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 In the Feather River at Thermalito Afterbay, flows under A6A_LLT would have variable results
36 relative to flows under Existing Conditions from February through June, with decreases to 46%
37 lower than under Existing Conditions, and would generally be lower than flows under Existing
38 Conditions during January (to 43% lower), July (to 45% lower), and October through December (to
39 30% lower). Flows under A6A_LLT would generally be similar to or greater than flows under
40 Existing Conditions for August and September, with one exception (31% lower in dry years during
41 August) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate reductions in
42 flows under A6A_LLT in drier water years would occur in January (to 20% lower), February (to 46%

1 lower), March (to 39% lower), June (27% lower), July (to 45% lower), August (31% lower), and
2 December (to 41% lower).

3 In the American River at Nimbus Dam, flows under A6A_LLT would have variable results in January
4 (to 27% greater in wetter water years and to 26% lower in drier water years), would be similar to
5 or greater than flows under Existing Conditions in February, March, and October with the exception
6 of in critical years (6% lower during February and 21% lower during March), and would be similar
7 to or lower than flows under Existing Conditions for the remaining months of the year (to 48%
8 lower). Flows under A6A_LLT during January and April through December in drier water years,
9 when effects on habitat conditions would be most critical, include small to substantial (48% lower)
10 flow reductions for most months.

11 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 6A would be the same as those
12 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
13 moderate reductions in flows during the period relative to Existing Conditions. Flow rates in the
14 Stanislaus River at the confluence with the San Joaquin River under A6A_LLT in drier water years,
15 when effects would be most critical for rearing conditions, consist of persistent, small to moderate
16 reductions (6% to 36% lower) for January through May, July, and October through December
17 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 *Water Temperature*

19 The percentage of months in which year-round in-stream temperatures would be outside of the
20 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was
21 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures
22 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.
23 Water temperatures were not modeled in the San Joaquin River or the Clear Creek.

24 Water temperatures in the Sacramento, Trinity, Feather, American, and Stanislaus rivers under
25 Alternative 6A would be the same as those under Alternative 1A. The analysis for Alternative 1A
26 indicates that there would be no temperature-related effects in these rivers during the April through
27 November period

28 **Summary of CEQA Conclusions**

29 Collectively, these results indicate that the impact would be significant because Alternative 6A
30 would cause a substantial reduction in hardhead rearing habitat. Flows would be substantially lower
31 during portions of the rearing period in two rivers, and much of the rearing period in most locations
32 analyzed, particularly in drier water year types, for most locations analyzed. There would be
33 moderate to substantial reductions in flows in the Trinity River (August through December, to 37%
34 lower), in Clear Creek in critical years (August to November, to 28% lower), in the Feather River in
35 drier water years (January through March, June through August, and December, to 45% lower), in
36 the American River in drier water years (April through January, to 48% lower), and in the Stanislaus
37 River for much of the year in drier water years (to 36% lower). Combined, these flow reductions
38 would substantially reduce or degrade upstream rearing habitat for hardhead. Flows under
39 Alternative 6A would generally be similar to or greater than flows under Existing Conditions during
40 the April-May hardhead spawning period, except for moderate reductions in the Feather River that
41 would not be prevalent enough to have biologically meaningful negative effects on the population.
42 The percentages of months outside all temperature thresholds are generally higher under
43 Alternative 6A than under Existing Conditions. This impact is a result of the specific reservoir

1 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
2 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
3 less than significant level would fundamentally change the alternative, thereby making it a different
4 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
5 unavoidable because there is no feasible mitigation available.

6 The NEPA and CEQA conclusions differ for this impact statement because they were determined
7 using two unique baselines. The NEPA conclusion was based on the comparison of A6A_LLT with
8 NAA and the CEQA conclusion was based on the comparison of A6A_LLT with Existing Conditions.
9 These baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
10 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
11 NEPA point of comparison is assumed to occur during the late long-term implementation period
12 whereas CEQA Existing Conditions are assumed to occur during existing climate conditions.
13 Therefore, differences in model outputs between CEQA Existing Conditions and Alternative 6A are
14 due primarily to both the alternative and future climate change.

15 ***California Bay Shrimp***

16 ***NEPA Effects:*** The effect of water operations on rearing habitat of California bay shrimp under
17 Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact
18 AQUA-203). For a detailed discussion, please see Alternative 1A, Impact AQUA-203. These effects
19 would not be adverse.

20 ***CEQA Conclusion:*** As described above the impacts on rearing habitat of California bay shrimp would
21 be less than significant.

22 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered** 23 **Aquatic Species of Primary Management Concern**

24 Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-
25 covered species of primary management concern.

26 ***Striped Bass***

27 Monthly flows in the Sacramento River downstream of the north Delta intakes would be reduced
28 (23–26% for NAA) under Alternative 6A during the adult striped bass migration. Sacramento River
29 flows are highly variable interannually, and striped bass are still able to migrate upstream the
30 Sacramento River during lower flow years.

31 ***NEPA Effects:*** The effect of reduced Sacramento flows under Alternative 6A would not be adverse.

32 ***CEQA Conclusion:*** Impacts would be as described immediately above and would be less than
33 significant because the changes in flow (27–34% lower compared to Existing Conditions) would not
34 interfere substantially with movement of pre-spawning striped bass through the Delta. No
35 mitigation would be required.

36 ***American Shad***

37 Flows in the Sacramento River downstream of the north Delta diversion facilities would be reduced
38 relative to NAA during March-May. Monthly flows on average would be reduced 23–26% relative to
39 NAA. Flows from the San Joaquin River at Vernalis would be unchanged under Alternative 6A.

1 Sacramento River flows are highly variable interannually, and American shad are still able to
2 migrate upstream the Sacramento River during years of lower flows.

3 **NEPA Effects:** Overall, the impact to American shad migration habitat conditions would not be
4 adverse under Alternative 6A.

5 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
6 significant because the changes in flow (25–34% lower compared to Existing Conditions) would not
7 interfere substantially with movement of American shad from the Delta to upstream spawning
8 habitat. No mitigation would be required.

9 **Threadfin Shad**

10 **NEPA Effects:** Threadfin shad are semi-anadromous, moving between freshwater and brackish
11 water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn.
12 Therefore there is no effect on migration habitat conditions.

13 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
14 significant because flow changes in the Delta under Alternative 6A would not alter movement
15 patterns for threadfin shad. No mitigation would be required.

16 **Largemouth Bass**

17 **NEPA Effects:** Largemouth bass are non-migratory fish within the Delta. Therefore they do not use
18 the Delta as migration habitat corridor. There would be no effect.

19 **CEQA Conclusion:** As described immediately above, flow changes under Alternative 6A would not
20 affect largemouth movements within the Delta. No mitigation would be required.

21 **Sacramento Tule Perch**

22 **NEPA Effects:** Similar with largemouth bass, Sacramento tule perch are a non-migratory species and
23 do not use the Delta as a migration corridor as they are a resident Delta species. There would be no
24 effect.

25 **CEQA Conclusion:** As described immediately above, flow changes would not affect Sacramento tule
26 perch movements within the Delta. No mitigation would be required.

27 **Sacramento-San Joaquin Roach**

28 **NEPA Effects:** For Sacramento-San Joaquin roach the overall flows and temperature in upstream
29 rivers during migration to their spawning grounds would be similar to those described under
30 Alternative 6A, Impact AQUA-202 for spawning. As described there, the flows would slightly
31 improve the upstream conditions relative to NAA. These conditions would not be adverse.

32 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
33 conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

34 **Hardhead**

35 **NEPA Effects:** For hardhead the overall flows and temperature in upstream rivers during migration
36 to their spawning grounds would be similar to those described under Alternative 6A, Impact AQUA-

1 202 for spawning. As described there, the flows would slightly improve the upstream conditions
2 relative to NAA. These conditions would not be adverse.

3 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
4 conditions for hardhead would not be significant and no mitigation is required.

5 **California Bay Shrimp**

6 **NEPA Effects:** The effect of water operations on migration conditions of California bay shrimp under
7 Alternative 6A would be similar to that described for Alternative 1A (see Alternative 1A, Impact
8 AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects
9 would not be adverse.

10 **CEQA Conclusion:** As described above the impacts on migration conditions of California bay shrimp
11 would be less than significant.

12 **Restoration and Conservation Measures**

13 The effects of restoration and conservation measures under Alternative 6A would be similar for all
14 non-covered species; therefore, the analysis below is combined for all non-covered species instead
15 of analyzed by individual species. However, the detailed discussions of impacts and conclusions
16 from restoration and conservation measures provided under Alternative 1A are identical for
17 Alternative 6A.

18 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic 19 Species of Primary Management Concern**

20 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non- 21 Covered Aquatic Species of Primary Management Concern**

22 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of 23 Primary Management Concern**

24 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of 25 Primary Management Concern (CM12)**

26 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered 27 Aquatic Species of Primary Management Concern (CM13)**

28 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic 29 Species of Primary Management Concern (CM14)**

30 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic 31 Species of Primary Management Concern (CM15)**

32 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of 33 Primary Management Concern (CM16)**

34 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of 35 Primary Management Concern (CM17)**

1 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**
2 **Primary Management Concern (CM18)**

3 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**
4 **of Primary Management Concern (CM19)**

5 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**
6 **Aquatic Species of Primary Management Concern (CM21)**

7 Refer to Impact AQUA-7 through Impact AQUA-18 for delta smelt under Alternative 1A, for detailed
8 discussions of potential effects of these restoration and conservation measures on aquatic species.

9 **NEPA Effects:** These restoration and conservation impact mechanisms have been determined to
10 range from no effect, to not adverse, or beneficial to aquatic species of primary management concern
11 for NEPA purposes, for the reasons identified for Alternative 1A (Impact AQUA-205 through AQUA-
12 216).

13 **CEQA Conclusion:** These restoration and conservation impact mechanisms would be considered to
14 range from no impact, to less than significant, or beneficial on aquatic species of primary
15 management concern, for the reasons identified for Alternative 1A (Impact AQUA-205 through
16 AQUA-216), and no mitigation is required.

17 **Upstream Reservoirs**

18 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

19 **NEPA Effects:** Similar to the description for Alternative 1A, this effect would not be adverse because
20 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 6A would not be
21 substantially reduced when compared to the No Action Alternative.

22 **CEQA Conclusion:** Similar to the description for Alternative 1A, Alternative 6A would reduce the
23 quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-11A-102. There would
24 be a greater than 5% increase (5 years) for several of the reservoirs, which could result in a
25 significant impact. These results are primarily caused by four factors: differences in sea level rise,
26 differences in climate change, future water demands, and implementation of the alternative. The
27 analysis described above comparing Existing Conditions to Alternative 6A does not partition the
28 effect of implementation of the alternative from those of sea level rise, climate change and future
29 water demands using the model simulation results presented in this chapter. However, the
30 increment of change attributable to the alternative is well informed by the results from the NEPA
31 analysis, which found this effect to be not adverse. As a result, the CEQA conclusion regarding
32 Alternative 6A, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
33 conclusion, and therefore would not in itself result in a significant impact on coldwater habitat in
34 upstream reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.12 Alternative 6B—Isolated Conveyance with East Alignment and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Alternative 6B includes the same five intakes on the Sacramento River as Alternative 1A and 6A, and the same culvert and tunnel siphons, and barge landings as Alternative 1B and 2B. Alternative 6B also has an east-side alignment surface canal conveyance like the one included in Alternatives 1B and 2B. Alternative 6B differs from Alternative 1B because it does not include the south Delta intakes. However, because no construction impacts on the aquatic environment are associated with the south Delta intakes, construction impacts would be the same as those described under Alternatives 1B and 2B. In addition, only one barge landing would be constructed under Alternative 6B compared to six under Alternative 1A. Implementation of mitigation measures (described below) and environmental commitments (Appendix 3B, *Environmental Commitments*) would reduce impacts as described under Alternative 1A.

Water supply and conveyance operations would follow the guidelines described as Scenario D. However, Alternative 6B has the same diversion and conveyance operations as Alternative 1A; consequently, the analysis under Alternative 1A is applicable to Alternative 6B.

CM2–CM22 would be implemented under this alternative, and these conservation measures would be identical to those under Alternative 1A. See Chapter 3, *Description of Alternatives*, for additional details on Alternative 6B.

Delta Smelt

Construction and Maintenance of CM1

The potential effects of construction and maintenance of water conveyance facilities on delta smelt or designated critical habitat would be similar to those described under Alternative 1A (Impact AQUA-1 and AQUA-2) because no differences in fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to those described in detail for Alternative 1A. The effects described for delta smelt and critical habitat under Alternative 1A also appropriately characterize effects under Alternative 6B.

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-1 and AQUA-2, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or critical habitat.

CEQA Conclusion: As described in Impact AQUA-1 and AQUA-2 under Alternative 1A for delta smelt, the impact of the construction of water conveyance facilities and maintenance activities on delta smelt or their critical habitat would not be significant except for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7 **Water Operations of CM1**

8 Alternative 6B has the same diversion and conveyance operations as Alternative 6A. The primary
9 difference between the two alternatives is that conveyance under Alternative 6B would be in a lined
10 or unlined canal, instead of a pipeline. Because there would be no difference in conveyance capacity
11 or operations, there would be no differences between these two alternatives in upstream of the
12 Delta river flows or reservoir operations, Delta inflow, and hydrodynamics in the Delta. Because no
13 differences in fish effects are anticipated anywhere in the affected environment under Alternative
14 6B compared to those described in detail for Alternative 6A (Impact AQUA-3 through Impact AQUA-
15 6), the fish effects described for Alternative 6A also appropriately characterize effects under
16 Alternative 6B.

17 The following impacts are those presented under Alternative 6A that are identical for Alternative
18 6B.

19 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

20 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
21 **Delta Smelt**

22 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

23 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

24 **NEPA Effects:** The impact mechanisms listed above, would be beneficial or not adverse to delta
25 smelt under Alternative 6B, including beneficial effects of Impact AQUA-3 and AQUA-4. This is the
26 same conclusion as described in detail under Alternative 6A, and is based on the expected overall
27 limited or beneficial impacts.

28 **CEQA Conclusion:** The effects of the above listed impact mechanisms would be less than significant,
29 or beneficial to delta smelt, and no mitigation would be required. Detailed discussions regarding
30 these conclusions are presented in Alternative 6A.

31 **Restoration and Conservation Measures**

32 Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no
33 substantial differences in fish effects are anticipated anywhere in the affected environment under
34 Alternative 6B compared to those described in detail for Alternative 1A, the effects described for
35 Alternative 1A (Impact AQUA-7 through Impact AQUA-18) also appropriately characterize effects
36 under Alternative 6B.

1 The following impacts are those presented under Alternative 1A that are identical for Alternative
2 6B.

3 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

4 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**
5 **Smelt**

6 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

7 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

8 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

9 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

10 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

11 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

12 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

13 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

14 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

15 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**
16 **(CM21)**

17 *NEPA Effects:* As described in detail under Alternative 1A (Impact AQUA-7 through AQUA-18), none
18 of these impact mechanisms would be adverse to delta smelt, and most would be at least slightly
19 beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to
20 selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on
21 delta smelt are uncertain.

22 *CEQA Conclusion:* All of these impact mechanisms listed above would be at least slightly beneficial,
23 or less than significant, and no mitigation is required.

24 **Longfin Smelt**

25 The potential effects of construction and maintenance of water conveyance facilities, operations of
26 water conveyance facilities, restoration measures and other conservation measures on longfin smelt
27 would be similar to those described under Alternative 1A.

28 **Construction and Maintenance of CM1**

29 The potential effects of construction and maintenance of water conveyance facilities on longfin
30 smelt would be similar to those described under Alternative 1A because no differences in fish effects
31 are anticipated anywhere in the affected environment under Alternative 6B compared to those
32 described in detail for Alternative 1A (Impact AQUA-19 and AQUA-20), the effects described for

1 longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under
2 Alternative 6B.

3 The following impacts on longfin smelt are those presented under Alternative 1A that are identical
4 for Alternative 6B.

5 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

6 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

7 **NEPA Effects:** These impact mechanisms would not be adverse to longfin smelt. While construction
8 activities (Impact AQUA-19) could result in adverse effects from impact pile driving activities, the
9 implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate
10 adverse effects from impact pile driving (e.g., injury or mortality).

11 **CEQA Conclusion:** Similar to the discussion provided above for Alternatives 1A and 6A, Impact
12 AQUA-19 could result in significant underwater noise effects from impact pile driving, although
13 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
14 impacts to less than significant.

15 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
16 **of Pile Driving and Other Construction-Related Underwater Noise**

17 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

18 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
19 **and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

21 **Water Operations of CM1**

22 The potential effects of water conveyance facility operations on longfin smelt would be similar to
23 those described under Alternative 6A. Because no differences in fish effects are anticipated
24 anywhere in the affected environment for Impact AQUA-21 through AQUA-24, the effects described
25 for longfin smelt under Alternatives 6A also appropriately characterize effects under Alternative 6B.

26 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

27 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**
28 **Habitat for Longfin Smelt**

29 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

30 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

31 **NEPA Effects:** As discussed in detail under Alternative 6A, the effects on longfin smelt from Impact
32 AQUA-22 could be an adverse effect. Despite a growing body of evidence supporting a positive
33 correlation between longfin smelt abundance and spring outflow, the specific timing and amount of
34 outflow needed to conserve longfin smelt is less clear, especially in light of potential increases in
35 food resources in the Plan Area and other benefits to spawning and rearing habitat. Therefore, the

1 implementation of adaptive management procedures under Alternative 6B, that could be used to
2 adjust spring operations, is expected to reduce potential effects to not be adverse. These adaptive
3 management procedures are described in Mitigation Measures 22a through 22c, under Alternative
4 1A.

5 **CEQA Conclusion:** As described above under Alternatives 1A and 6A, water operations under
6 Alternative 6B would generally reduce the quantity and quality of longfin smelt rearing habitat
7 relative to Existing Conditions. The results also indicate that the difference in rearing habitat could
8 be significant because Delta outflows would be reduced in the spring, which would have the
9 potential to contribute to substantial reductions in longfin smelt abundances. These effects are due
10 to the specific reservoir operations and resulting flows associated with this alternative. However,
11 the implementation of Mitigation Measures AQUA-22a through 22c, habitat restoration and reduced
12 larval entrainment would reduce this impact to less than significant, so no additional mitigation
13 would be required.

14 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**
15 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**
16 **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

17 Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

18 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**
19 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

20 Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

21 **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**
22 **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

23 Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

24 **Restoration and Conservation Measures**

25 The potential effects of restoration measures and other conservation measures on longfin smelt
26 would be similar to those described under Alternative 1A. Because no differences in fish effects are
27 anticipated anywhere in the affected environment under Alternative 6B compared to those
28 described in detail for Alternative 1A (Impact AQUA-25 through AQUA-36), the fish effects described
29 for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under
30 Alternative 6B.

31 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

32 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**
33 **Smelt**

34 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

35 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

36 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**
37 **(CM13)**

1 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

2 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

3 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

4 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

5 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

6 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

7 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**
8 **(CM21)**

9 *NEPA Effects:* As described in Alternative 1A (Impact AQUA-25 through AQUA-36) these impact
10 mechanisms have been determined to range from no effect, to not adverse, or beneficial to longfin
11 smelt for NEPA purposes. Specifically for AQUA-26, the effects of contaminants on longfin smelt with
12 respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of
13 methylmercury on longfin smelt are uncertain.

14 *CEQA Conclusion:* These impact mechanisms would be considered to range from no impact, to less
15 than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is
16 required.

17 **Winter-Run Chinook Salmon**

18 The potential effects of construction and maintenance of water conveyance facilities, operations of
19 water conveyance facilities, restoration measures and other conservation measures on winter-run
20 Chinook salmon would be similar to those described under Alternative 1A.

21 **Construction and Maintenance of CM1**

22 The potential effects of construction and maintenance of water conveyance facilities on winter-run
23 Chinook salmon would be similar to those described under Alternative 1A because no differences in
24 fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to
25 those described in detail for Alternative 1A (Impact AQUA-37 and AQUA-38). The effects described
26 for winter-run Chinook salmon under Alternative 1A also appropriately characterize effects under
27 Alternative 6B.

28 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
29 **(Winter-Run ESU)**

30 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
31 **(Winter-Run ESU)**

32 *NEPA Effects:* These impact mechanisms would not be adverse to winter-run Chinook salmon. While
33 construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving
34 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or
35 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

1 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 6A, Impact
2 AQUA-37 could result in significant underwater noise effects from impact pile driving, although
3 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
4 impacts to less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

11 **Water Operations of CM1**

12 The potential effects of operations of water conveyance facilities on winter-run Chinook salmon
13 would be similar to those described for Alternative 6A. Because no differences in fish effects are
14 anticipated anywhere in the affected environment under Alternative 6B compared to those
15 described in detail for Alternative 6A (Impacts AQUA-39 through AQUA-42), the effects
16 described for winter-run Chinook salmon also appropriately characterize the effects under
17 Alternative 6B.

18 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**
19 **Run ESU)**

20 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
21 **Chinook Salmon (Winter-Run ESU)**

22 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
23 **(Winter-Run ESU)**

24 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**
25 **(Winter-Run ESU)**

26 **NEPA Effects:** As discussed for Alternative 6A, with the exception of Impact AQUA-42, the impact
27 mechanisms listed above would not be adverse to winter-run Chinook salmon under Alternative 6B.
28 However, Alternative 6B would be adverse to migration conditions for winter-run Chinook salmon.
29 While the effect on migration conditions is adverse, the implementation of applicable conservation
30 measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*), as described in Chapter
31 3 (Section 3.6) would minimize potential effects, although the effect would still be adverse.

32 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 6A, Impact AQUA-42
33 would result in significant effects on migration conditions. While the implementation of applicable
34 conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*), as
35 described in Chapter 3 (Section 3.6) would minimize potential effects, the effect would remain
36 significant and unavoidable.

37 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
38 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat

1 habitats on the waterside side of levees along channels that provide rearing and outmigration
2 habitat for juvenile salmonids.

3 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
4 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
5 locations of high predation risk (i.e., predation “hotspots”), including the NDD intakes. This
6 conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are
7 particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment
8 methods and efficacy, implementation of CM15 would involve discrete pilot projects and
9 research actions coupled with an adaptive management and monitoring program to evaluate
10 effectiveness.

11 In addition to these conservation measures, the implementation of the mitigation measures listed
12 below also has the potential to reduce the severity of the impact, although the effect would still
13 likely remain significant and unavoidable. These mitigation measures would provide an adaptive
14 management process, that may be conducted as a part of the Adaptive Management and Monitoring
15 Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and
16 developing appropriate minimization measures.

17 **Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional**
18 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**
19 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

20 Please refer to Mitigation Measure AQUA-42a under Alternative 1A (Impact AQUA-42) for
21 winter-run Chinook salmon.

22 **Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts**
23 **on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

24 Please refer to Mitigation Measure AQUA-42b under Alternative 1A (Impact AQUA-42) for
25 winter-run Chinook salmon.

26 **Mitigation Measure AQUA-42c: Consult with USFWS, and CDFW to Identify and Implement**
27 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**
28 **Conditions Consistent with CM1**

29 Please refer to Mitigation Measure AQUA-42c under Alternative 1A (Impact AQUA-42) for
30 winter-run Chinook salmon.

31 **Restoration and Conservation Measures**

32 The potential effects of restoration measures and other conservation measures on winter-run
33 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in
34 fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to
35 those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects
36 described for winter-run Chinook salmon under Alternative 1A also appropriately characterize
37 effects under Alternative 6B.

38 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**
39 **(Winter-Run ESU)**

1 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**
2 **Salmon (Winter-Run ESU)**

3 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**
4 **ESU)**

5 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**
6 **ESU) (CM12)**

7 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
8 **(Winter-Run ESU) (CM13)**

9 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**
10 **Run ESU) (CM14)**

11 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
12 **(Winter-Run ESU) (CM15)**

13 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**
14 **(CM16)**

15 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**
16 **(CM17)**

17 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**
18 **(CM18)**

19 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**
20 **ESU) (CM19)**

21 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
22 **(Winter-Run ESU) (CM21)**

23 *NEPA Effects:* As discussed in detail for Alternative 1A, the impact mechanisms listed above would
24 not be adverse, and would typically be beneficial to winter-run Chinook salmon. Specifically for
25 AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium,
26 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run
27 Chinook salmon are uncertain.

28 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, these impact
29 mechanisms would be less than significant, or beneficial, so no additional mitigation would be
30 required.

31 **Spring-Run Chinook Salmon**

32 The potential effects of construction and maintenance of water conveyance facilities, operations of
33 water conveyance facilities, restoration measures and other conservation measures on spring-run
34 Chinook salmon would be similar to those described under Alternative 1A.

1 **Construction and Maintenance of CM1**

2 The potential effects of construction and maintenance activities on spring-run Chinook salmon
3 would be similar to those described under Alternative 1A because no differences in fish effects are
4 anticipated anywhere in the affected environment under Alternative 6B compared to those
5 described in detail for Alternative 1A (Impact AQUA-55 through Impact AQUA-72), the fish effects
6 described for spring-run Chinook salmon under Alternative 1A also appropriately characterize
7 effects for spring-run Chinook salmon under Alternative 6B.

8 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
9 **(Spring-Run ESU)**

10 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
11 **(Spring-Run ESU)**

12 *NEPA Effects:* These impact mechanisms would not be adverse to spring-run Chinook salmon. While
13 construction activities (Impact AQUA-55) could result in adverse effects from impact pile driving
14 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or
15 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

16 *CEQA Conclusion:* Similar to the discussion provided above for Alternatives 1A, Impact AQUA-55
17 could result in significant underwater noise effects from impact pile driving, although
18 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
19 impacts to less than significant.

20 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
21 **of Pile Driving and Other Construction-Related Underwater Noise**

22 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

23 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
24 **and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

26 **Water Operations of CM1**

27 The potential effects of water conveyance facility operations on spring-run Chinook salmon
28 would be similar to those described under Alternative 6A. Because no differences in fish effects
29 are anticipated anywhere in the affected environment under Alternative 6B compared to
30 Alternative 6A (Impact AQUA-57 through AQUA-60), the effects described for spring-run
31 Chinook salmon under Alternatives 6A also appropriately characterize effects under Alternative
32 6B.

33 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**
34 **ESU)**

35 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
36 **Chinook Salmon (Spring-Run ESU)**

1 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**
2 **Run ESU)**

3 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**
4 **(Spring-Run ESU)**

5 **NEPA Effects:** As discussed in detail for Alternative 6A, the impact mechanisms listed above would
6 range from beneficial to adverse under Alternative 6B for spring-run Chinook salmon. Adverse
7 effects would occur because migration conditions for juvenile spring-run Chinook salmon would be
8 substantially reduced, and because it has the potential to substantially increase predation, and
9 remove important instream habitat as the result of the presence of five north Delta intake
10 structures. While the implementation of the mitigation measures listed below, as well as CM6,
11 *Channel Margin Enhancement* and CM15, *Predator Control* would reduce potential effects, the effect
12 would likely remain adverse.

13 **CEQA Conclusion:** As discussed in detail for Alternative 6A, the effects of the impact mechanisms
14 listed above would range from beneficial to significant under Alternative 6B for spring-run Chinook
15 salmon. Impact AQUA-60 would result in significant effects on migration conditions. Implementation
16 of CM6 and CM15 would address these impacts, but are not anticipated to reduce them to a level
17 considered less than significant.

18 Applicable conservation measures are briefly described below and full descriptions are found in
19 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized
20 Reduction of Predatory Fishes (Predator Control) (CM15).

21 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
22 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat
23 habitats on the waterside side of levees along channels that provide rearing and outmigration
24 habitat for juvenile salmonids.

25 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
26 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
27 locations of high predation risk (i.e., predation “hotspots”), including the NDD intakes. This
28 conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are
29 particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment
30 methods and efficacy, implementation of CM15 would involve discrete pilot projects and
31 research actions coupled with an adaptive management and monitoring program to evaluate
32 effectiveness.

33 In addition to these conservation measures, the implementation of the mitigation measures listed
34 below also has the potential to reduce the severity of the impact, although the effect would still
35 likely remain significant and unavoidable. These mitigation measures would provide an adaptive
36 management process, that may be conducted as a part of the Adaptive Management and Monitoring
37 Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and
38 developing appropriate minimization measures.

1 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**
2 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**
3 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

4 Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for
5 spring-run Chinook salmon.

6 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**
7 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

8 Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for
9 spring-run Chinook salmon.

10 **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**
11 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**
12 **Conditions Consistent with CM1**

13 Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for
14 spring-run Chinook salmon.

15 **Restoration and Conservation Measures**

16 The potential effects of restoration measures and other conservation measures on spring-run
17 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in
18 fish effects are anticipated anywhere in the affected environment under Alternative 6B compared to
19 those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the
20 effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects
21 under Alternative 6B.

22 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**
23 **(Spring-Run ESU)**

24 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**
25 **Salmon (Spring-Run ESU)**

26 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

27 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**
28 **ESU) (CM12)**

29 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
30 **(Spring-Run ESU) (CM13)**

31 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**
32 **Run ESU) (CM14)**

33 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
34 **(Spring-Run ESU) (CM15)**

1 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**
2 **(CM16)**

3 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**
4 **(CM17)**

5 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**
6 **(CM18)**

7 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**
8 **ESU) (CM19)**

9 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
10 **(Spring-Run ESU) (CM21)**

11 *NEPA Effects:* As discussed for Alternative 1A and 6A, the other impact mechanisms would not be
12 adverse, and with the implementation of environmental commitments and conservation measures,
13 the effects would typically be beneficial to spring-run Chinook salmon. Specifically for AQUA-62, the
14 effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia
15 and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon
16 are uncertain.

17 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, these impact
18 mechanisms would be beneficial or less than significant, and no mitigation would be required.

19 **Fall-/Late Fall–Run Chinook Salmon**

20 The potential effects of construction and maintenance of water conveyance facilities, operations of
21 water conveyance facilities, restoration measures and other conservation measures on fall- and late
22 fall-run Chinook salmon would be similar to those described under Alternative 1A.

23 **Construction and Maintenance of CM1**

24 The potential effects of construction and maintenance activities on fall- and late fall-run Chinook
25 salmon would be similar to those described under Alternative 1A because no differences in fish
26 effects are anticipated anywhere in the affected environment under Alternative 6B compared to
27 those described in detail for Alternative 1A (Impact AQUA-73 and AQUA-74), the effects described
28 for fall- and late fall-run Chinook salmon under Alternative 1A also appropriately characterize
29 effects under Alternative 6B.

30 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
31 **(Fall-/Late Fall–Run ESU)**

32 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
33 **(Fall-/Late Fall–Run ESU)**

34 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, these impact mechanisms
35 would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact
36 AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of

1 Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from
2 impact pile driving (e.g., injury or mortality).

3 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-73
4 could result in significant underwater noise effects from impact pile driving, although
5 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
6 impacts to less than significant.

7 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
8 **of Pile Driving and Other Construction-Related Underwater Noise**

9 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

10 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
11 **and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

13 **Water Operations of CM1**

14 The potential effects of water conveyance facility operations on fall- and late fall-run Chinook
15 salmon would be similar to those described for Alternative 6A. Because no differences in fish effects
16 are anticipated anywhere in the affected environment under Alternative 6B compared to those
17 described in detail for Alternative 6A (Impacts AQUA-75 through AQUA-78), the effects described
18 for fall- and late fall-run Chinook salmon also appropriately characterize the effects for Alternative
19 6B.

20 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**
21 **Fall-Run ESU)**

22 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
23 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

24 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
25 **(Fall-/Late Fall-Run ESU)**

26 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**
27 **(Fall-/Late Fall-Run ESU)**

28 **NEPA Effects:** Overall, the effects of water operations vary by location. Similar to effects described in
29 detail under Alternative 6A, Alternative 6B would have an adverse effect on fall-/late fall-run
30 Chinook salmon juvenile survival due to habitat and predation losses at the NDD intakes. Through-
31 delta conditions on the Sacramento River would substantially affect migration conditions relative to
32 NAA while through-Delta conditions on the San Joaquin River would be positive. However, upstream
33 of the Delta, Alternative 6B conditions relative to NAA would not substantially affect migration
34 conditions. The implementation of the conservation and mitigation measures listed below, would
35 reduce the overall effects, but they would still likely remain adverse.

36 **CEQA Conclusion:** The results of the Impact AQUA-78 CEQA analysis indicate differences between
37 the CEQA baseline and Alternative 6B depending on location. Through-Delta conditions on the
38 Sacramento River would substantially impact migration conditions relative to Existing Conditions

1 while through-Delta conditions on the San Joaquin River would be positive relative to Existing
2 Conditions. Upstream of the Delta conditions relative to Existing Conditions would be reduced
3 although the impacts are related to climate change. Alternative 6B also has the potential to
4 substantially increase predation and remove important instream habitat as the result of the
5 presence of five NDD structures.

6 Implementation of *CM6 Channel Margin Enhancement* and *CM15 Localized Reduction of Predatory*
7 *Fishes (Predator Control)* would address habitat and predation losses, therefore, would potentially
8 minimize impacts to some extent but not to a less than significant level.

9 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
10 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat
11 habitats on the waterside side of levees along channels that provide rearing and outmigration
12 habitat for juvenile salmonids.

13 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
14 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
15 locations of high predation risk (i.e., predation “hotspots”), including the NDD intakes. This
16 conservation measure seeks to reduce mortality rates of juvenile migratory salmonids that are
17 particularly vulnerable to predatory fishes. Because of uncertainties regarding treatment
18 methods and efficacy, implementation of CM15 would involve discrete pilot projects and
19 research actions coupled with an adaptive management and monitoring program to evaluate
20 effectiveness.

21 As with the conservation measures, the implementation of the mitigation measures listed below also
22 has the potential to reduce the severity of the impact though not necessarily to a less-than-
23 significant level. These mitigation measures would provide an adaptive management process, that
24 may be conducted as a part of the Adaptive Management and Monitoring Program required by the
25 BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate
26 minimization measures.

27 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**
28 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**
29 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

30 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for
31 fall/late fall-run Chinook salmon.

32 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**
33 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**
34 **of CM1**

35 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for
36 fall/late fall-run Chinook salmon.

37 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**
38 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**
39 **Migration Conditions Consistent with CM1**

40 Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for
41 fall/late fall-run Chinook salmon.

1 **Restoration and Conservation Measures**

2 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**
3 **(Fall-/Late Fall-Run ESU)**

4 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**
5 **Salmon (Fall-/Late Fall-Run ESU)**

6 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**
7 **Run ESU)**

8 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**
9 **Run ESU) (CM12)**

10 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
11 **(Fall-/Late Fall-Run ESU) (CM13)**

12 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**
13 **/Late Fall-Run ESU) (CM14)**

14 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
15 **(Fall-/Late Fall-Run ESU) (CM15)**

16 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**
17 **Run ESU) (CM16)**

18 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**
19 **ESU) (CM17)**

20 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**
21 **ESU) (CM18)**

22 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**
23 **Fall-Run ESU) (CM19)**

24 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
25 **(Fall-/Late Fall-Run ESU) (CM21)**

26 **NEPA Effects:** As discussed in detail for Alternative 1A, these restoration and conservation
27 commitment impact mechanisms (Impact AQUA-79 through AQUA-90), would not be adverse, and
28 would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80, the
29 effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper,
30 ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-
31 run Chinook salmon are uncertain.

32 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact
33 mechanisms would be beneficial or less than significant, and no mitigation would be required.

1 **Steelhead**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of
3 water conveyance facilities, restoration measures and other conservation measures on steelhead
4 would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance activities on steelhead would be similar to
7 those described under Alternative 1A because no differences in fish effects are anticipated anywhere
8 in the affected environment under Alternative 6B compared to those described in detail for
9 Alternative 1A (Impact AQUA-91 and AQUA-92). Therefore, the effects described for steelhead
10 under Alternative 1A also appropriately characterize effects under Alternative 6B.

11 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

12 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

13 *NEPA Effects:* These impact mechanisms would typically not be adverse to steelhead. While
14 construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving
15 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or
16 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

17 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-91
18 could result in significant underwater noise effects from impact pile driving, although
19 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
20 impacts to less than significant.

21 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
22 **of Pile Driving and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

24 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
25 **and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

27 **Water Operations of CM1**

28 The potential effects of water conveyance facility operations on steelhead would be similar to those
29 described above under Alternative 6A. Because no differences in fish effects are anticipated
30 anywhere in the affected environment under Alternative 6B compared to those described in detail
31 for Alternative 6A (Impact AQUA-93 through AQUA-96), the fish effects described for steelhead
32 under Alternative 6A also appropriately characterize effects under Alternative 6B.

33 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

34 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
35 **Steelhead**

36 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

1 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

2 **NEPA Effects:** As described in detail under Alternative 6A, these impact mechanisms would
3 adversely affect steelhead migration conditions, primarily as a result of unacceptable levels of
4 uncertainty regarding the cumulative impacts of near-field and far-field effects associated with the
5 presence and operation of the five intakes.

6 While the implementation of the conservation and mitigation measures described below would
7 address these impacts, these measures are not anticipated to reduce the impact to a level considered
8 not adverse. Therefore, the effects would remain adverse to steelhead under Alternative 6B.

9 **CEQA Conclusion:** Collectively, the analysis indicates that the difference between the CEQA baseline
10 and Alternative 6B could be significant because, under the CEQA baseline, the alternative could
11 substantially reduce the amount of suitable habitat and substantially interfere with steelhead
12 migrations in some areas. Alternative 6B would also negatively affect juvenile and adult migration
13 conditions in some areas.

14 Applicable conservation measures are briefly described below and full descriptions are found in
15 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized
16 Reduction of Predatory Fishes (Predator Control) (CM15).

17 In addition to the conservation measures, the mitigation measures identified below would provide
18 an adaptive management process, that may be conducted as a part of the Adaptive Management and
19 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing
20 impacts and developing appropriate minimization measures. However, this would not necessarily
21 result in a less than significant determination.

22 **Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional**
23 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**
24 **Reduce Impacts to Migration Conditions**

25 Please refer to Mitigation Measure AQUA-96a under Alternative 1A for steelhead.

26 **Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts**
27 **on Steelhead Migration Conditions Following Initial Operations of CM1**

28 Please refer to Mitigation Measure AQUA-96b under Alternative 1A for steelhead.

29 **Mitigation Measure AQUA-96c: Consult with USFWS, and CDFW to Identify and Implement**
30 **Potentially Feasible Means to Minimize Effects on Steelhead Migration Conditions**
31 **Consistent with CM1**

32 Please refer to Mitigation Measure AQUA-96a under Alternative 1A for steelhead.

33 If feasible means are identified to reduce impacts on migration habitat consistent with the overall
34 operational framework of Alternative 6B without causing new significant adverse impacts on other
35 covered species, such means shall be implemented. If sufficient operational flexibility to reduce
36 effects on steelhead habitat is not feasible under Alternative 6B operations, achieving further impact
37 reduction pursuant to this mitigation measure would not be feasible under this alternative, and the
38 impact on steelhead would remain significant and unavoidable.

1 **Restoration and Conservation Measures**

2 The potential effects of restoration measures and other conservation measures on steelhead would
3 be similar to those described under Alternative 1A. Because no differences in fish effects are
4 anticipated anywhere in the affected environment under Alternative 6B, compared to those
5 described in detail for Alternative 1A (Impact AQUA-97 through AQUA-108), the fish effects
6 described for steelhead also appropriately characterize the effects under Alternative 6B.

7 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

8 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

9 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

10 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

11 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

12 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

13 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

14 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

15 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

16 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

17 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

18 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**
19 **(CM21)**

20 **NEPA Effects:** As discussed for Alternative 1A and 6A, the other impact mechanisms would not be
21 adverse, and would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of
22 contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be
23 adverse. The effects of methylmercury on steelhead are uncertain.

24 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 6A, these impact
25 mechanisms would be beneficial or less than significant, and no mitigation would be required.

26 **Sacramento Splittail**

27 The potential effects of construction and maintenance of water conveyance facilities, operations of
28 water conveyance facilities, restoration measures and other conservation measures on Sacramento
29 splittail would be similar to those described under Alternative 1A.

30 **Construction and Maintenance of CM1**

31 The potential effects of construction and maintenance activities on Sacramento splittail would be
32 similar to those described under Alternative 1A because no differences in fish effects are anticipated

1 anywhere in the affected environment under Alternative 6B compared to those described in detail
2 for Alternative 1A (Impact AQUA-109 and AQUA-110), the fish effects described for Sacramento
3 splittail under Alternative 1A also appropriately characterize effects for Sacramento splittail under
4 Alternative 6B.

5 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**
6 **Splittail**

7 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**
8 **Splittail**

9 *NEPA Effects:* These impact mechanisms would generally not be adverse to Sacramento splittail.
10 While construction activities (Impact AQUA-109) could result in adverse effects from impact pile
11 driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would
12 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

13 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-109
14 could result in significant underwater noise effects from impact pile driving, although
15 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
16 impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no
17 additional mitigation would be required.

18 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
19 **of Pile Driving and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

21 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
22 **and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

24 **Water Operations of CM1**

25 The potential effects of water conveyance facility operations on Sacramento splittail would be
26 similar to those described for Alternative 6A. Because no differences in fish effects are anticipated
27 anywhere in the affected environment under Alternative 6B, compared to those described in detail
28 for Alternative 6A (Impacts AQUA-111 through AQUA-114), the fish effects described would also
29 appropriately characterize the effects under Alternative 6B.

30 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

31 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
32 **Sacramento Splittail**

33 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

34 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**
35 **Splittail**

1 **NEPA Effects:** As discussed in detail for Alternative 6A, the operations impact mechanisms would
2 not be adverse to Sacramento splittail.

3 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 6A, these impact
4 mechanisms would be less than significant, and no mitigation would be required.

5 **Restoration and Conservation Measures**

6 The potential effects of restoration measures and other conservation measures on Sacramento
7 splittail would be similar to those described for Alternative 1A. Because no differences in fish effects
8 are anticipated anywhere in the affected environment under Alternative 6B compared to those
9 described in detail for Alternative 1A (Impacts AQUA-115 through AQUA-126), the fish effects
10 described also appropriately characterize the effects under Alternative 6B.

11 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

12 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on** 13 **Sacramento Splittail**

14 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

15 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

16 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento** 17 **Splittail (CM13)**

18 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail** 19 **(CM14)**

20 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail** 21 **(CM15)**

22 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

23 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

24 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

25 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

26 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento** 27 **Splittail (CM21)**

28 **NEPA Effects:** As discussed for Alternative 1A, the other impact mechanisms would not be adverse,
29 and would typically be beneficial to Sacramento splittail. Specifically for AQUA-116, the effects of
30 contaminants on Sacramento splittail with respect to selenium, copper, ammonia and pesticides
31 would not be adverse. The effects of methylmercury on Sacramento splittail are uncertain.

32 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact
33 mechanisms would be beneficial or less than significant, and no mitigation would be required.

1 **Green Sturgeon**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of
3 water conveyance facilities, restoration measures and other conservation measures on green
4 sturgeon would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance activities on green sturgeon would be similar
7 to those described under Alternative 1A because no differences in fish effects are anticipated
8 anywhere in the affected environment under Alternative 6B compared to those described in detail
9 for Alternative 1A (Impact AQUA-127 and AQUA-128), the fish effects described for green sturgeon
10 under Alternative 1A also appropriately characterize effects for green sturgeon under Alternative
11 6B.

12 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

13 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

14 **NEPA Effects:** While the maintenance impact mechanism (Impact AQUA-128) would not be adverse
15 to green sturgeon, construction activities (Impact AQUA-127) could result in adverse effects from
16 impact pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and
17 AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or
18 mortality).

19 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-127
20 could result in significant underwater noise effects from impact pile driving, although
21 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
22 impacts to less than significant. The other impact mechanism would be less than significant, so no
23 additional mitigation would be required.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

30 **Water Operations of CM1**

31 The potential effects of operations of water conveyance facilities on green sturgeon would be
32 similar to those described for Alternative 6A. Because no differences in fish effects are
33 anticipated anywhere in the affected environment under Alternative 6B compared to those
34 described in detail for Alternative 6A (Impacts AQUA-129 through AQUA-132), the fish effects
35 described for green sturgeon also appropriately characterize the effects under Alternative 6B.

36 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

1 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
2 **Green Sturgeon**

3 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

4 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

5 *NEPA Effects:* As discussed for Alternative 6A, Impact AQUA-129 would be beneficial for green
6 sturgeon because of the elimination of entrainment and entrainment-related predation loss at the
7 south Delta facilities. As discussed for Alternative 1A and 6A, Impact AQUA-130 and AQUA-132 are
8 expected to negatively affect green sturgeon spawning and rearing habitat conditions under
9 Alternative 6B. These effects are a result of the specific reservoir operations and resulting flows
10 associated with this alternative. However, as discussed for Alternative 6A, the overall effect would
11 not be adverse.

12 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, Impact
13 AQUA-130 through AQUA-132, effects on spawning, incubation, and rearing habitat conditions
14 would be negatively affected, compared to CEQA baseline. However, this would not in itself result in
15 a significant impact on green sturgeon, if adjusted to exclude sea level rise and climate change. In
16 addition, entrainment effects would likely be beneficial. Therefore, the overall effect would be less
17 than significant, and no mitigation would be needed.

18 **Restoration and Conservation Measures**

19 Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no
20 substantial differences in fish effects are anticipated anywhere in the affected environment under
21 Alternative 6B compared to those described in detail for Alternative 1A, the effects of the restoration
22 and conservation measures described for green sturgeon under Alternative 1A (Impact AQUA-133
23 through Impact AQUA-144) also appropriately characterize effects under Alternative 6B.

24 The following impacts are those presented under Alternative 1A that are identical for Alternative
25 6B.

26 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

27 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**
28 **Sturgeon**

29 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

30 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

31 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**
32 **(CM13)**

33 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

34 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**
35 **(CM15)**

1 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

2 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

3 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

4 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

5 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**
6 **Sturgeon (CM21)**

7 *NEPA Effects:* As described in Alternative 1A, these impact mechanisms have been determined to
8 range from no effect, to not adverse, or beneficial effects on green sturgeon for NEPA purposes, for
9 the reasons identified for Alternative 1A (Impact AQUA-133 through 144). Specifically for AQUA-
10 134, the effects of contaminants on green sturgeon with respect to copper, ammonia and pesticides
11 would not be adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

12 *CEQA Conclusion:* These impact mechanisms would be considered to range from no impact, to less
13 than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A
14 (Impact AQUA-133 through 144), and no mitigation is required.

15 **White Sturgeon**

16 The potential effects of construction and maintenance of water conveyance facilities, operations of
17 water conveyance facilities, restoration measures and other conservation measures on white
18 sturgeon would be similar to those described under Alternative 1A.

19 **Construction and Maintenance of CM1**

20 The potential effects of construction and maintenance activities on white sturgeon would be similar
21 to those described under Alternative 1A because no differences in fish effects are anticipated
22 anywhere in the affected environment under Alternative 6B compared to those described in detail
23 for Alternative 1A (Impact AQUA-145 and Impact AQUA-146), the effects described for white
24 sturgeon under Alternative 1A also appropriately characterize effects for white sturgeon under
25 Alternative 6B.

26 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

27 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

28 *NEPA Effects:* As concluded for Alternative 1A (Impact AQUA-145 and AQUA-146), environmental
29 commitments and mitigation measures would be available to avoid and minimize potential effects,
30 so the effect would not be adverse for white sturgeon.

31 *CEQA Conclusion:* As described under Alternative 1A (Impact AQUA-145 and AQUA-146), the
32 impact of the construction and maintenance of water conveyance facilities on white sturgeon would
33 be less than significant except for construction noise associated with pile driving. Implementation of
34 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
35 less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7 **Water Operations of CM1**

8 The potential effects of operations of water conveyance facilities on white sturgeon would be
9 similar to those described for Alternative 6A. Because no differences in fish effects are
10 anticipated anywhere in the affected environment under Alternative 6B compared to those
11 described in detail for Alternative 6A (Impacts AQUA-147 through AQUA-150), the effects
12 described for white sturgeon also appropriately characterize the effects under Alternative 6B.

13 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

14 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
15 **White Sturgeon**

16 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

17 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

18 **NEPA Effects:** The effect on entrainment and entrainment-related predation under Alternative 6B
19 would be beneficial to the species, because of the elimination of entrainment and entrainment-
20 related predation loss at the south Delta facilities. In general, Alternative 6B would not be adverse to
21 spawning, egg incubation, or rearing habitat for white sturgeon relative to NAA. However, there is
22 scientific uncertainty regarding which mechanisms are responsible for the positive correlation
23 between year class strength and high river/Delta flow, which could be affected by Alternative 6B
24 operations. These uncertainties will be addressed through targeted research and monitoring to be
25 conducted in the years leading up to the initiation of north Delta facilities operations. If these
26 targeted investigations find that the positive correlation is related to in-Delta and through-Delta
27 flow conditions, then Alternative 6B would be deemed adverse due to the magnitude of reductions
28 in through-Delta flow conditions in Alternative 6B as compared to NAA. However, adaptive
29 management procedures would be implemented to meet the biological goals and objectives.

30 **CEQA Conclusion:** The impact and conclusion for entrainment are the same as described
31 immediately above, and would be mostly beneficial, due to elimination of entrainment losses at the
32 south Delta diversions. Collectively, the results of the Impact AQUA-149 and AQUA-150 analyses
33 indicate that the difference between the CEQA baseline and Alternative 6B could be significant, but
34 the differences would generally be due to climate change, sea level rise, and future demand, and not
35 the alternative. As a result, the CEQA conclusion regarding Alternative 6B, if adjusted to exclude sea
36 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would
37 be less than significant. Additionally, as described above in the NEPA Effects statement, further
38 investigation is needed to better understand the association of Delta outflow to sturgeon
39 recruitment, and if needed, adaptive management would be used to make adjustments to meet the

1 biological goals and objectives. This impact is found to be less than significant and no mitigation is
2 required.

3 **Restoration and Conservation Measures**

4 Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no
5 substantial differences in fish effects are anticipated anywhere in the affected environment under
6 Alternative 6B compared to those described in detail for Alternative 1A, the effects of these
7 measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact
8 AQUA-162) also appropriately characterize effects under Alternative 6B.

9 The following impacts are those presented under Alternative 1A that are identical for Alternative
10 6B.

11 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

12 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White**
13 **Sturgeon**

14 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

15 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

16 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**
17 **(CM13)**

18 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

19 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**
20 **(CM15)**

21 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

22 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

23 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

24 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

25 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**
26 **Sturgeon (CM21)**

27 **NEPA Effects:** The restoration and conservation measure impact mechanisms have been determined
28 to range from no effect, to not adverse, or beneficial effects on white sturgeon for NEPA purposes,
29 for the reasons identified for Alternative 1A (Impact AQUA-151 through 162). Specifically for AQUA-
30 152, the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides
31 would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

32 **CEQA Conclusion:** The restoration and conservation measure impact mechanisms would be
33 considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the

1 reasons identified for Alternative 1A (Impact AQUA-151 through 162), and no mitigation is
2 required.

3 **Pacific Lamprey**

4 The potential effects of construction and maintenance of water conveyance facilities, operations of
5 water conveyance facilities, restoration measures and other conservation measures on Pacific
6 lamprey would be similar to those described under Alternative 1A.

7 **Construction and Maintenance of CM1**

8 The potential effects of construction and maintenance activities on Pacific lamprey would be similar
9 to those described under Alternative 1A because no differences in fish effects are anticipated
10 anywhere in the affected environment under Alternative 6B compared to those described in detail
11 for Alternative 1A (Impact AQUA-163 and Impact AQUA-164), the effects described for Pacific
12 lamprey under Alternative 1A also appropriately characterize effects for Pacific lamprey under
13 Alternative 6B.

14 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

15 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

16 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-163 and AQUA-164, environmental
17 commitments and mitigation measures would be available to avoid and minimize potential effects,
18 and the effect would not be adverse for Pacific lamprey.

19 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-163 and AQUA-164, the impact
20 of the construction and maintenance of water conveyance facilities on Pacific lamprey would be less
21 than significant except for construction noise associated with pile driving. Implementation of
22 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
23 less than significant.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

30 **Water Operations of CM1**

31 The potential effects of water conveyance facility operations on Pacific lamprey would be similar to
32 those described under Alternative 6A. Because no differences in fish effects are anticipated
33 anywhere in the affected environment under Alternative 6B compared to those described in detail
34 for Alternative 6A (Impact AQUA-165 and Impact AQUA-168), the effects described for Pacific
35 lamprey under Alternative 6A also appropriately characterize effects for Pacific lamprey under
36 Alternative 6B.

1 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

2 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
3 **Pacific Lamprey**

4 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

5 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

6 *NEPA Effects:* As discussed in detail for Alternative 6A, entrainment and entrainment-related
7 predation on Pacific lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6B
8 would not be adverse because it would not substantially reduce suitable spawning habitat, or
9 substantially interfere with the movement of fish. In addition, the effects would not increase egg or
10 ammocoete mortality. As a result, the overall effects would not be adverse.

11 *CEQA Conclusion:* As described in detail under Alternative 6A, while entrainment effects are likely
12 to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and
13 Alternative 6A could be significant, contrary to the NEPA conclusion set forth above, due to
14 reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in
15 rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate
16 change, Alternative 6B would be less than significant and no mitigation is required.

17 **Restoration and Conservation Measures**

18 Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no
19 substantial differences in fish effects are anticipated anywhere in the affected environment under
20 Alternative 6B compared to those described in detail for Alternative 1A, the effects of these
21 measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact
22 AQUA-180) also appropriately characterize effects under Alternative 6B.

23 The following impacts are those presented under Alternative 1A that are identical for Alternative
24 6B.

25 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

26 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**
27 **Lamprey**

28 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

29 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

30 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**
31 **(CM13)**

32 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

33 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**
34 **(CM15)**

- 1 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**
2 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**
3 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**
4 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**
5 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**
6 **Lamprey (CM21)**

7 *NEPA Effects:* As discussed in detail for Alternative 1A and 6A, the restoration and conservation
8 measure impact mechanisms (Impact AQUA-169 through AQUA-180) have been determined to
9 range from no effect, to not adverse, or beneficial to Pacific lamprey for NEPA purposes. Therefore,
10 the effect would not be adverse.

11 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, these impact
12 mechanisms would be beneficial or less than significant under Alternative 6B, and no mitigation
13 would be required.

14 **River Lamprey**

15 The potential effects of construction and maintenance of water conveyance facilities, operations of
16 water conveyance facilities, restoration measures and other conservation measures on river
17 lamprey would be similar to those described under Alternative 1A.

18 **Construction and Maintenance of CM1**

19 The potential effects of construction and maintenance activities on river lamprey would be similar
20 to those described under Alternative 1A because no differences in fish effects are anticipated
21 anywhere in the affected environment under Alternative 6B compared to those described in detail
22 for Alternative 1A (Impact AQUA-181 and Impact AQUA-182), the fish effects described for river
23 lamprey under Alternative 1A also appropriately characterize effects for river lamprey under
24 Alternative 6B.

25 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

26 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

27 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-181 and AQUA-182, environmental
28 commitments and mitigation measures would be available to avoid and minimize potential effects,
29 and the effect would not be adverse for river lamprey.

30 *CEQA Conclusion:* As described under Alternative 1A, Impact AQUA-181 and AQUA-182, the impact
31 of the construction and maintenance of water conveyance facilities on river lamprey would be less
32 than significant except for construction noise associated with pile driving. Implementation of
33 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
34 less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7 **Water Operations of CM1**

8 The potential effects of water conveyance facility operations on river lamprey would be similar to
9 those described under Alternative 6A. Because no differences in fish effects are anticipated
10 anywhere in the affected environment under Alternative 6B compared to those described in detail
11 for Alternative 6A (Impact AQUA-183 through Impact AQUA-186). Therefore, the effects described
12 for river lamprey under Alternative 6A also appropriately characterize effects under Alternative 6B.

13 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

14 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
15 **River Lamprey**

16 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

17 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

18 *NEPA Effects:* As discussed in detail for Alternative 6A, entrainment and entrainment-related
19 predation on river lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6B
20 would not be adverse because it would not substantially reduce suitable spawning or rearing
21 habitat, and would not increase egg or ammocoete mortality. The water operations would also not
22 substantially interfere with the movement of fish. As a result, the overall effects would not be
23 adverse.

24 *CEQA Conclusion:* As described in detail under Alternative 6A, while entrainment effects are likely
25 to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and
26 Alternative 6A could be significant, contrary to the NEPA conclusion set forth above, due to
27 reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in
28 rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate
29 change, Alternative 6B would be less than significant and no mitigation is required.

30 **Restoration and Conservation Measures**

31 Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no
32 substantial differences in fish effects are anticipated anywhere in the affected environment under
33 Alternative 6B compared to those described in detail for Alternative 1A, the effects of these
34 measures described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact
35 AQUA-198) also appropriately characterize effects under Alternative 6B.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative
37 6B.

1 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

2 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**
3 **Lamprey**

4 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

5 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

6 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**
7 **(CM13)**

8 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

9 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

10 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

11 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

12 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

13 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

14 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**
15 **(CM21)**

16 **NEPA Effects:** As discussed in detail for Alternative 1A, the restoration and conservation measure
17 impact mechanisms (Impact AQUA-187 through AQUA-198) have been determined to range from no
18 effect, to not adverse, or beneficial to river lamprey for NEPA purposes.

19 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact
20 mechanisms would be beneficial or less than significant, and no mitigation would be required.

21 **Non-Covered Aquatic Species of Primary Management Concern**

22 The potential effects of construction and maintenance of water conveyance facilities, operations of
23 water conveyance facilities, restoration measures and other conservation measures on non-covered
24 species of primary concern would be similar to those described under Alternative 1A.

25 **Construction and Maintenance of CM1**

26 The potential effects of construction and maintenance activities on non-covered species would be
27 similar to those described under Alternative 1A because no differences in fish effects are anticipated
28 anywhere in the affected environment under Alternative 6B compared to those described in detail
29 for Alternative 1A (Impact AQUA-199 and Impact AQUA-200), the effects described for non-covered
30 aquatic species of primary management concern under Alternative 1A also appropriately
31 characterize effects for non-covered aquatic species of primary management concern under
32 Alternative 6B.

1 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**
2 **Aquatic Species of Primary Management Concern**

3 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**
4 **Aquatic Species of Primary Management Concern**

5 *NEPA Effects:* As concluded for Alternative 1A (Impact AQUA-199 and AQUA-200), environmental
6 commitments and mitigation measures would be available to avoid and minimize potential effects,
7 and the effect would not be adverse for non-covered aquatic species of primary management
8 concern.

9 *CEQA Conclusion:* As described under Alternative 1A (Impact AQUA-199 and AQUA-200), the
10 impact of the construction and maintenance of water conveyance facilities on non-covered aquatic
11 species of primary management concern would be less than significant except potentially for
12 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and
13 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

14 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
15 **of Pile Driving and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

17 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
18 **and Other Construction-Related Underwater Noise**

19 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

20 **Water Operations of CM1**

21 The potential effects of water conveyance facility operations on non-covered species would be
22 similar to those described under Alternative 6A. Because no differences in fish effects are
23 anticipated anywhere in the affected environment under Alternative 6B compared to those
24 described in detail for Alternative 6A (Impact AQUA-201 through Impact AQUA-204), the effects
25 described for non-covered aquatic species of primary management concern under Alternative 6A
26 also appropriately characterize effects for non-covered aquatic species of primary management
27 concern under Alternative 6B.

28 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**
29 **Species of Primary Management Concern**

30 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
31 **Non-Covered Aquatic Species of Primary Management Concern**

32 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**
33 **Species of Primary Management Concern**

34 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**
35 **Aquatic Species of Primary Management Concern**

36 *NEPA Effects:* These impact mechanisms would not be adverse to the non-covered species of
37 primary management concern, and with the implementation of environmental commitments and

1 conservation measures, the effects would typically be beneficial to non-covered fish species of
2 primary management concern.

3 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 6A, most of these
4 impact mechanisms would be beneficial or less than significant, although Impact AQUA-203 and
5 AQUA-204 could result in significant, but unavoidable effects on rearing habitat and migration
6 habitat conditions for several fish species of primary management concern. These species include
7 largemouth bass, Sacramento-San Joaquin roach, and hardhead. There are also no feasible
8 mitigation measures available to mitigate for these impacts. The other impact mechanisms would be
9 less than significant, or beneficial, so no additional mitigation would be required.

10 **Restoration and Conservation Measures**

11 Alternative 6B has the same restoration and conservation measures as Alternative 1A. Because no
12 substantial differences in fish effects are anticipated anywhere in the affected environment under
13 Alternative 6B compared to those described in detail for Alternative 1A, the effects of these
14 measures described for non-covered aquatic species of primary management concern under
15 Alternative 1A (Impact AQUA-205 through Impact AQUA-216) also appropriately characterize
16 effects under Alternative 6B.

17 The following impacts are those presented under Alternative 1A that are identical for Alternative
18 6B.

19 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic** 20 **Species of Primary Management Concern**

21 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-** 22 **Covered Aquatic Species of Primary Management Concern**

23 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of** 24 **Primary Management Concern**

25 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of** 26 **Primary Management Concern (CM12)**

27 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered** 28 **Aquatic Species of Primary Management Concern (CM13)**

29 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic** 30 **Species of Primary Management Concern (CM14)**

31 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic** 32 **Species of Primary Management Concern (CM15)**

33 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of** 34 **Primary Management Concern (CM16)**

35 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of** 36 **Primary Management Concern (CM17)**

1 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**
2 **Primary Management Concern (CM18)**

3 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**
4 **of Primary Management Concern (CM19)**

5 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**
6 **Aquatic Species of Primary Management Concern (CM21)**

7 *NEPA Effects:* As discussed in detail under Alternative 1A and 6A, these impact mechanisms would
8 not be adverse, and would typically be beneficial to non-covered fish species of primary
9 management concern.

10 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, these impact
11 mechanisms would be beneficial or less than significant, and no mitigation would be required.

12 **Upstream Reservoirs**

13 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

14 *NEPA Effects:* Similar to the description for Alternative 1A, Impact AQUA-217 would not be adverse
15 because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 6B would
16 not be substantially reduced when compared to the No Action Alternative.

17 *CEQA Conclusion:* Similar to the description for Alternative 1A, Alternative 6B would reduce the
18 quantity of coldwater fish habitat in the CVP and SWP. There would be a greater than 5% increase (5
19 years) for several of the reservoirs, which could result in a significant impact. These results are
20 primarily caused by four factors: differences in sea level rise, differences in climate change, future
21 water demands, and implementation of the alternative. The analysis described above comparing
22 Existing Conditions to Alternative 6B does not partition the effect of implementation of the
23 alternative from those of sea level rise, climate change and future water demands using the model
24 simulation results presented in this chapter. However, the increment of change attributable to the
25 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
26 adverse. As a result, the CEQA conclusion regarding Alternative 6B, if adjusted to exclude sea level
27 rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in
28 a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than
29 significant and no mitigation is required.

11.3.4.13 Alternative 6C—Isolated Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario D)

Construction impacts from Alternative 6C would be the same as those discussed for Alternative 1C. Like Alternative 1C, Alternative 6C would convey water from five fish-screened intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through a tunnel and two large canal segments to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, like Alternatives 6A and 6B, Alternative 6C would be an isolated conveyance, no longer involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant. Other than the isolated conveyance, the culvert siphons, and the number of barge landings, the physical and structural components would be similar to those under Alternative 1C. Implementation of mitigation measures (described below) and environmental commitments (Appendix 3B, *Environmental Commitments*) would reduce impacts as described under Alternative 1A.

Water supply and conveyance operations would follow the guidelines described as Scenario D. However, Alternative 6C has the same diversion and conveyance operations as Alternative 1A; consequently, the analysis under Alternative 1A is applicable to Alternative 6C.

CM2–CM22 would be implemented under this alternative, and these conservation measures would be identical to those under Alternative 1A. See Chapter 3, *Description of Alternatives*, for additional details on Alternative 6C.

Delta Smelt

Construction and Maintenance of CM1

The potential effects of construction and maintenance of water conveyance facilities on delta smelt or designated critical habitat would be similar to those described under Alternative 1A (Impact AQUA-1 and AQUA-2) because no differences in fish or habitat effects are anticipated anywhere in the affected environment under Alternative 6C compared to those described in detail for Alternative 1A. The effects described for delta smelt and critical habitat under Alternative 1A also appropriately characterize effects under Alternative 6C.

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-1 and Impact AQUA-2, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or designated critical habitat.

CEQA Conclusion: As described in Impact AQUA-1 and Impact AQUA-2 under Alternative 1A for delta smelt, the impact of the construction and maintenance of water conveyance facilities on delta smelt or critical habitat would not be significant except for construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7 **Water Operations of CM1**

8 Alternative 6C has the same diversion and conveyance operations as Alternative 6A. The primary
9 difference between the two alternatives is that conveyance under Alternative 6C would be in a lined
10 or unlined canal, instead of a pipeline. Because there would be no difference in conveyance capacity
11 or operations, there would be no differences between these two alternatives in upstream of the
12 Delta river flows or reservoir operations, Delta inflow, and hydrodynamics in the Delta. Because no
13 differences in fish effects are anticipated anywhere in the affected environment under Alternative
14 6B compared to those described in detail for Alternative 6A (Impact AQUA-3 through Impact AQUA-
15 6), the fish effects described for Alternative 6A also appropriately characterize effects under
16 Alternative 6C.

17 The following impacts are those presented under Alternative 6A that are identical for Alternative 6C.

18 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

19 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
20 **Delta Smelt**

21 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

22 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

23 **NEPA Effects:** With the exception of Impact AQUA-5, the other impact mechanisms listed above,
24 would be beneficial or not adverse to delta smelt under Alternative 6C, including beneficial effects of
25 Impact AQUA-3 and AQUA-4. This is the same conclusion as described in detail under Alternative 6A,
26 and is based on the expected overall limited or slightly beneficial impacts. However, the overall
27 effect of Impact AQUA-5 on delta smelt rearing habitat would remain adverse because there likely
28 would still be a loss of suitable habitat even with BDCP restoration efforts (see Alternative 1A,
29 AQUA-5 for details on expected effects).

30 **CEQA Conclusion:** The effects of three of the above listed impact mechanisms would be less than
31 significant, or slightly beneficial to delta smelt, and no mitigation would be required. In addition, the
32 effects of Impact AQUA-5 would also be considered less than significant, because it would not
33 substantially reduce rearing habitat. Therefore, no mitigation would be required for any of the
34 impact mechanisms listed above. Detailed discussions regarding these conclusions are presented in
35 Alternative 6A.

1 **Restoration and Conservation Measures**

2 Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no
3 substantial differences in fish effects are anticipated anywhere in the affected environment under
4 Alternative 6C compared to those described in detail for Alternative 1A, the effects described for
5 Alternative 1A (Impact AQUA-7 through Impact AQUA-18) also appropriately characterize effects
6 under Alternative 6C.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

8 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

9 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**
10 **Smelt**

11 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

12 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

13 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

14 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

15 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

16 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

17 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

18 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

19 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

20 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**
21 **(CM21)**

22 **NEPA Effects:** As described in detail under Alternative 1A, none of these impact mechanisms
23 (Impact AQUA-7 through AQUA-18) would be adverse to delta smelt, and most would be at least
24 slightly beneficial. Specifically for AQUA-8, the effects of contaminants on delta smelt with respect to
25 selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on
26 delta smelt are uncertain.

27 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or
28 less than significant, and no mitigation is required.

29 **Longfin Smelt**

30 The potential effects of construction and maintenance of water conveyance facilities, operations of
31 water conveyance facilities, restoration measures and other conservation measures on longfin smelt
32 would be similar to those described under Alternative 1A.

1 **Construction and Maintenance of CM1**

2 The potential effects of construction and maintenance activities on longfin smelt would be similar to
3 those described under Alternative 1A because no differences in fish effects are anticipated anywhere
4 in the affected environment under Alternative 6C compared to those described in detail for
5 Alternative 1A (Impact AQUA-19 and Impact AQUA-20), the effects described for longfin smelt
6 under Alternative 1A also appropriately characterize effects for longfin smelt under Alternative 6C.

7 The following impacts on longfin smelt are those presented under Alternative 1A that are identical
8 for Alternative 6C.

9 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

10 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

11 *NEPA Effects:* These impact mechanisms would not be adverse to longfin smelt. While construction
12 activities (Impact AQUA-19) could result in adverse effects from impact pile driving activities, the
13 implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate
14 adverse effects from impact pile driving (e.g., injury or mortality).

15 *CEQA Conclusion:* Similar to the discussion provided above for Alternatives 1A and 6A, Impact
16 AQUA-19 could result in significant underwater noise effects from impact pile driving, although
17 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
18 impacts to less than significant.

19 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
20 **of Pile Driving and Other Construction-Related Underwater Noise**

21 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

22 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
23 **and Other Construction-Related Underwater Noise**

24 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

25 **Water Operations of CM1**

26 The potential effects of water conveyance facility operations on longfin smelt would be similar to
27 those described under Alternative 6A. Because no differences in fish effects are anticipated
28 anywhere in the affected environment for Impact AQUA-21 through AQUA-24, the effects described
29 for longfin smelt under Alternatives 6A also appropriately characterize effects under Alternative 6C.

30 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

31 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**
32 **Habitat for Longfin Smelt**

33 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

34 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

1 **NEPA Effects:** The potential effects of water operations on longfin smelt under Alternative 6C would
2 be similar to those described above under Alternative 6A. As discussed under Alternative 6A, the
3 effects on longfin smelt from Impact AQUA-22 could be an adverse effect. Despite a growing body of
4 evidence supporting a positive correlation between longfin smelt abundance and spring outflow, the
5 specific timing and amount of outflow needed to conserve longfin smelt is less clear, especially in
6 light of potential increases in food resources in the Plan Area and other benefits to spawning and
7 rearing habitat. Therefore, the implementation of adaptive management procedures under
8 Alternative 6C, that could be used to adjust spring operations, is expected to reduce potential effects
9 to not be adverse. These adaptive management procedures are described in Mitigation Measures
10 22a through 22c, under Alternative 1A.

11 **CEQA Conclusion:** As described above under Alternatives 1A and 6A, water operations under
12 Alternative 6C would generally reduce the quantity and quality of longfin smelt rearing habitat
13 relative to Existing Conditions. The results also indicate that the difference in rearing habitat could
14 be significant because Delta outflows would be reduced in the spring, which would have the
15 potential to contribute to substantial reductions in longfin smelt abundances. These effects are due
16 to the specific reservoir operations and resulting flows associated with this alternative. However,
17 the implementation of Mitigation Measures AQUA-22a through 22c, habitat restoration and reduced
18 larval entrainment would reduce this impact to less than significant, so no additional mitigation
19 would be required.

20 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**
21 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**
22 **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

23 Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

24 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**
25 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

26 Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

27 **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**
28 **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

29 Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

30 **Restoration and Conservation Measures**

31 The potential effects of restoration measures and other conservation measures on longfin smelt
32 would be similar to those described under Alternative 1A. Because no differences in fish effects are
33 anticipated anywhere in the affected environment under Alternative 6C compared to those
34 described in detail for Alternative 1A (Impact AQUA-25 through AQUA-36), the fish effects described
35 for longfin smelt under Alternative 1A also appropriately characterize effects for longfin smelt under
36 Alternative 6C.

37 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

38 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**
39 **Smelt**

1 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

2 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

3 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**
4 **(CM13)**

5 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

6 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

7 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

8 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

9 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

10 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

11 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**
12 **(CM21)**

13 *NEPA Effects:* As described in Alternative 1A (Impact AQUA-25 through AQUA-36) these impact
14 mechanisms have been determined to range from no effect, to not adverse, or beneficial to longfin
15 smelt for NEPA purposes. Specifically for AQUA-26, the effects of contaminants on longfin smelt with
16 respect to selenium, copper, ammonia and pesticides would not be adverse. The effects of
17 methylmercury on longfin smelt are uncertain.

18 *CEQA Conclusion:* These impact mechanisms would be considered to range from no impact, to less
19 than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is
20 required.

21 **Winter-Run Chinook Salmon**

22 The potential effects of construction and maintenance of water conveyance facilities, operations of
23 water conveyance facilities, restoration measures and other conservation measures on winter-run
24 Chinook salmon would be similar to those described under Alternative 1A.

25 **Construction and Maintenance of CM1**

26 The potential effects of construction and maintenance activities on winter-run Chinook salmon
27 would be similar to those described under Alternative 1A because no differences in fish effects are
28 anticipated anywhere in the affected environment under Alternative 6C compared to those
29 described in detail for Alternative 1A (Impact AQUA-37 and Impact AQUA-38), the effects described
30 for winter-run Chinook salmon under Alternative 1A also appropriately characterize effects under
31 Alternative 6C.

32 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
33 **(Winter-Run ESU)**

1 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
2 **(Winter-Run ESU)**

3 *NEPA Effects:* These impact mechanisms would not be adverse to winter-run Chinook salmon. While
4 construction activities (Impact AQUA-37) could result in adverse effects from impact pile driving
5 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or
6 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

7 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, Impact
8 AQUA-37 could result in significant underwater noise effects from impact pile driving, although
9 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
10 impacts to less than significant.

11 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
12 **of Pile Driving and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

14 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
15 **and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

17 **Water Operations of CM1**

18 The potential effects of operations of water conveyance facilities on winter-run Chinook salmon
19 would be similar to those described for Alternative 6A. Because no differences in fish effects are
20 anticipated anywhere in the affected environment under Alternative 6C compared to those
21 described in detail for Alternative 6A (Impacts AQUA-39 through AQUA-42), the effects
22 described for winter-run Chinook salmon also appropriately characterize the effects under
23 Alternative 6C.

24 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**
25 **Run ESU) Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation**
26 **Habitat for Chinook Salmon (Winter-Run ESU)**

27 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
28 **(Winter-Run ESU)**

29 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**
30 **(Winter-Run ESU)**

31 *NEPA Effects:* As discussed for Alternative 6A, with the exception of Impact AQUA-42, the impact
32 mechanisms listed above would not be adverse to winter-run Chinook salmon under Alternative 6C.
33 However, Alternative 6C would be adverse to migration conditions for winter-run Chinook salmon.
34 While the implementation of applicable conservation measures (CM6, *Channel Margin Enhancement*
35 and CM15, *Predator Control*), as described in Chapter 3 (Section 3.6), would minimize potential
36 effects, the effect would remain adverse.

37 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 6A, Impact AQUA-42
38 would result in significant effects on migration conditions. While the implementation of applicable

1 conservation measures (CM6, *Channel Margin Enhancement* and CM15, *Predator Control*), as
2 described in Chapter 3 (Section 3.6) would minimize potential effects, the effect would remain
3 significant and unavoidable.

4 **Restoration and Conservation Measures**

5 The potential effects of restoration measures and other conservation measures on winter-run
6 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in
7 fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to
8 those described in detail for Alternative 1A (Impact AQUA-43 through AQUA-54), the effects
9 described for winter-run Chinook salmon under Alternative 1A also appropriately characterize
10 effects under Alternative 6C.

11 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon** 12 **(Winter-Run ESU)**

13 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook** 14 **Salmon (Winter-Run ESU)**

15 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run** 16 **ESU)**

17 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run** 18 **ESU) (CM12)**

19 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon** 20 **(Winter-Run ESU) (CM13)**

21 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-** 22 **Run ESU) (CM14)**

23 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon** 24 **(Winter-Run ESU) (CM15)**

25 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)** 26 **(CM16)**

27 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)** 28 **(CM17)**

29 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)** 30 **(CM18)**

31 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run** 32 **ESU) (CM19)**

33 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon** 34 **(Winter-Run ESU) (CM21)**

1 **NEPA Effects:** As discussed in detail for Alternative 1A, the impact mechanisms listed above would
2 not be adverse, and would typically be beneficial to winter-run Chinook salmon. Specifically for
3 AQUA-44, the effects of contaminants on winter-run Chinook salmon with respect to selenium,
4 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run
5 Chinook salmon are uncertain.

6 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact
7 mechanisms would be less than significant, or beneficial, so no additional mitigation would be
8 required.

9 **Spring-Run Chinook Salmon**

10 The potential effects of construction and maintenance of water conveyance facilities, operations of
11 water conveyance facilities, restoration measures and other conservation measures on spring-run
12 Chinook salmon would be similar to those described under Alternative 1A.

13 **Construction and Maintenance of CM1**

14 The potential effects of construction and maintenance activities on spring-run Chinook salmon
15 would be similar to those described under Alternative 1A because no differences in fish effects are
16 anticipated anywhere in the affected environment under Alternative 6C compared to those
17 described in detail for Alternative 1A (Impact AQUA-55 and Impact AQUA-56). The fish effects
18 described for spring-run Chinook salmon under Alternative 1A also appropriately characterize
19 effects for spring-run Chinook salmon under Alternative 6C.

20 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 21 **(Spring-Run ESU)**

22 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 23 **(Spring-Run ESU)**

24 **NEPA Effects:** These impact mechanisms would not be adverse to spring-run Chinook salmon. While
25 construction activities (Impact AQUA-55) could result in adverse effects from impact pile driving
26 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or
27 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

28 **CEQA Conclusion:** Similar to the discussion provided above for Alternatives 1A, Impact AQUA-55
29 could result in significant underwater noise effects from impact pile driving, although
30 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
31 impacts to less than significant.

32 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 33 **of Pile Driving and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

35 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 36 **and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

1 **Water Operations of CM1**

2 The potential effects of water conveyance facility operations on spring-run Chinook salmon would
3 be similar to those described under Alternative 6A. Because no differences in fish effects are
4 anticipated anywhere in the affected environment under Alternative 6C compared to Alternative 6A
5 (Impact AQUA-57 through AQUA-60), the effects described for spring-run Chinook salmon under
6 Alternatives 6A also appropriately characterize effects under Alternative 6C.

7 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run
8 ESU)**

9 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for
10 Chinook Salmon (Spring-Run ESU)**

11 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-
12 Run ESU)**

13 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon
14 (Spring-Run ESU)**

15 *NEPA Effects:* As discussed in detail for Alternative 6A, the impact mechanisms listed above would
16 range from beneficial to adverse under Alternative 6C for spring-run Chinook salmon. Adverse
17 effects would occur because migration conditions would be substantially reduced, and because it
18 has the potential to substantially increase predation, and remove important instream habitat as the
19 result of the presence of five north Delta intake structures. While the implementation of the
20 conservation and mitigation listed below, would reduce potential effects, the effect would likely
21 remain adverse.

22 *CEQA Conclusion:* As discussed in detail for Alternative 6A, the effects of the impact mechanisms
23 listed above would range from beneficial to significant under Alternative 6C for spring-run Chinook
24 salmon. Impact AQUA-60 would result in significant effects on migration conditions. Implementation
25 of CM6, *Channel Margin Enhancement* (Chapter 3, Section 3.6.2.5) and CM15, *Localized Reduction of
26 Predatory Fishes* (Chapter 3, Section 3.6.3.4) would address these impacts, but are not anticipated to
27 reduce them to a level considered less than significant.

28 Applicable conservation measures are briefly described below and full descriptions are found in
29 Chapter 3, Section 3.6.2.5 Channel Margin Enhancement (CM6) and Section 3.6.3.4 Localized
30 Reduction of Predatory Fishes (Predator Control) (CM15).

31 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
32 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat
33 habitats on the waterside side of levees along channels that provide rearing and outmigration
34 habitat for juvenile salmonids.

35 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
36 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
37 locations of high predation risk (i.e., predation “hotspots”), including the NDD intakes. Because
38 of uncertainties regarding treatment methods and efficacy, implementation of CM15 would
39 involve discrete pilot projects and research actions coupled with an adaptive management and
40 monitoring program to evaluate effectiveness.

1 In addition to these conservation measures, the implementation of the mitigation measures listed
2 below also has the potential to reduce the severity of the impact, although the effect would still
3 likely remain significant and unavoidable. These mitigation measures would provide an adaptive
4 management process, that may be conducted as a part of the Adaptive Management and Monitoring
5 Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and
6 developing appropriate minimization measures.

7 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**
8 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**
9 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

10 Please refer to Mitigation Measure AQUA-60a under Alternative 1A (Impact AQUA-60) for
11 spring-run Chinook salmon.

12 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**
13 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

14 Please refer to Mitigation Measure AQUA-60b under Alternative 1A (Impact AQUA-60) for
15 spring-run Chinook salmon.

16 **Mitigation Measure AQUA-60c: Consult with USFWS, and CDFW to Identify and Implement**
17 **Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon Migration**
18 **Conditions Consistent with CM1**

19 Please refer to Mitigation Measure AQUA-60c under Alternative 1A (Impact AQUA-60) for
20 spring-run Chinook salmon.

21 **Restoration and Conservation Measures**

22 The potential effects of restoration measures and other conservation measures on spring-run
23 Chinook salmon would be similar to those described under Alternative 1A. Because no differences in
24 fish effects are anticipated anywhere in the affected environment under Alternative 6C compared to
25 those described in detail for Alternative 1A (Impact AQUA-61 through AQUA-72). Therefore, the
26 effects on spring-run Chinook salmon under Alternative 1A also appropriately characterize effects
27 under Alternative 6C.

28 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**
29 **(Spring-Run ESU)**

30 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**
31 **Salmon (Spring-Run ESU)**

32 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

33 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**
34 **ESU) (CM12)**

35 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
36 **(Spring-Run ESU) (CM13)**

1 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**
2 **Run ESU) (CM14)**

3 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
4 **(Spring-Run ESU) (CM15)**

5 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**
6 **(CM16)**

7 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**
8 **(CM17)**

9 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**
10 **(CM18)**

11 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**
12 **ESU) (CM19)**

13 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
14 **(Spring-Run ESU) (CM21)**

15 *NEPA Effects:* As discussed for Alternative 1A and 6A, the other impact mechanisms would not be
16 adverse, and with the implementation of environmental commitments and conservation measures,
17 the effects would typically be beneficial to spring-run Chinook salmon. Specifically for AQUA-62, the
18 effects of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia
19 and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon
20 are uncertain.

21 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, these impact
22 mechanisms would be beneficial or less than significant, and no mitigation would be required.

23 **Fall-/Late Fall–Run Chinook Salmon**

24 The potential effects of construction and maintenance of water conveyance facilities, operations of
25 water conveyance facilities, restoration measures and other conservation measures on fall- and late
26 fall-run Chinook salmon would be similar to those described under Alternative 1A.

27 **Construction and Maintenance of CM1**

28 The potential effects of construction and maintenance activities on fall- and late fall-run Chinook
29 salmon would be similar to those described under Alternative 1A because no differences in fish
30 effects are anticipated anywhere in the affected environment under Alternative 6C compared to
31 those described in detail for Alternative 1A (Impact AQUA-73 and Impact AQUA-74), the fish effects
32 described for fall- and late fall-run Chinook salmon under Alternative 1A also appropriately
33 characterize effects for fall- and late fall-run Chinook salmon under Alternative 6C.

34 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
35 **(Fall-/Late Fall–Run ESU)**

1 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
2 **(Fall-/Late Fall-Run ESU)**

3 *NEPA Effects:* Similar to the discussion provided above for Alternative 1A, these impact mechanisms
4 would not be adverse to fall- and late fall-run Chinook salmon. While construction activities (Impact
5 AQUA-73) could result in adverse effects from impact pile driving activities, the implementation of
6 Mitigation Measures AQUA-1a and AQUA-1b, would minimize or eliminate adverse effects from
7 impact pile driving (e.g., injury or mortality).

8 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-73
9 could result in significant underwater noise effects from impact pile driving, although
10 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
11 impacts to less than significant.

12 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
13 **of Pile Driving and Other Construction-Related Underwater Noise**

14 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

15 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
16 **and Other Construction-Related Underwater Noise**

17 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

18 **Water Operations of CM1**

19 The potential effects of water conveyance facility operations on fall- and late fall-run Chinook
20 salmon would be similar to those described for Alternative 6A. Because no differences in fish effects
21 are anticipated anywhere in the affected environment under Alternative 6C compared to those
22 described in detail for Alternative 6A (Impacts AQUA-75 through AQUA-78), the effects described
23 for fall- and late fall-run Chinook salmon also appropriately characterize the effects for Alternative
24 6C.

25 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**
26 **Fall-Run ESU)**

27 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
28 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

29 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
30 **(Fall-/Late Fall-Run ESU)**

31 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**
32 **(Fall-/Late Fall-Run ESU)**

33 *NEPA Effects:* Overall, the effects of water operations vary by location. Similar to effects described in
34 detail under Alternative 6A, Alternative 6C would have an adverse effect on fall-/late fall-run
35 Chinook salmon juvenile survival due to habitat and predation losses at the NDD intakes. Through-
36 delta conditions on the Sacramento River would substantially affect migration conditions relative to
37 NAA while through-Delta conditions on the San Joaquin River would be positive. The

1 implementation of the conservation and mitigation measures listed below, would reduce the overall
2 effects, but the they would still likely remain adverse.

3 **CEQA Conclusion:** The results of the Impact AQUA-78 CEQA analysis indicate differences between
4 the CEQA baseline and Alternative 6C depending on location. Through-Delta conditions on the
5 Sacramento River would substantially impact migration conditions relative to Existing Conditions
6 while through-Delta conditions on the San Joaquin River would be positive. Implementation of *CM6*
7 *Channel Margin Enhancement* and *CM15 Localized Reduction of Predatory Fishes (Predator Control)*
8 would address habitat and predation losses, therefore, would potentially minimize impacts to some
9 extent, but not to a less than significant level.

10 **CM6 Channel Margin Enhancement.** CM6 would entail restoration of 20 linear miles of
11 channel margin by improving channel geometry and restoring riparian, marsh, and mudflat
12 habitats on the waterside side of levees along channels that provide rearing and outmigration
13 habitat for juvenile salmonids.

14 **CM15 Localized Reduction of Predatory Fishes (Predator Control).** CM15 would seek to
15 reduce populations of predatory fishes at specific locations or modify holding habitat at selected
16 locations of high predation risk (i.e., predation “hotspots”), including the NDD intakes. Because
17 of uncertainties regarding treatment methods and efficacy, implementation of CM15 would
18 involve discrete pilot projects and research actions coupled with an adaptive management and
19 monitoring program to evaluate effectiveness.

20 As with the conservation measures, the implementation of the mitigation measures listed below also
21 has the potential to reduce the severity of the impact though not necessarily to a less-than-
22 significant level. These mitigation measures would provide an adaptive management process, that
23 may be conducted as a part of the Adaptive Management and Monitoring Program required by the
24 BDCP (Chapter 3 of the BDCP, Section 3.6), for assessing impacts and developing appropriate
25 minimization measures.

26 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**
27 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**
28 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

29 Please refer to Mitigation Measure AQUA-78a under Alternative 1A (Impact AQUA-78) for
30 fall/late fall-run Chinook salmon.

31 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**
32 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**
33 **of CM1**

34 Please refer to Mitigation Measure AQUA-78b under Alternative 1A (Impact AQUA-78) for
35 fall/late fall-run Chinook salmon.

36 **Mitigation Measure AQUA-78c: Consult with USFWS and CDFW to Identify and Implement**
37 **Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook Salmon**
38 **Migration Conditions Consistent with CM1**

39 Please refer to Mitigation Measure AQUA-78c under Alternative 1A (Impact AQUA-78) for
40 fall/late fall-run Chinook salmon.

1 **Restoration and Conservation Measures**

2 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon**
3 **(Fall-/Late Fall-Run ESU)**

4 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook**
5 **Salmon (Fall-/Late Fall-Run ESU)**

6 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-**
7 **Run ESU)**

8 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**
9 **Run ESU) (CM12)**

10 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
11 **(Fall-/Late Fall-Run ESU) (CM13)**

12 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**
13 **/Late Fall-Run ESU) (CM14)**

14 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
15 **(Fall-/Late Fall-Run ESU) (CM15)**

16 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**
17 **Run ESU) (CM16)**

18 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**
19 **ESU) (CM17)**

20 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**
21 **ESU) (CM18)**

22 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**
23 **Fall-Run ESU) (CM19)**

24 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
25 **(Fall-/Late Fall-Run ESU) (CM21)**

26 **NEPA Effects:** As discussed in detail for Alternative 1A, these restoration and conservation
27 commitment impact mechanisms (Impact AQUA-79 through AQUA-90), would not be adverse, and
28 would typically be beneficial to fall- and late fall-run Chinook salmon. Specifically for AQUA-80, the
29 effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium, copper,
30 ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and late fall-
31 run Chinook salmon are uncertain.

32 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these impact
33 mechanisms would be beneficial or less than significant, and no mitigation would be required.

1 **Steelhead**

2 The potential effects of construction and maintenance of water conveyance facilities, operations of
3 water conveyance facilities, restoration measures and other conservation measures on steelhead
4 would be similar to those described under Alternative 1A.

5 **Construction and Maintenance of CM1**

6 The potential effects of construction and maintenance activities on steelhead would be similar to
7 those described under Alternative 1A because no differences in fish effects are anticipated anywhere
8 in the affected environment under Alternative 6C compared to those described in detail for
9 Alternative 1A (Impact AQUA-91 and Impact AQUA-92), the fish effects described for steelhead
10 under Alternative 1A also appropriately characterize effects for steelhead under Alternative 6C.

11 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

12 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

13 *NEPA Effects:* These impact mechanisms would typically not be adverse to steelhead. While
14 construction activities (Impact AQUA-91) could result in adverse effects from impact pile driving
15 activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b, would minimize or
16 eliminate adverse effects from impact pile driving (e.g., injury or mortality).

17 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-91
18 could result in significant underwater noise effects from impact pile driving, although
19 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
20 impacts to less than significant.

21 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
22 **of Pile Driving and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

24 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
25 **and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

27 **Water Operations of CM1**

28 The potential effects of water conveyance facility operations on steelhead would be similar to those
29 described above under Alternative 6A. Because no differences in fish effects are anticipated
30 anywhere in the affected environment under Alternative 6C compared to those described in detail
31 for Alternative 6A (Impact AQUA-93 through AQUA-96), the fish effects described for steelhead
32 under Alternative 6A also appropriately characterize effects under Alternative 6C.

33 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

34 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
35 **Steelhead**

1 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

2 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

3 *NEPA Effects:* As described in detail under Alternative 6A, these impact mechanisms would result in
4 variable effects on steelhead, but the effects would not result in biologically meaningful reductions
5 in overall survival of steelhead. Therefore, the effects would not be adverse to steelhead under
6 Alternative 6C.

7 *CEQA Conclusion:* Collectively, the analysis indicates that the difference between the CEQA baseline
8 and Alternative 6C could be significant because, under the CEQA baseline, the alternative could
9 substantially reduce the amount of suitable habitat and substantially interfere with steelhead
10 migrations in some areas. Alternative 6C would also negatively affect juvenile and adult migration
11 conditions in some areas. Despite the variability in effects of Alternative 6C, if adjusted to exclude
12 sea level rise and climate change, the alternative would not in itself result in a significant impact on
13 steelhead.

14 **Restoration and Conservation Measures**

15 The potential effects of restoration measures and other conservation measures on steelhead would
16 be similar to those described under Alternative 1A. Because no differences in fish effects are
17 anticipated anywhere in the affected environment under Alternative 6C, compared to those
18 described in detail for Alternative 1A (Impact AQUA-97 through AQUA-108), the fish effects
19 described for steelhead also appropriately characterize the effects under Alternative 6C.

20 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

21 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

22 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

23 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

24 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

25 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

26 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

27 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

28 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

29 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

30 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

31 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**
32 **(CM21)**

1 **NEPA Effects:** As discussed for Alternative 1A and 6A, the other impact mechanisms would not be
2 adverse, and would typically be beneficial to steelhead. Specifically for AQUA-98, the effects of
3 contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be
4 adverse. The effects of methylmercury on steelhead are uncertain.

5 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A and 6A, these impact
6 mechanisms would be beneficial or less than significant, and no mitigation would be required.

7 **Sacramento Splittail**

8 The potential effects of construction and maintenance of water conveyance facilities, operations of
9 water conveyance facilities, restoration measures and other conservation measures on Sacramento
10 splittail would be similar to those described under Alternative 1A.

11 **Construction and Maintenance of CM1**

12 The potential effects of construction and maintenance activities on Sacramento splittail would be
13 similar to those described under Alternative 1A because no differences in fish effects are anticipated
14 anywhere in the affected environment under Alternative 6C compared to those described in detail
15 for Alternative 1A (Impact AQUA-109 and Impact AQUA-110). The fish effects described for
16 Sacramento splittail under Alternative 1A also appropriately characterize effects for Sacramento
17 splittail under Alternative 6C.

18 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento 19 Splittail**

20 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento 21 Splittail**

22 **NEPA Effects:** These impact mechanisms would generally not be adverse to Sacramento splittail.
23 While construction activities (Impact AQUA-109) could result in adverse effects from impact pile
24 driving activities, the implementation of Mitigation Measures AQUA-1a and AQUA-1b would
25 minimize or eliminate adverse effects from impact pile driving (e.g., injury or mortality).

26 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, Impact AQUA-109
27 could result in significant underwater noise effects from impact pile driving, although
28 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
29 impacts to less than significant. The effects of Impact AQUA-110 would be less than significant, so no
30 additional mitigation would be required.

31 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects 32 of Pile Driving and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

34 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving 35 and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

1 **Water Operations of CM1**

2 The potential effects of water conveyance facility operations on Sacramento splittail would be
3 similar to those described for Alternative 6A. Because no differences in fish effects are anticipated
4 anywhere in the affected environment under Alternative 6C, compared to those described in detail
5 for Alternative 6A (Impacts AQUA-111 through AQUA-114), the fish effects described would also
6 appropriately characterize the effects under Alternative 6C.

7 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

8 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
9 **Sacramento Splittail**

10 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

11 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**
12 **Splittail**

13 *NEPA Effects:* As discussed in detail for Alternative 6A, the operations impact mechanisms would
14 not be adverse to Sacramento splittail.

15 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 6A, these impact
16 mechanisms would be less than significant, and no mitigation would be required.

17 **Restoration and Conservation Measures**

18 The potential effects of restoration measures and other conservation measures on Sacramento
19 splittail would be similar to those described for Alternative 1A. Because no differences in fish effects
20 are anticipated anywhere in the affected environment under Alternative 6C compared to those
21 described in detail for Alternative 1A (Impacts AQUA-115 through AQUA-126), the fish effects
22 described also appropriately characterize the effects under Alternative 6C.

23 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

24 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**
25 **Sacramento Splittail**

26 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

27 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

28 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**
29 **Splittail (CM13)**

30 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**
31 **(CM14)**

32 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**
33 **(CM15)**

34 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

1 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

2 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

3 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

4 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**
5 **Splittail (CM21)**

6 *NEPA Effects:* As discussed for Alternative 1A, the restoration and conservation impact mechanisms
7 would not be adverse, and would typically be beneficial to Sacramento splittail. Specifically for
8 AQUA-116, the effects of contaminants on Sacramento splittail with respect to selenium, copper,
9 ammonia and pesticides would not be adverse. The effects of methylmercury on Sacramento splittail
10 are uncertain.

11 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, the restoration and
12 conservation measures impact mechanisms would be beneficial or less than significant, and no
13 mitigation would be required.

14 **Green Sturgeon**

15 The potential effects of construction and maintenance of water conveyance facilities, operations of
16 water conveyance facilities, restoration measures and other conservation measures on green
17 sturgeon would be similar to those described under Alternative 1A.

18 **Construction and Maintenance of CM1**

19 The potential effects of construction and maintenance activities on green sturgeon would be similar
20 to those described under Alternative 1A because no differences in fish effects are anticipated
21 anywhere in the affected environment under Alternative 6C compared to those described in detail
22 for Alternative 1A (Impact AQUA-127 and Impact AQUA-128). Overall, the fish effects described for
23 green sturgeon under Alternative 1A also appropriately characterize effects for green sturgeon
24 under Alternative 6C.

25 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

26 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

27 *NEPA Effects:* While the maintenance impact mechanism (Impact AQUA-128) would not be adverse
28 to green sturgeon, construction activities (Impact AQUA-127) could result in adverse effects from
29 impact pile driving activities. However, the implementation of Mitigation Measures AQUA-1a and
30 AQUA-1b, would minimize or eliminate adverse effects from impact pile driving (e.g., injury or
31 mortality).

32 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A, Impact AQUA-127
33 could result in significant underwater noise effects from impact pile driving, although
34 implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the severity of
35 impacts to less than significant. The other impact mechanism would be less than significant, so no
36 additional mitigation would be required.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in delta smelt.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in delta smelt.

7 **Water Operations of CM1**

8 The potential effects of operations of water conveyance facilities on green sturgeon would be similar
9 to those described for Alternative 6A. Because no differences in fish effects are anticipated
10 anywhere in the affected environment under Alternative 6C compared to those described in detail
11 for Alternative 6A (Impacts AQUA-129 through AQUA-132), the effects described for green sturgeon
12 also appropriately characterize the effects under Alternative 6C.

13 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

14 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
15 **Green Sturgeon**

16 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

17 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

18 **NEPA Effects:** As discussed for Alternative 6A, Impact AQUA-129 would be beneficial for green
19 sturgeon because of the elimination of entrainment and entrainment-related predation loss at the
20 south Delta facilities. As discussed for Alternative 6A, Impact AQUA-130 and AQUA-132 are expected
21 to negatively affect green sturgeon spawning and rearing habitat conditions under Alternative 6C.
22 These effects are a result of the specific reservoir operations and resulting flows associated with this
23 alternative. However, as discussed for Alternative 6A, the overall effect would not be adverse.

24 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 6A, Impact AQUA-130
25 through AQUA-132, effects on spawning, incubation, and rearing habitat conditions would be
26 negatively affected, compared to Existing Conditions. However, this would not in itself result in a
27 significant impact on green sturgeon, if adjusted to exclude sea level rise and climate change. In
28 addition, entrainment effects would likely be beneficial. Therefore, the overall effect would be less
29 than significant, and no mitigation would be needed.

30 **Restoration and Conservation Measures**

31 Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no
32 substantial differences in fish effects are anticipated anywhere in the affected environment under
33 Alternative 6C compared to those described in detail for Alternative 1A, the effects of the restoration
34 and conservation measures described for green sturgeon under Alternative 1A (Impact AQUA-133
35 through Impact AQUA-144) also appropriately characterize effects under Alternative 6C.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

1 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

2 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**
3 **Sturgeon**

4 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

5 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

6 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**
7 **(CM13)**

8 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

9 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**
10 **(CM15)**

11 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

12 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

13 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

14 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

15 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**
16 **Sturgeon (CM21)**

17 **NEPA Effects:** As described in Alternative 1A, these impact mechanisms have been determined to
18 range from no effect, to not adverse, or beneficial effects on green sturgeon for NEPA purposes, for
19 the reasons identified for Alternative 1A (Impact AQUA-133 through 144). Specifically for AQUA-
20 134, the effects of contaminants on green sturgeon with respect to copper, ammonia and pesticides
21 would not be adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

22 **CEQA Conclusion:** These impact mechanisms would be considered to range from no impact, to less
23 than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A
24 (Impact AQUA-133 through 144), and no mitigation is required.

25 **White Sturgeon**

26 The potential effects of construction and maintenance of water conveyance facilities, operations of
27 water conveyance facilities, restoration measures and other conservation measures on white
28 sturgeon would be similar to those described under Alternative 1A.

29 **Construction and Maintenance of CM1**

30 The potential effects of construction and maintenance activities on white sturgeon would be similar
31 to those described under Alternative 1A because no differences in fish effects are anticipated
32 anywhere in the affected environment under Alternative 6C compared to those described in detail
33 for Alternative 1A (Impact AQUA-145 and Impact AQUA-146), the fish effects described for white

1 sturgeon under Alternative 1A also appropriately characterize effects for white sturgeon under
2 Alternative 6C.

3 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

4 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

5 *NEPA Effects:* As concluded for Alternative 1A (Impact AQUA-145 and AQUA-146), environmental
6 commitments and mitigation measures would be available to avoid and minimize potential effects,
7 so the effect would not be adverse for white sturgeon.

8 *CEQA Conclusion:* As described under Alternative 1A (Impact AQUA-145 and AQUA-146), the
9 impact of the construction and maintenance of water conveyance facilities on white sturgeon would
10 be less than significant except for construction noise associated with pile driving. Implementation of
11 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
12 less than significant.

13 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
14 **of Pile Driving and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

16 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
17 **and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

19 **Water Operations of CM1**

20 The potential effects of operations of water conveyance facilities on white sturgeon would be similar
21 to those described for Alternative 6A. Because no differences in fish effects are anticipated
22 anywhere in the affected environment under Alternative 6C compared to those described in detail
23 for Alternative 6A (Impacts AQUA-147 through AQUA-150), the effects described for white sturgeon
24 also appropriately characterize the effects under Alternative 6C.

25 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

26 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
27 **White Sturgeon**

28 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

29 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

30 *NEPA Effects:* As discussed for Alternative 6A, Impact AQUA-147 would be beneficial for white
31 sturgeon because of the elimination of entrainment and entrainment-related predation loss at the
32 south Delta facilities. As described in detail under Alternative 6A, the effects of water operations on
33 white sturgeon would not be adverse. However, uncertainty regarding the mechanisms responsible
34 for the positive correlation between year class strength and high river/Delta flow would be
35 addressed through targeted research and monitoring, prior to the initiation of north Delta facilities
36 operations. If these targeted investigations determine that Alternative 6C operations are likely to be

1 adverse, adaptive management procedures would be implemented to meet the biological goals and
2 objectives.

3 **CEQA Conclusion:** The impact and conclusion for entrainment are the same as described
4 immediately above, and would be mostly beneficial, due to elimination of entrainment losses at the
5 south Delta diversions. Collectively, the results of the Impact AQUA-149 and AQUA-150 analyses
6 indicate that the difference between the CEQA baseline and Alternative 6C could be significant, but
7 the differences would generally be due to climate change, sea level rise, and future demand, and not
8 the alternative. As a result, the CEQA conclusion regarding Alternative 6C, if adjusted to exclude sea
9 level rise and climate change would be less than significant. Additionally, as described above in the
10 NEPA Effects statement, further investigation is needed to better understand the association of Delta
11 outflow to sturgeon recruitment, and if needed, adaptive management would be used to make
12 adjustments to meet the biological goals and objectives. Therefore, these impact measures would be
13 less than significant and no mitigation is required.

14 **Restoration and Conservation Measures**

15 Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no
16 substantial differences in fish effects are anticipated anywhere in the affected environment under
17 Alternative 6C, compared to those described in detail for Alternative 1A, the effects of these
18 measures described for white sturgeon under Alternative 1A (Impact AQUA-151 through Impact
19 AQUA-162) also appropriately characterize effects under Alternative 6C.

20 The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

21 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

22 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White** 23 **Sturgeon**

24 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

25 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

26 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon** 27 **(CM13)**

28 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

29 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon** 30 **(CM15)**

31 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

32 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

33 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

34 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

1 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**
2 **Sturgeon (CM21)**

3 **NEPA Effects:** The restoration and conservation measure impact mechanisms have been determined
4 to range from no effect, to not adverse, or beneficial effects on white sturgeon for NEPA purposes,
5 for the reasons identified for Alternative 1A (Impact AQUA-151 through 162). Specifically for AQUA-
6 152, the effects of contaminants on white sturgeon with respect to copper, ammonia and pesticides
7 would not be adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

8 **CEQA Conclusion:** The restoration and conservation measure impact mechanisms would be
9 considered to range from no impact, to less than significant, or beneficial on white sturgeon, for the
10 reasons identified for Alternative 1A (Impact AQUA-151 through 162), and no mitigation is
11 required.

12 **Pacific Lamprey**

13 The potential effects of construction and maintenance of water conveyance facilities, operations of
14 water conveyance facilities, restoration measures and other conservation measures on Pacific
15 lamprey would be similar to those described under Alternative 1A.

16 **Construction and Maintenance of CM1**

17 The potential effects of construction and maintenance activities on Pacific lamprey would be similar
18 to those described under Alternative 1A because no differences in fish effects are anticipated
19 anywhere in the affected environment under Alternative 6C compared to those described in detail
20 for Alternative 1A (Impact AQUA-163 and Impact AQUA-164), the fish effects described for Pacific
21 lamprey under Alternative 1A also appropriately characterize effects for Pacific lamprey under
22 Alternative 6C.

23 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

24 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

25 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-163 and AQUA-164, environmental
26 commitments and mitigation measures would be available to avoid and minimize potential effects,
27 and the effect would not be adverse for Pacific lamprey.

28 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-163 and AQUA-164, the impact
29 of the construction and maintenance of water conveyance facilities on Pacific lamprey would be less
30 than significant except for construction noise associated with pile driving. Implementation of
31 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
32 less than significant.

33 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
34 **of Pile Driving and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

1 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
2 **and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

4 **Water Operations of CM1**

5 The potential effects of water conveyance facility operations on Pacific lamprey would be similar to
6 those described under Alternative 6A. Because no differences in fish effects are anticipated
7 anywhere in the affected environment under Alternative 6C compared to those described in detail
8 for Alternative 6A (Impact AQUA-165 and Impact AQUA-168), the effects described for Pacific
9 lamprey under Alternative 6A also appropriately characterize effects for Pacific lamprey under
10 Alternative 6C.

11 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

12 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
13 **Pacific Lamprey**

14 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

15 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

16 *NEPA Effects:* As discussed in detail for Alternative 6A, entrainment and entrainment-related
17 predation on Pacific lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6C
18 would not be adverse because it would not substantially reduce suitable spawning habitat, or
19 substantially interfere with the movement of fish. In addition, the effects would not increase egg or
20 ammocoete mortality. Therefore, the overall effects would not be adverse.

21 *CEQA Conclusion:* As described in detail under Alternative 6A, while entrainment effects are likely
22 to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and
23 Alternative 6C could be significant, contrary to the NEPA conclusion set forth above, due to
24 reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in
25 rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate
26 change, Alternative 6C would be less than significant and no mitigation is required.

27 **Restoration and Conservation Measures**

28 Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no
29 substantial differences in fish effects are anticipated anywhere in the affected environment under
30 Alternative 6C compared to those described in detail for Alternative 1A, the effects of these
31 measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169 through Impact
32 AQUA-180) also appropriately characterize effects under Alternative 6C.

33 The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

34 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

35 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**
36 **Lamprey**

1 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

2 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

3 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**
4 **(CM13)**

5 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

6 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**
7 **(CM15)**

8 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

9 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

10 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

11 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

12 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**
13 **Lamprey (CM21)**

14 *NEPA Effects:* As discussed in detail for Alternatives 1A and 6A, the restoration and conservation
15 measure impact mechanisms (Impact AQUA-169 through AQUA-180) have been determined to
16 range from no effect, to not adverse, or beneficial to Pacific lamprey for NEPA purposes. Therefore,
17 the effect would not be adverse.

18 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, these impact
19 mechanisms would be beneficial or less than significant under Alternative 6C, and no mitigation
20 would be required.

21 **River Lamprey**

22 The potential effects of construction and maintenance of water conveyance facilities, operations of
23 water conveyance facilities, restoration measures and other conservation measures on river
24 lamprey would be similar to those described under Alternative 1A.

25 **Construction and Maintenance of CM1**

26 The potential effects of construction and maintenance of water conveyance facilities on river
27 lamprey would be similar to those described under Alternative 1A because no differences in fish
28 effects are anticipated anywhere in the affected environment under Alternative 6C compared to
29 those described in detail for Alternative 1A (Impact AQUA-181 and Impact AQUA-182). As a result,
30 the fish effects described for river lamprey under Alternative 1A also appropriately characterize
31 effects for river lamprey under Alternative 6C.

32 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

33 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

1 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181 and AQUA-182, environmental
2 commitments and mitigation measures would be available to avoid and minimize potential effects,
3 and the effect would not be adverse for river lamprey.

4 **CEQA Conclusion:** As described under Alternative 1A, Impact AQUA-181 and AQUA-182, the impact
5 of the construction and maintenance of water conveyance facilities on river lamprey would be less
6 than significant except for construction noise associated with pile driving. Implementation of
7 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
8 less than significant.

9 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
10 **of Pile Driving and Other Construction-Related Underwater Noise**

11 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

12 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
13 **and Other Construction-Related Underwater Noise**

14 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

15 **Water Operations of CM1**

16 The potential effects of water conveyance facility operations on river lamprey would be similar to
17 those described under Alternative 6A. Because no differences in fish effects are anticipated
18 anywhere in the affected environment under Alternative 6C, compared to those described in detail
19 for Alternative 6A (Impact AQUA-183 through Impact AQUA-186). Therefore, the effects described
20 for river lamprey under Alternative 6A also appropriately characterize effects under Alternative 6C.

21 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

22 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
23 **River Lamprey**

24 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

25 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

26 **NEPA Effects:** As discussed in detail for Alternative 6A, entrainment and entrainment-related
27 predation on river lamprey would not be adverse, and mostly beneficial. Similarly, Alternative 6C
28 would not be adverse because it would not substantially reduce suitable spawning or rearing
29 habitat, and would not increase egg or ammocoete mortality. The water operations would also not
30 substantially interfere with the movement of fish. As a result, the overall effects would not be
31 adverse.

32 **CEQA Conclusion:** As described in detail under Alternative 6A, while entrainment effects are likely
33 to be beneficial, the CEQA analyses indicate that the difference between the CEQA baseline and
34 Alternative 6C could be significant, contrary to the NEPA conclusion set forth above, due to
35 reductions in suitable spawning habitat, increased egg and ammocoete mortality, and reductions in
36 rearing and migration conditions. However, if adjusted to exclude effects of sea level rise and climate
37 change, Alternative 6C would be less than significant and no mitigation is required.

1 **Restoration and Conservation Measures**

2 Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no
3 substantial differences in fish effects are anticipated anywhere in the affected environment under
4 Alternative 6C compared to those described in detail for Alternative 1A, the effects of the measures
5 described for river lamprey under Alternative 1A (Impact AQUA-187 through Impact AQUA-198)
6 also appropriately characterize effects under Alternative 6C.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

8 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

9 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**
10 **Lamprey**

11 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

12 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

13 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**
14 **(CM13)**

15 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

16 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

17 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

18 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

19 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

20 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

21 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**
22 **(CM21)**

23 **NEPA Effects:** As discussed in detail for Alternative 1A, these restoration and conservation measure
24 impact mechanisms (Impact AQUA-187 through AQUA-198) have been determined to range from no
25 effect, to not adverse, or beneficial to river lamprey for NEPA purposes.

26 **CEQA Conclusion:** Similar to the discussion provided above for Alternative 1A, these restoration and
27 conservation measure impact mechanisms would be beneficial or less than significant, and no
28 mitigation would be required.

29 **Non-Covered Aquatic Species of Primary Management Concern**

30 The potential effects of construction and maintenance of water conveyance facilities, operations of
31 water conveyance facilities, restoration measures and other conservation measures on non-covered
32 species would be similar to those described under Alternative 1A.

1 **Construction and Maintenance of CM1**

2 The potential effects of construction and maintenance activities on non-covered species of primary
3 concern would be similar to those described under Alternative 1A because no differences in fish
4 effects are anticipated anywhere in the affected environment under Alternative 6C compared to
5 those described in detail for Alternative 1A (Impact AQUA-199 and Impact AQUA-200), the effects
6 described for non-covered aquatic species of primary management concern under Alternative 1A
7 also appropriately characterize effects for non-covered aquatic species of primary management
8 concern under Alternative 6C.

9 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**
10 **Aquatic Species of Primary Management Concern**

11 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**
12 **Aquatic Species of Primary Management Concern**

13 *NEPA Effects:* As concluded for Alternative 1A (Impact AQUA-199 and AQUA-200), environmental
14 commitments and mitigation measures would be available to avoid and minimize potential effects,
15 and the effect would not be adverse for non-covered aquatic species of primary management
16 concern.

17 *CEQA Conclusion:* As described under Alternative 1A (Impact AQUA-199 and AQUA-200), the
18 impact of the construction and maintenance of water conveyance facilities on non-covered aquatic
19 species of primary management concern would be less than significant except potentially for
20 construction noise associated with pile driving. Implementation of Mitigation Measure AQUA-1a and
21 Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

22 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
23 **of Pile Driving and Other Construction-Related Underwater Noise**

24 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

25 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
26 **and Other Construction-Related Underwater Noise**

27 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

28 **Water Operations of CM1**

29 The potential effects of water conveyance facility operations on non-covered species would be
30 similar to those described under Alternative 6A, because no differences in fish effects are
31 anticipated anywhere in the affected environment under Alternative 6C compared to those
32 described in detail for Alternative 6A (Impact AQUA-201 through Impact AQUA-204), the effects
33 described for non-covered aquatic species of primary management concern under Alternative 6A
34 also appropriately characterize effects for non-covered aquatic species of primary management
35 concern under Alternative 6C.

36 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**
37 **Species of Primary Management Concern**

1 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
2 **Non-Covered Aquatic Species of Primary Management Concern**

3 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**
4 **Species of Primary Management Concern**

5 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**
6 **Aquatic Species of Primary Management Concern**

7 *NEPA Effects:* These impact mechanisms would not be adverse to the non-covered species of
8 primary management concern, and with the implementation of environmental commitments and
9 conservation measures, the effects would typically be beneficial.

10 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, most of these
11 impact mechanisms would be beneficial or less than significant. However, Impact AQUA-203 and
12 AQUA-204 could result in significant, but unavoidable effects on rearing habitat and migration
13 habitat conditions for several fish species of primary management concern. These species include
14 largemouth bass, Sacramento-San Joaquin roach, and hardhead. There are also no feasible
15 mitigation measures available to mitigate for these impacts. The other impact mechanisms would be
16 less than significant, or beneficial, so no additional mitigation would be required.

17 **Restoration and Conservation Measures**

18 Alternative 6C has the same restoration and conservation measures as Alternative 1A. Because no
19 substantial differences in fish effects are anticipated anywhere in the affected environment under
20 Alternative 6C compared to those described in detail for Alternative 1A, the effects of these
21 measures described for non-covered aquatic species of primary management concern under
22 Alternative 1A (Impact AQUA-205 through Impact AQUA-216) also appropriately characterize
23 effects under Alternative 6C.

24 The following impacts are those presented under Alternative 1A that are identical for Alternative 6C.

25 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic**
26 **Species of Primary Management Concern**

27 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**
28 **Covered Aquatic Species of Primary Management Concern**

29 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**
30 **Primary Management Concern**

31 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**
32 **Primary Management Concern (CM12)**

33 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**
34 **Aquatic Species of Primary Management Concern (CM13)**

35 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**
36 **Species of Primary Management Concern (CM14)**

1 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**
2 **Species of Primary Management Concern (CM15)**

3 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**
4 **Primary Management Concern (CM16)**

5 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**
6 **Primary Management Concern (CM17)**

7 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**
8 **Primary Management Concern (CM18)**

9 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**
10 **of Primary Management Concern (CM19)**

11 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**
12 **Aquatic Species of Primary Management Concern (CM21)**

13 *NEPA Effects:* As discussed in detail under Alternative 1A and 6A, these restoration and
14 conservation measure impact mechanisms would not be adverse, and would typically be beneficial
15 to non-covered fish species of primary management concern.

16 *CEQA Conclusion:* Similar to the discussion provided above for Alternative 1A and 6A, these
17 restoration and conservation measure impact mechanisms would be beneficial or less than
18 significant, and no mitigation would be required.

19 **Upstream Reservoirs**

20 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

21 *NEPA Effects:* Similar to the description for Alternative 1A, Impact AQUA-217 would not be adverse
22 because coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 6C would
23 not be substantially reduced when compared to the No Action Alternative.

24 *CEQA Conclusion:* Similar to the description for Alternative 1A, Alternative 6C would reduce the
25 quantity of coldwater fish habitat in the CVP and SWP. There would be a greater than 5% increase (5
26 years) for several of the reservoirs, which could result in a significant impact. These results are
27 primarily caused by four factors: differences in sea level rise, differences in climate change, future
28 water demands, and implementation of the alternative. The analysis described above comparing
29 Existing Conditions to Alternative 6C does not partition the effect of implementation of the
30 alternative from those of sea level rise, climate change and future water demands using the model
31 simulation results presented in this chapter. However, the increment of change attributable to the
32 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
33 adverse. As a result, the CEQA conclusion regarding Alternative 6C, if adjusted to exclude sea level
34 rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself result in
35 a significant impact on coldwater habitat in upstream reservoirs. This impact is found to be less than
36 significant and no mitigation is required.

1 **11.3.4.14 Alternative 7—Dual Conveyance with Tunnel, Intakes 2, 3, and 5,**
2 **and Enhanced Aquatic Conservation (9,000 cfs; Operational**
3 **Scenario E)**

4 Alternative 7 is the same as Alternative 1A except that it involves Intakes 2, 3, and 5 instead of
5 Intakes 1, 2, 3, 4, and 5 and includes a different operational scenario. While Alternative 1A would
6 divert up to 15,000 cfs and uses Operational Scenario A, Alternative 7 would divert up to 9,000 cfs
7 and uses Operational Scenario E. The dimensions of the intakes are in Table 11-5 Alternative 7 has
8 Enhanced Aquatic Conservation which would enhance 20,000 acres of floodplain habitat versus
9 10,000 acres for Alternative 1A. A total of 40 linear miles of channel margin habitat would be
10 enhanced under Alternative 7 instead of 20 linear miles for Alternative 1A. Alternative 7 has the
11 same six barge facilities as Alternative 1A.

12 **Delta Smelt**

13 **Construction and Maintenance of CM1**

14 Small numbers of delta smelt eggs, larvae, and adults could be present in the north Delta in June
15 during construction of intake facilities. Small numbers of delta smelt eggs and larvae could also be
16 present in June or July during construction of the barge landings in the east Delta and south Delta
17 (see Table 11-6). Very low delta smelt abundance would be expected in the south Delta near the
18 southern barge landings during the in-water construction period. The construction and maintenance
19 sites also occur entirely within designated critical habitat for delta smelt.

20 Construction impacts on delta smelt and critical habitat would be as described for Alternative 1A
21 (Impact AQUA-1) except that Alternative 7 would include only Intakes 2, 3, and 5. Therefore, no
22 impacts would occur at the locations of Intakes 1 and 4 that are proposed under Alternative 1A.

23 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

24 The potential effects of construction of the water conveyance facilities on delta smelt or critical
25 habitat would be similar to those described for Alternative 1A (Impact AQUA-1) except that
26 Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the
27 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
28 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
29 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
30 shoreline and would require 27.3 acres of dredging.

31 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-1, environmental commitments and
32 mitigation measures would be available to avoid and minimize potential effects, and the effect would
33 not be adverse for delta smelt or their critical habitat.

34 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-1, the impact of the construction of
35 water conveyance facilities on delta smelt or critical habitat would be less than significant except for
36 construction noise associated with pile driving. Potential pile driving impacts would be less than
37 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
38 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
39 less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of
4 Alternative 1A.

5 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
6 **and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
8 Alternative 1A.

9 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

10 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
11 Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-2) except
12 that only three intakes would need to be maintained under Alternative 7 rather than five under
13 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the impact would not be adverse for
14 delta smelt or critical habitat.

15 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-2 for delta smelt, the impact of the
16 maintenance of water conveyance facilities on delta smelt or critical habitat would be less than
17 significant and no mitigation would be required.

18 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

19 ***Water Exports from SWP/CVP South Delta Facilities***

20 Overall, operational activities under Alternative 7 would benefit delta smelt by substantially
21 reducing proportional entrainment losses of larvae/juveniles and adults at the south Delta facilities
22 (Figure 11-7-1 and 11-7-2). Average larval/juvenile proportional entrainment across all years under
23 Alternative 7 (about 0.09, or 9% of the juvenile population) would be 0.15 less (about 15% of the
24 population) than under NAA, representing a 36% relative decrease (Figure 11-7-1, Table 11-7-1).
25 Average adult proportional entrainment would be approximately 0.072 (7.2% of the population)
26 across all water years, which would be 0.028 less (2.8% of adult population) compared to NAA, a
27 38% relative decrease (Figure 11-7-2, Table 11-7-1). Combined Juvenile and adult delta smelt
28 average proportional entrainment would be reduced by 0.081 (8.1% of the population, a 36%
29 relative decrease compared to NAA) (Table 11-7-1).

1 **Table 11-7-1. Proportional Entrainment Index of Delta Smelt at SWP/CVP South Delta Facilities for**
2 **Alternative 7**

Water Year	Proportional Entrainment ^a	
	Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A7_LL1	NAA vs. A7_LL1
Total Population		
Wet	-0.030 (-27%)	-0.055 (-41%)
Above Normal	-0.064 (-39%)	-0.091 (-48%)
Below Normal	-0.068 (-31%)	-0.098 (-39%)
Dry	-0.078 (-29%)	-0.096 (-34%)
Critical	-0.082 (-26%)	-0.081 (-25%)
All Years	-0.059 (-30%)	-0.081 (-36%)
Juvenile Delta Smelt (March–June)		
Wet	-0.006 (-16%)	-0.032 (-50%)
Above Normal	-0.030 (-37%)	-0.059 (-54%)
Below Normal	-0.033 (-24%)	-0.065 (-38%)
Dry	-0.043 (-24%)	-0.064 (-31%)
Critical	-0.053 (-22%)	-0.058 (-23%)
All Years	-0.029 (-24%)	-0.052 (-36%)
Adult Delta Smelt^b (December–March)		
Wet	-0.024 (-34%)	-0.023 (-33%)
Above Normal	-0.033 (-42%)	-0.032 (-41%)
Below Normal	-0.035 (-43%)	-0.033 (-41%)
Dry	-0.034 (-42%)	-0.033 (-41%)
Critical	-0.029 (-38%)	-0.023 (-33%)
All Years	-0.030 (-39%)	-0.028 (-38%)

Note: Negative values indicate lower entrainment loss under Alternative than under Existing Conditions.

^a Proportional entrainment index calculated in accordance with UFWs BiOp (U.S. Fish and Wildlife Service 2008a).

^b Adult proportional entrainment adjusted according to Kimmerer (2011).

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 The impact would be similar to Impact AQUA-3 in Alternative 1A for north Delta intakes. Potential
6 entrainment and impingement would be limited since delta smelt rarely occur in the vicinity of the
7 proposed intake site. The intake would be screened to exclude fish larger than 15mm SL. Alternative
8 7 would have only three intakes, compared to five intakes for Alternative 1A, and therefore potential
9 entrainment and impingement risks would be even lower.

10 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

11 Potential entrainment of larval delta smelt at the NBA, as estimated by particle-tracking models was
12 low, averaging 1.6% under Alternative 7 compared to 2.0% under NAA, or 22% lower in relative
13 terms (Table 11-7-2).

1 Tidal habitat restoration under CM4 would potentially result in the decommissioning of more than
2 12% of Plan Area agricultural diversions. Particle entrainment under Alternative 7 would be
3 sometimes slightly increased (0.73%, n=6 for NAA) and sometimes reduced (~0.8%, n=11 runs for
4 NAA) compared to baseline conditions, but the difference was negligible (Table 11-7-2).

5 **Table 11-7-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt**
6 **Entrained by the North Bay Aqueduct under Alternative 7 and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A7_LL	A7_LL vs. EXISTING CONDITIONS	A7_LL vs. NAA
2.1	2.0	1.6	-0.55 (-26%)	-0.45 (-22%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario.

7

8 ***Predation Associated with Entrainment***

9 Because proportional entrainment of combined juvenile and adult delta smelt would be reduced
10 under Alternative 7 (36% relative decrease compared to NAA), predation loss would also be
11 reduced concomitantly. Predation loss at the proposed north Delta intakes would be limited because
12 few delta smelt occur that far upstream.

13 ***NEPA Effects:*** Under Alternative 7 overall potential entrainment of delta smelt would be reduced at
14 the south Delta SWP/CVP facilities and the NBA. Entrainment and impingement could potentially
15 occur at the proposed north Delta intakes, but the risk would be low due to the location, design and
16 operation of intakes, and offset by reduced entrainment at the south Delta facilities. Overall,
17 Alternative 7 would benefit delta smelt due to a reduction in entrainment and associated predation
18 losses at the south Delta facilities and minimizing entrainment at the north Delta facilities and NBA
19 intakes. The impact on delta smelt is considered to be beneficial.

20 ***CEQA Conclusion:*** As described above, Alternative 7 would result in an overall reduction of
21 entrainment as a whole compared to Existing Conditions. At the south Delta facilities, proportional
22 entrainment of juvenile and adult delta smelt would be substantially reduced (Table 11-7-1, Figures
23 11-7-1 and 11-7-2) due to substantial reductions in water exports from the south Delta.
24 Proportional entrainment averaged across years would be reduced by 0.030 for adults (i.e., 3% of
25 population, a 39% relative decrease) and reduced by 0.029 for juveniles (a 24% relative decrease)
26 compared to Existing Conditions (Table 11-7-1). The risk of entrainment and impingement at the
27 proposed north Delta intake facilities due to low abundances of delta smelt in the vicinity, and would
28 be minimized by state-of-the-art screens. Potential entrainment of larvae is low under Existing
29 Conditions and under Alternative 7 would be slightly reduced (<1%) at the NBA and changed
30 negligibly (<0.5%) at agricultural diversions compared to Existing Conditions (Table 11-7-2).
31 Overall, Alternative 7 would benefit delta smelt due to a substantial reduction in entrainment and
32 associated predation losses at the south Delta facilities and minimizing entrainment at the north
33 Delta facilities and NBA intakes. The impact is considered to be beneficial.

1 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
2 **Delta Smelt**

3 The effects of operations under Alternative 7 on abiotic spawning habitat would be the same as
4 described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta intakes would
5 not reduce available spawning habitat. In-Delta water temperatures, which can affect spawning
6 timing, would not change across Alternatives, because they would be in thermal equilibrium with
7 atmospheric conditions and not strongly influenced by the flow changes.

8 **NEPA Effects:** The effect of Alternative 7 operations on spawning would not be adverse, because
9 there would be little change in abiotic spawning conditions for delta smelt.

10 **CEQA Conclusion:** As described above, operations under Alternative 7 would not reduce abiotic
11 spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the
12 impact would be less than significant, and no mitigation would be required.

13 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

14 As described for other Alternatives (Impact AQUA-5 for delta smelt), rearing habitat conditions for
15 juvenile delta smelt are considered with respect to an abiotic habitat index (Feyrer et al. 2011) with
16 and without the assumption that BDCP habitat restoration benefits are realized.

17 **NEPA Effects:** The average abiotic habitat index across all water years would increased 13% under
18 Alternative 7 without restoration compared to NAA (Table 11-7-3). There would be substantial
19 increases in the abiotic habitat index in below normal and dry years (25–29% increase) compared
20 to NAA.

21 Alternative 7 would further benefit delta smelt by habitat restoration (CMs 2 and 4), particularly in
22 the Suisun Marsh, West Delta, and Cache Slough ROAs which are closer to delta smelt's main range.
23 Habitat restoration, similar in scale to Alternative 1A, has the potential to increase spawning and
24 rearing habitat and supplement food production and export to rearing areas. With habitat
25 restoration, Alternative 7 flows could result in a 44% increase in the abiotic habitat index compared
26 to NAA when all water years are averaged. The abiotic habitat index would be increased greatest in
27 below normal and dry years, increasing 59–64% compared to NAA. These overall effects would be
28 due to the inundation of new areas of the Delta resulting from habitat restoration effects; it is
29 assumed that 100% of the newly restored habitat would be utilized by delta smelt. However,
30 because delta smelt are a pelagic species, the actual proportional use would likely be lower.

31 **CEQA Conclusion:** Without BDCP habitat restoration efforts, delta smelt fall abiotic habitat index
32 would increase by 38% when compared to Existing Conditions, which do not include Fall X2 criteria.
33 The abiotic habitat index would increase in all water years under Alternative 7 flows, even without
34 habitat restoration. As described above, habitat restoration under Alternative 7 could further
35 increase the delta smelt fall abiotic habitat index, resulting in an estimated 76% increase in habitat
36 relative to Existing Conditions when averaged for all water years (Figure 11-7-3). The impact on
37 delta smelt rearing habitat would be beneficial, because fall abiotic habitat would be increased
38 substantially even without habitat restoration actions.

1 **Table 11-7-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 7 and**
 2 **Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year**
 3 **Type**

Water Year	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A7_LL1	NAA vs. A7_LL1	vs. A7_LL1	NAA vs. A7_LL1
All	1,525 (38%)	639 (13%)	3,037 (76%)	2,152 (44%)
Wet	2,590 (55%)	394 (6%)	4,611 (98%)	2,415 (35%)
Above Normal	2,227 (58%)	559 (10%)	3,870 (101%)	2,202 (40%)
Below Normal	832 (20%)	980 (25%)	2,201 (53%)	2,350 (59%)
Dry	909 (25%)	1,001 (29%)	2,138 (60%)	2,230 (64%)
Critical	303 (10%)	303 (10%)	1,189 (40%)	1,188 (40%)

Note: Negative values indicate lower habitat indices under the alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

4

5 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

6 **NEPA Effects:** The effects of operations under Alternative 7 on migration conditions would be the
 7 same as described for Alternative 1A (Impact AQUA-6). Alternative 7 would not affect the first flush
 8 of winter precipitation and the turbidity cues associated with adult delta smelt migration. In-Delta
 9 water temperatures would not change across Alternatives, because they would be in thermal
 10 equilibrium with atmospheric conditions and not strongly influenced by the flow changes under
 11 BDCP operations.

12 As described for other Alternatives, Alternative 7 may decrease sediment supply to the estuary by 8
 13 to 9 percent, with the potential for decreased habitat suitability for delta smelt in some locations.

14 **CEQA Conclusion:** As described above, operations under Alternative 7 would not substantially alter
 15 the turbidity cues associated with winter flush events that may initiate migration, nor would there
 16 be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt
 17 migration conditions would be less than significant, and no mitigation would be required.

18 **Restoration Measures (CM2, CM4–CM7, and CM10)**

19 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

20 The potential effects of restoration construction activities under Alternative 7 would be greater than
 21 that described for Alternative 1A due to the increased floodplain and channel margin habitat
 22 enhancement (see Impact AQUA-7). This would include potential effects of turbidity, exposure to
 23 methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish
 24 stranding, and predation.

25 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-7, restoration construction activities are
 26 not expected to adversely affect delta smelt.

27 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-7 for delta smelt, the potential
 28 impact of restoration construction activities is considered less than significant, and no mitigation
 29 would be required.

1 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**
2 **Smelt**

3 The potential effects of contaminants associated with restoration measures under Alternative 7
4 would be the same as those described for Alternative 1A (see Impact AQUA-8). This would include
5 potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides
6 and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of
7 seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects
8 would be the same as described under Alternative 1A.

9 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-8, contaminants associated with
10 restoration measures are not expected to adversely affect delta smelt with respect to selenium,
11 copper, ammonia and pesticides. The effects of methylmercury on delta smelt are uncertain.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-8 for delta smelt, the potential
13 impact of contaminants associated with restoration measures is considered less than significant, and
14 no mitigation would be required. The same conclusion applies to the additional restoration in
15 Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of
16 channel margin habitat).

17 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

18 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
19 described for Alternative 1A (see Impact AQUA-9). These would include CM2 Yolo Bypass Fisheries
20 Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain
21 Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and
22 CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally
23 inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

24 **NEPA Effects:** As discussed in Alternative 1A, Impact AQUA-9 for delta smelt, CM5 is not expected to
25 have any effects on delta smelt, while CM6 may provide some benefits. As concluded in Alternative
26 1A, Impact AQUA-9, restored habitat conditions are expected to be beneficial for delta smelt and the
27 additional CM6 restoration included in Alternative 7 provides proportionally more benefit.

28 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-9 for delta smelt, the potential
29 impact of restored habitat conditions on delta smelt is considered to be beneficial. The additional
30 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20
31 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation
32 would be required.

33 **Other Conservation Measures (CM12–CM19 and CM21)**

34 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

35 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

36 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

37 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

38 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

1 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

2 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

3 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

4 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**
5 **(CM21)**

6 **NEPA Effects:** Detailed discussions regarding the potential effects of these impact mechanisms on
7 delta smelt are the same as those described under Alternative 1A (Impact AQUA-10 through 18).
8 The effects range from no effect, to not adverse, to beneficial.

9 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
10 less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is
11 required.

12 **Longfin Smelt**

13 **Construction and Maintenance of CM1**

14 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

15 The potential effects of construction of the water conveyance facilities on longfin smelt would be
16 similar to those described for Alternative 1A (Impact AQUA-19) except that Alternative 7 would
17 include three intakes compared to five intakes under Alternative 1A, so the effects would be
18 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
19 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
20 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
21 would require 27.3 acres of dredging.

22 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-19, environmental commitments and
23 mitigation measures would be available to avoid and minimize potential effects, and the effect would
24 not be adverse for longfin smelt.

25 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-19, the impact of the construction of
26 water conveyance facilities on longfin smelt would be less than significant except for construction
27 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A
28 because only three intakes would be constructed rather than five. Implementation of Mitigation
29 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
30 significant.

31 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
32 **of Pile Driving and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

34 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
35 **and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-20) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-20, the impact would not be adverse for longfin smelt.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-20, the impact of the maintenance of water conveyance facilities on longfin smelt would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt

Water Exports from SWP/CVP South Delta Facilities

Potential entrainment risk for larval longfin smelt, as simulated by mean percent particles entrained at the south Delta diversions, was 0% under Alternative 7, compared to 2.2 for NAA (Table 11-7-4). Entrainment risk of larval longfin smelt to the south Delta facilities is expected to be minimal under Alternative 7.

Table 11-7-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the South Delta Facilities under Alternative 7 and Baseline Scenarios

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A7_LLТ	A7_LLТ vs. EXISTING CONDITIONS	A7_LLТ vs. NAA
Wetter	1.9	1.6	0.0	-1.88 (-100%)	-1.70 (-100%)
Drier	2.5	2.2	0.0	-2.51 (-100%)	-2.24 (-100%)

Longfin smelt entrainment at the south Delta SWP/CVP facilities would be reduced to negligible levels for juveniles (reduced 100%) and substantially reduced for adults (82% less) compared NAA (Table 11-7-5).

These entrainment reductions would be due to strict limits on south Delta pumping under Alternative 7, which would substantially reduce OMR reverse flows. From December through May, OMR flows would be strongly positive under Alternative 7 for all water year types, whereas baseline conditions typically would have negative flows in December to March (all water years), and sometimes April and May (drier water years).

1 **Table 11-7-5. Longfin Smelt Entrainment Index^a (March–June) at the SWP and CVP Salvage**
 2 **Facilities and Differences (Absolute and Percentage) between Model Scenarios**

Life Stage	Water Year	Absolute Difference (Percent Difference)	
		EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Juvenile (March–June)	Wet	-63,749 (-100%)	-69,191 (-100%)
	Above Normal	-4,521 (-100%)	-4,810 (-100%)
	Below Normal	-3,040 (-99%)	-3,249 (-99%)
	Dry	-529,626 (-100%)	-587,933 (-100%)
	Critical	-567,468 (-100%)	-493,597 (-100%)
	All Years	-267,511 (-100%)	-292,522 (-100%)
Adult (December–March)	Wet	-95 (-73%)	-98 (-74%)
	Above Normal	-508 (-78%)	-548 (-79%)
	Below Normal	-1,721 (-89%)	-1,644 (-88%)
	Dry	-1,171 (-98%)	-1,106 (-97%)
	Critical	-24,331 (-100%)	-22,198 (-100%)
	All Years	-2,964 (-82%)	-2,928 (-82%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost, based on normalized data.

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 The proposed new north Delta intakes would increase entrainment potential in this area and locally
 6 attract piscivorous fish predators, but entrainment and predation losses of longfin smelt at the north
 7 Delta would be extremely low because this species is only expected to occur occasionally in very low
 8 numbers this far upstream.

9 Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

10 For larval longfin smelt, entrainment risk was simulated using particle tracking modeling. Average
 11 entrainment loss as modeled by PTM under the wetter starting distribution was 0.14% under
 12 Alternative 7 compared to 0.08% under NAA, a 71% relative increase (Table 11-7-6). Under the
 13 drier starting distribution, average entrainment was 0.17% under Alternative 7 compared to 0.11%
 14 under NAA, a 62% increase in relative terms. Overall, entrainment of larval longfin smelt under
 15 Alternative 7 to the NBA is expected to be low and similar to NAA.

16 **Table 11-7-6. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae**
 17 **Entrained by the North Bay Aqueduct under Alternative 7 and Baseline Scenarios**

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A7_LLT	A7_LLT vs. EXISTING CONDITIONS	A7_LLT vs. NAA
Wetter	0.20	0.08	0.14	-0.07 (-32.6%)	0.06 (70.8%)
Drier	0.25	0.11	0.17	-0.08 (-30.5%)	0.06 (61.5%)

18

1 In summation, under Alternative 7 entrainment of longfin smelt would be substantially reduced or
2 eliminated at the SWP/CVP South Delta facilities, especially for juveniles longfin smelt. Longfin smelt
3 entrainment to the NBA would also be reduced. Entrainment loss of longfin smelt at the proposed
4 North Delta intakes would be rare since longfin smelt are not expected to occur in that area of the
5 Sacramento River, and the intakes would be screened.

6 ***Predation Associated with Entrainment***

7 Pre-screen losses of longfin smelt at the SWP/CVP facilities are believed to be high. Based on a study
8 of tagged delta smelt (Castillo et al. 2012), over 90% of delta smelt entrained at CCF were presumed
9 to be lost to predation prior to the screens. It is assumed that predation loss of longfin smelt would
10 be similar based on their similar size, shape, and pelagic nature. Thus reduced entrainment of
11 longfin smelt at the south Delta would also reduce predation loss. Predation loss of juveniles would
12 be eliminated and predation loss of adults would also be substantially reduced (82% reduction).
13 Predation loss at the proposed north Delta intakes would be limited because few longfin smelt occur
14 that far upstream.

15 ***NEPA Effects:*** The impact and conclusion for the risk of entrainment and entrainment-related
16 predation associated with the NPB structures would be the same as described for Alternative 1A. The
17 effect under Alternative 7 would be beneficial because fewer longfin smelt would be lost to
18 predation.

19 ***CEQA Conclusion:*** As described above, entrainment loss of longfin smelt should be avoided or
20 substantially reduced under Alternative 7. Entrainment to the south Delta facilities under
21 Alternative 7 would be nearly eliminated for juveniles and significantly reduced (82% less) for
22 adults compared to Existing Conditions, with concomitant reduction in pre-screen losses due to
23 predation at the facilities. Larval longfin smelt entrainment to the south delta facilities would be
24 reduced under Alternative 7. Larval entrainment to the NBA would increase slightly compared to
25 Existing Conditions, however total entrainment to that facility would affect less than 1% of the
26 population.

27 Predation loss of juveniles at the south Delta facilities would be eliminated while predation loss of
28 adult would be reduced by 82% compared to Existing Conditions. Little predation loss would occur
29 at the SWP/CVP north Delta intakes because longfin smelt rarely occur in that vicinity.

30 In summary, the impact would be beneficial because of the substantial reduction in entrainment and
31 entrainment-related predation loss; no mitigation would be required.

32 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing** 33 **Habitat for Longfin Smelt**

34 The indices of abundance of longfin smelt based on the Fall Midwater, Bay Otter, and Bay Midwater
35 trawl data have been correlated to outflow (expressed as the location of X2) in the preceding winter
36 and spring months, when spawning and rearing is occurring (January through June) (Kimmerer
37 2002a; Kimmerer et al. 2009; Rosenfield and Baxter 2007; Mac Nally et al. 2010; Thomson et al.
38 2010). Based on Kimmerer et al. (2009), reduced outflows in January through June have the
39 potential to reduce longfin smelt abundance.

40 ***NEPA Effects:*** Average relative longfin smelt abundance would be 20% greater (based on Fall
41 Midwater Trawl index estimates) to 25% greater (based on Bay Otter Trawl indices) under

1 Alternative 7 compared to NAA. The biggest increases occur in below normal (21–26% more), dry
2 (30–37% more) and critical (46–58% more) water year types (Table 11-7-7).

3 Rearing conditions for larval and juvenile longfin smelt can also be analyzed by assessing Delta
4 outflows. On average, Delta outflow would be similar under Alternative 7 compared to NAA from
5 January through May, and increased by 12% in June.

6 **Table 11-7-7. Estimated Differences Between Scenarios for Longfin Smelt Relative Abundance in the**
7 **Fall Midwater Trawl or Bay Otter Trawl^a**

Water Year Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A7_LL T	NAA vs. A7_LL T	EXISTING CONDITIONS vs. A7_LL T	NAA vs. A7_LL T
All	-730 (-14%)	747 (20%)	-2,390 (-17%)	2,366 (25%)
Wet	-5,089 (-28%)	1,275 (11%)	-21,096 (-33%)	5,052 (13%)
Above Normal	-2,584 (-30%)	249 (4%)	-9,197 (-35%)	848 (5%)
Below Normal	-668 (-16%)	631 (21%)	-2,104 (-18%)	1,916 (26%)
Dry	-2 (0%)	490 (30%)	-7 (0%)	1,330 (37%)
Critical	244 (26%)	378 (46%)	592 (31%)	906 (58%)

Shading indicates a decrease of 10% or greater in relative abundance.

^a Based on the X2-Relative Abundance Regression of Kimmerer et al. (2009).

8

9 **CEQA Conclusion:** Under Alternative 7, average flows for Sacramento River at Rio Vista would be
10 similar (<10% difference) to Existing Conditions from January through March, and reduced 10% in
11 December. The impact of Alternative 7 on spawning habitat would be less than significant because
12 flow conditions near longfin smelt spawning habitat would be largely similar to baseline. No
13 mitigation would be required.

14 In general, under Alternative 7 water operations, the quantity and quality of rearing habitat for
15 longfin smelt would be reduced relative to Existing Conditions, but largely attributable to sea level
16 rise and climate change, and not to the operational scenarios. As a result, the differences between
17 Alternative 7 (which is under LLT conditions that include future sea level rise and climate change)
18 and the Existing Conditions may therefore either overstate the effects of Alternative 7 or suggest
19 significant effects that are largely attributable to sea level rise and climate change, and not to
20 Alternative 7.

21 Relative longfin smelt abundance (based on Kimmerer et al. 2009) averaged across all water years
22 would be 14–17% less compared to Existing Conditions (Table 11-7-7). Relative abundance by
23 water year type would be greater under Alternative 7 in critical years (26–31%), similar in dry
24 years, and lower in below normal (16–18%) and wetter water years (28–35% less). During the
25 larval longfin smelt transport period from January-June, average Delta outflows would be increased
26 12% in January, but reduced 18% in May compared to Existing Conditions. During the other months,
27 Delta outflow would be similar (<10% difference) to Existing Conditions.

28 Collectively, the results of the Impact AQUA-23 CEQA analysis indicate that the difference between
29 Existing Conditions and Alternative 7 could be significant because, the alternative could
30 substantially reduce modeled longfin smelt population indices, contrary to the NEPA conclusion set

1 forth above. Habitat restoration conservation measures (CM2 and CM4) and reduced larval
2 entrainment may reduce the severity of this impact. In addition, adaptive management plans
3 included in Mitigation Measures AQUA-22a through 22c have the potential to reduce the severity of
4 impact, potentially to a less-than-significant level. If this impact is found to be less than significant,
5 as a result of the adaptive management process, no additional mitigation would be required.

6 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**
7 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**
8 **Mitigation to Reduce Impacts to Rearing Habitat**

9 Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

10 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**
11 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

12 Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

13 **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**
14 **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

15 Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

16 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

17 Discussion provided above, under Impact AQUA-22

18 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

19 Discussion provided above, under Impact AQUA-22

20 **Restoration Measures (CM2, CM4–CM7, and CM10)**

21 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

22 The potential effects of restoration construction activities under Alternative 7 would be greater than
23 that described for Alternative 1A due to the increased floodplain and channel margin habitat
24 enhancement (see Impact AQUA-25). This would include potential effects of turbidity, mercury
25 methylation, accidental spills, disturbance of contaminated sediments, underwater noise, fish
26 stranding, and predation elements.

27 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-25, restoration construction activities
28 are not expected to adversely affect longfin smelt.

29 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-25 for longfin smelt, the potential
30 impact of restoration construction activities is considered less than significant, and no mitigation
31 would be required.

32 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**
33 **Smelt**

34 The potential effects of contaminants associated with restoration measures under Alternative 7
35 would be the same as those described for Alternative 1A (see Impact AQUA-26). This would include

1 potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides
2 and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of
3 seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects
4 would be the same as described under Alternative 1A.

5 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-26, contaminants associated with
6 restoration measures are not expected to adversely affect longfin smelt with respect to selenium,
7 copper, ammonia and pesticides. The effects of mercury on longfin smelt are uncertain.

8 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-26 for longfin smelt, the potential
9 impact of contaminants associated with restoration measures is considered less than significant, and
10 no mitigation would be required. The same conclusion applies to the additional restoration in
11 Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of
12 channel margin habitat).

13 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

14 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
15 described for Alternative 1A (see Impact AQUA-27). These would include CM2 Yolo Bypass Fisheries
16 Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain
17 Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and
18 CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally
19 inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

20 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-27, restored habitat conditions are
21 expected to be beneficial for longfin smelt and the additional restoration included in Alternative 7
22 provides proportionally more benefit.

23 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-27 for longfin smelt, the potential
24 impact of restored habitat conditions on longfin smelt is considered to be beneficial. The additional
25 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20
26 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation
27 would be required.

28 **Other Conservation Measures (CM12–CM19 and CM21)**

29 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

30 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt** 31 **(CM13)**

32 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

33 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

34 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

35 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

36 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

1 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

2 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**
3 **(CM21)**

4 *NEPA Effects:* Detailed discussions regarding the potential effects of these impact mechanisms on
5 longfin smelt for Alternative 7 are the same as those described under Alternative 1A (Impact AQUA-
6 28 through 36). The effects range from no effect, to not adverse, to beneficial.

7 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
8 less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-28
9 through 36), and no mitigation is required.

10 **Winter-Run Chinook Salmon**

11 **Construction and Maintenance of CM1**

12 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
13 **(Winter-Run ESU)**

14 The potential effects of construction of the water conveyance facilities on winter-run Chinook
15 salmon would be similar to those described for Alternative 1A (Impact AQUA-37) except that
16 Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the
17 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
18 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
19 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
20 shoreline and would require 27.3 acres of dredging.

21 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-37, environmental commitments and
22 mitigation measures would be available to avoid and minimize potential effects, and the effect would
23 not be adverse for winter-run Chinook salmon.

24 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-37, the impact of the construction of
25 water conveyance facilities on Chinook salmon would be less than significant except for
26 construction noise associated with pile driving. Potential pile driving impacts would be less than
27 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
28 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
29 less than significant.

30 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
31 **of Pile Driving and Other Construction-Related Underwater Noise**

32 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

33 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
34 **and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

1 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
2 **(Winter-Run ESU)**

3 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
4 the same as those described for Alternative 1A (see Impact AQUA-38) except that only three intakes
5 would need to be maintained under Alternative 7 rather than five under Alternative 1A.

6 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-38, the impact would not be adverse for
7 Chinook salmon.

8 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance
9 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
10 would be required.

11 **Water Operations of CM1**

12 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**
13 **Run ESU)**

14 ***Water Exports from SWP/CVP South Delta Facilities***

15 Alternative 7 would substantially reduce overall entrainment of juvenile winter-run Chinook salmon
16 at the south Delta export facilities, estimated as salvage density, by about 82% (~5,500–5,700 fish;
17 Table 11-7-8) across all years compared to NAA. As discussed for Alternative 1A (Impact AQUA-39),
18 entrainment is highest in wet years and decreases with reduced flows. Pre-screen losses, typically
19 attributed to predation, would be expected to decrease commensurate with decreased entrainment
20 at the south Delta facilities.

21 The proportion of the annual winter-run Chinook population entrained would decrease slightly
22 (difference less than 1.5%) under Alternative 7 (compared to NAA). The proportion of the annual
23 winter-run Chinook population (assumed to be 500,000 juveniles approaching the Delta) lost at the
24 south Delta facilities across all years averaged 1.4% under baseline scenario and decreased to 0.4%
25 under Alternative 7.

26 ***Water Exports from SWP/CVP North Delta Intake Facilities***

27 The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook Salmon under
28 Alternative 1A. Potential entrainment of juvenile salmonids at the north Delta intakes would be
29 greater than baseline, but the effects would be minimal because the north Delta intakes would have
30 state-of-the-art screens to exclude juvenile fish.

31 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

32 The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook salmon under
33 Alternative 1A. Potential entrainment and impingement effects for juvenile salmonids would be
34 minimal because intakes would have state-of-the-art screens installed.

1 **Table 11-7-8. Juvenile Winter-Run Chinook Salmon Annual Entrainment Index^a at the**
 2 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Winter-run Chinook salmon		
Wet	-8,255 (-73%)	-8,675 (-74%)
Above Normal	-5,358 (-81%)	-5,483 (-81%)
Below Normal	-5,953 (-83%)	-5,529 (-82%)
Dry	-3,701 (-98%)	-3,393 (-97%)
Critical	-1,261 (-100%)	-1,122 (-100%)
All Years	-5,565 (-82%)	-5,505 (-82%)

^a Estimated annual number of fish lost, based on normalized data.

3

4 **NEPA Effects:** Overall, the effects of entrainment and predation would not be an adverse effect on
 5 Chinook salmon because of the minimal population level impacts.

6 **CEQA Conclusion:** As described above, entrainment losses of juvenile Chinook salmon at the south
 7 Delta facilities would decrease under Alternative 7 compared to Existing Conditions (Table 11-7-8).
 8 Overall, impacts of water operations on entrainment of Chinook salmon (winter-run ESU) would be
 9 beneficial due to a reduction in entrainment and no mitigation would be required.

10 Although combined predation losses at the south Delta and the proposed north Delta intakes would
 11 increase for all races of juveniles, there would not be substantial effects on population levels. Thus
 12 the impact would be less than significant, no mitigation would be required.

13 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
 14 **Chinook Salmon (Winter-Run ESU)**

15 In general, effects of Alternative 7 on spawning and egg incubation habitat conditions for winter-run
 16 Chinook salmon relative to NAA are uncertain.

17 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were
 18 examined during the May through September winter-run spawning period (Appendix 11C, *CALSIM II*
 19 *Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for
 20 spawning and egg incubation. Flows under A7_LLT during May through September would generally
 21 be similar to or greater than flows under NAA, except in above normal, and below normal years
 22 during September (7% to 8% and 18% to 20% lower, respectively). These results indicate that there
 23 would be intermittent negligible to small flow-related effects of Alternative 7 on spawning and egg
 24 incubation habitat.

25 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the
 26 May through September winter-run spawning and egg incubation period. May Shasta storage
 27 volume under A7_LLT would be similar to or greater than storage under NAA for all water year
 28 types (Table 11-7-9).

29 These results indicate that there would be negligible (<5%) effects of Alternative 7 relative to NAA
 30 on winter-run Chinook salmon spawning and egg incubation habitat.

1 **Table 11-7-9. Difference and Percent Difference in May Water Storage Volume (thousand**
2 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-42 (-1%)	-8 (0%)
Above Normal	-126 (-3%)	-40 (-1%)
Below Normal	-249 (-6%)	-51 (-1%)
Dry	-431 (-11%)	13 (0%)
Critical	-627 (-26%)	-43 (-2%)

3
4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
5 examined during the May through September winter-run spawning period (Appendix 11D,
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
8 NAA and Alternative 7 in any month or water year type throughout the period at either location.

9 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
10 determined for each month (May through September) and year of the 82-year modeling period
11 (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were
12 further assigned a “level of concern”, as defined in Table 11-7-11. Differences between baselines and
13 Alternative 7 in the highest level of concern across all months and all 82 modeled years are
14 presented in Table 11-7-12. There would be no difference in levels of concern between NAA and
15 Alternative 7.

16 **Table 11-7-10. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided**
17 **by NMFS and Used in the BDCP Effects Analysis**

Location	Period	Maximum Water Temperature (°F)	Purpose
Upper Sacramento River			
Bend Bridge	May-Sep	56	Winter- and spring-run spawning and egg incubation
		63	Green sturgeon spawning and egg incubation
Red Bluff	Oct-Apr	56	Spring-, fall-, and late fall-run spawning and egg incubation
Hamilton City	Mar-Jun	61 (optimal), 68 (lethal)	White sturgeon spawning and egg incubation
Feather River			
Robinson Riffle (RM 61.6)	Sep-Apr	56	Spring-run and steelhead spawning and incubation
	May-Aug	63	Spring-run and steelhead rearing
Gridley Bridge	Oct-Apr	56	Fall- and late fall-run spawning and steelhead rearing
	May-Sep	64	Green sturgeon spawning, incubation, and rearing
American River			
Watt Avenue Bridge	May-Oct	65	Juvenile steelhead rearing

18

1 **Table 11-7-11. Number of Days per Month Required to Trigger Each Level of Concern for Water**
 2 **Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided**
 3 **by NMFS and Used in the BDCP Effects Analysis**

Exceedance above Water Temperature Threshold (°F)	Level of Concern			
	None	Yellow	Orange	Red
1	0-9 days	10-14 days	15-19 days	≥20 days
2	0-4 days	5-9 days	10-14 days	≥15 days
3	0 days	1-4 days	5-9 days	≥10 days

4

5 **Table 11-7-12. Differences between Baseline and Alternative 7 Scenarios in the Number of Years**
 6 **in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**
 7 **Sacramento River at Bend Bridge, May through September**

Level of Concern ^a	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Red	33 (67%)	0 (0%)
Orange	-14 (-100%)	0 (NA)
Yellow	-16 (-100%)	0 (NA)
None	-3 (-100%)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a For definitions of levels of concern, see Table 11-7-11.

8

9 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type
 10 during May through September (Table 11-7-13). Total degree-days under Alternative 7 would be
 11 similar to those under NAA during May, 2% lower than under NAA during June and July, and 7%
 12 higher during August and September.

1 **Table 11-7-13. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days**
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the**
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	1,121 (297%)	-81 (-5%)
	Above Normal	328 (154%)	-27 (-5%)
	Below Normal	549 (251%)	86 (13%)
	Dry	444 (239%)	30 (5%)
	Critical	403 (182%)	-7 (-1%)
	All	2,845 (234%)	1 (0%)
June	Wet	472 (123%)	-239 (-22%)
	Above Normal	226 (153%)	-3 (-1%)
	Below Normal	412 (296%)	60 (12%)
	Dry	598 (318%)	64 (9%)
	Critical	601 (150%)	51 (5%)
	All	2,308 (183%)	-68 (-2%)
July	Wet	626 (121%)	20 (2%)
	Above Normal	269 (332%)	-1 (0%)
	Below Normal	372 (253%)	-84 (-14%)
	Dry	847 (300%)	-81 (-7%)
	Critical	1,805 (219%)	19 (0.7%)
	All	3,919 (212%)	-127 (-2%)
August	Wet	2,094 (300%)	131 (5%)
	Above Normal	833 (204%)	174 (16%)
	Below Normal	1,137 (429%)	102 (8%)
	Dry	1,851 (276%)	241 (11%)
	Critical	2,812 (189%)	193 (5%)
	All	8,726 (247%)	839 (7%)
September	Wet	816 (111%)	107 (7%)
	Above Normal	538 (75%)	138 (12%)
	Below Normal	1,659 (222%)	513 (27%)
	Dry	2,608 (204%)	12 (0%)
	Critical	1,975 (95%)	84 (2%)
	All	7,599 (137%)	854 (7%)

4

5 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the
 6 Sacramento River under A7_LLT would be 11%, 100%, and 45% greater than mortality under NAA
 7 in above normal, below normal, and dry water years, respectively (Table 11-7-14). The increase in
 8 the percent of winter-run population subject to mortality would be 0.2%, 2%, and 3% in above
 9 normal, below normal, and dry years, respectively. Therefore, the increase in mortality of up to 3%
 10 from NAA to A7_LLT, although relatively large, would be negligible at an absolute scale to the
 11 winter-run population. These results indicate that climate change would cause the majority of the
 12 increase in winter-run egg mortality.

1 **Table 11-7-14. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook**
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	1 (269%)	-0.04 (-2%)
Above Normal	2 (404%)	0.2 (11%)
Below Normal	3 (273%)	2 (100%)
Dry	9 (596%)	3 (45%)
Critical	45 (169%)	1 (2%)
All	10 (210%)	1 (9%)

3
4 SacEFT predicts that there would be a 28% decrease in the percentage of years with good spawning
5 availability, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-15).
6 These results indicate that there may be small negative effects of Alternative 7 on spawning habitat
7 availability. SacEFT predicts that the percentage of years with good (lower) redd scour risk under
8 A7_LLT would be similar to the percentage of years under NAA. SacEFT predicts that the percentage
9 of years with good egg incubation conditions under A7_LLT would be similar to (<5% difference)
10 that under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering
11 risk under A7_LLT would be 17% lower (5% lower on an absolute scale) than risk under NAA.

12 The biological significance of a reduction in available suitable spawning habitat varies at the
13 population level in response to a number of factors, including adult escapement. For those years
14 when adult escapement is less than the carrying capacity of the spawning habitat, a reduction in
15 area would have little or no population level effect. In years when escapement exceeds carrying
16 capacity of the reduced habitat, competition among spawners for space (e.g., increased redd
17 superimposition) would increase, resulting in reduced reproductive success. The reduction in the
18 frequency of years in which spawning habitat availability is considered to be good by SacEFT could
19 result in reduced reproductive success and abundance of winter-run Chinook salmon if the number
20 of spawners is limited by spawning habitat quantity.

21 **Table 11-7-15. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
22 **for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spawning WUA	-35 (-60%)	-9 (-28%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-22 (-23%)	1 (1%)
Redd Dewatering Risk	-1 (-4%)	-5 (-17%)
Juvenile Rearing WUA	-27 (-54%)	-2 (-8%)
Juvenile Stranding Risk	2 (10%)	-9 (-29%)

WUA = Weighted Usable Area.

23
24 **NEPA Effects:** Available analytical tools show conflicting results regarding the temperature effects of
25 relatively small changes in predicted summer and fall flows in the Sacramento River. Several
26 models (CALSIM, SRWQM, and Reclamation Egg Mortality Model) generally show no change in
27 upstream conditions as a result of Alternative 7. However, one model, SacEFT, shows adverse effects

1 under some conditions. After extensive investigation of these results, they appear to be a function of
2 high model sensitivity to relatively small changes in estimated upstream conditions, which may or
3 may not accurately predict adverse effects. The new NDD structures allow for spring time deliveries
4 of water south of the Delta that are currently constrained under the NAA. For this reason, additional
5 spring storage criteria may be necessary to ensure Shasta Reservoir operations similar to what was
6 modeled. These discussions will occur in the Section 7 consultation with Reclamation on Shasta
7 Reservoir and system-wide operations, which is outside the scope of BDCP. In conclusion,
8 Alternative 7 modeling results support a finding that effects are uncertain, but modeled results are
9 mixed and operations that match the CALSIM modeling are not assured. Model results will be
10 submitted to independent peer review to confirm that adverse effects are not reasonably anticipated
11 to occur.

12 **CEQA Conclusion:** In general, Alternative 7 would not affect the quantity and quality of spawning
13 and egg incubation habitat for winter-run Chinook salmon relative to CEQA Existing Conditions.

14 CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined
15 during the May through September winter-run spawning and egg incubation period (Appendix 11C,
16 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLTP during June through
17 August would generally be similar to or greater than flows under Existing Conditions, except in wet
18 years during August (6% lower) and critical years during July (7% to 8% lower depending on
19 location) and August (21% to 25% lower depending on location). Flows under A7_LLTP during May
20 and September would generally be lower than flows under Existing Conditions by up to 23%.

21 Shasta Reservoir storage volume at the end of May under A7_LLTP would be similar to Existing
22 Conditions in wet and above normal water years, but lower by 6% to 26% in below normal, dry, and
23 critical water years (Table 11-7-9). This indicates that there would be a small to moderate effect of
24 Alternative 7 on flows during the spawning and egg incubation period.

25 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
26 examined during the May through September winter-run spawning period (Appendix 11D,
27 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
28 *Fish Analysis*). There would be no (<5%) differences in mean monthly water temperature between
29 Existing Conditions and Alternative 7 during June and one water year type with greater than 5%
30 difference during May and July. Mean monthly water temperature would be up to 11% higher under
31 Alternative 7 during August and September depending on month, water year type, and location.

32 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
33 determined for each month (May through September) and year of the 82-year modeling period
34 (Table 11-7-10). The combination of number of days and degrees above the 56°F threshold were
35 further assigned a “level of concern”, as defined in Table 11-7-11. The number of years classified as
36 “red” would increase by 67% under Alternative 7 relative to Existing Conditions (Table 11-7-12).

37 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the
38 Sacramento River under A7_LLTP would be 169% to 596% greater than mortality under Existing
39 Conditions depending on water year type (Table 11-7-14). These increases would only affect the
40 winter-run population during dry and critical years, in which the absolute percent increase of the
41 winter-run population would be 9 and 45%, respectively. These results indicate that Alternative 7
42 would cause increased winter-run Chinook salmon mortality in the Sacramento River.

1 SacEFT predicts that there would be a 60% decrease in the percentage of years with good spawning
2 availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table
3 11-7-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk under
4 A7_LLT would be similar to the percentage of years under Existing Conditions. SacEFT predicts that
5 the percentage of years with good egg incubation conditions under A7_LLT would be 23% lower
6 than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd
7 dewatering risk under A7_LLT would be similar to the percentage of years under Existing
8 Conditions. These results indicate that Alternative 7 would cause small to moderate reductions in
9 spawning WUA and egg incubation conditions.

10 **Summary of CEQA Conclusion**

11 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between
12 the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA
13 baseline, the alternative could substantially reduce suitable spawning habitat and substantially
14 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth
15 above, which is directly related to the inclusion of climate change effects in Alternative 7.

16 Egg mortality in drier years, during which winter-run Chinook salmon would already be stressed
17 due to reduced flows and increased temperatures, would be up to 45% greater due to Alternative 7
18 compared to Existing Conditions (Table 11-7-14). Further, the extent of spawning habitat would be
19 60% lower due to Alternative 7 compared to Existing Conditions (Table 11-7-15), which represents
20 a substantial reduction in spawning habitat and, therefore, in adult spawner and redd carrying
21 capacity.

22 These results are primarily caused by four factors: differences in sea level rise, differences in climate
23 change, future water demands, and implementation of the alternative. The analysis described above
24 comparing Existing Conditions to the alternative does not partition the effect of implementation of
25 the alternative from those of sea level rise, climate change and future water demands using the
26 model simulation results presented in this chapter. However, the increment of change attributable
27 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
28 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
29 implementation period, which does include future sea level rise, climate change, and water
30 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
31 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
32 effect of the alternative from those of sea level rise, climate change, and water demands.

33 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
34 Conditions in the late long-term implementation period and the alternative indicates that flows and
35 reservoir storage in the locations and during the months analyzed above would generally be similar
36 between Existing Conditions and the alternative. This indicates that the differences between
37 Existing Conditions and the alternative found above would generally be due to climate change, sea
38 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
39 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
40 conclusion, and therefore would not in itself result in a significant impact on spawning habitat for
41 winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is
42 required.

1 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
2 **(Winter-Run ESU)**

3 In general, Alternative 7 would not affect the quantity and quality of rearing habitat for fry and
4 juvenile winter-run Chinook salmon relative to NAA.

5 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
6 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
7 *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing
8 habitat. Flows under A7_LLT would generally be similar to or greater than flows under NAA during
9 August, October, and December, but up to 18% lower than flows under NAA during September and
10 November.

11 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
12 examined during the August through December winter-run juvenile rearing period (Appendix 11D,
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
15 NAA and Alternative 7 in any month or water year type throughout the period at either location.

16 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
17 measured as weighted usable area, under A7_LLT would be 8% lower than that under NAA (Table
18 11-7-14). In addition, the percentage of years with good (low) juvenile stranding risk under A7_LLT
19 is predicted to be 29% lower than that under NAA. On an absolute scale, the reduction in juvenile
20 rearing habitat availability and stranding risk would be small (2% and 9%, respectively) and would
21 not have a biologically meaningful effect on winter-run Chinook salmon. These results indicate that
22 neither the quantity nor quality of juvenile rearing habitat in the Sacramento River would differ
23 between NAA and Alternative 7.

24 SALMOD predicts that mean winter-run smolt equivalent habitat-related mortality under A7_LLT
25 would be negligible (<5%) compared to NAA.

26 **NEPA Effects:** These results indicate that the effect is not adverse because it has the potential to
27 substantially reduce the amount of suitable habitat and substantially interfere with the winter-run
28 Chinook salmon rearing. Differences in flows are generally small and inconsistent among months
29 and water year types. SALMOD and SacEFT predicted contradicting results regarding habitat-related
30 mortality although the magnitude of effect predicted by both models would not be biologically
31 meaningful.

32 **CEQA Conclusion:** In general, Alternative 7 would not affect the quantity and quality of fry and
33 juvenile rearing habitat for winter-run Chinook salmon relative to Existing Conditions.

34 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
35 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
36 *in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows under
37 Existing Conditions during October and November, but up to 21% lower than flows under Existing
38 Conditions during August, September, and December.

39 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
40 examined during the August through December winter-run rearing period (Appendix 11D,
41 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
42 *Fish Analysis*). Mean monthly water temperature would be up to 15% higher under Alternative 7 in

1 August through October depending on month, water year type, and location. There would be no
2 differences (<5%) between Existing Conditions and Alternative 7 in mean monthly water
3 temperature during November and December at either location.

4 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
5 measured as weighted usable area, under A7_LLTP would be 54% lower than under Existing
6 Conditions (Table 11-7-15). In addition, the percentage of years with good (low) juvenile stranding
7 risk under A7_LLTP is predicted to be 10% greater than under Existing Conditions. These results
8 indicate that the quantity of juvenile rearing habitat in the Sacramento River would be lower under
9 A7_LLTP relative to Existing Conditions.

10 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A7_LLTP would
11 be 12% higher than under Existing Conditions.

12 **Summary of CEQA Conclusion**

13 Collectively, the results of the Impact AQUA-41 CEQA analysis indicate that the difference between
14 the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA
15 baseline, the alternative could substantially reduce suitable spawning habitat and substantially
16 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth
17 above, which is directly related to the inclusion of climate change effects in Alternative 7.

18 Differences in flows are moderately large during the majority of months and water year types.
19 Further, a 54% reduction in rearing habitat quantity risk would reduce upstream habitat conditions
20 for winter-run fry and juveniles.

21 These results are primarily caused by four factors: differences in sea level rise, differences in climate
22 change, future water demands, and implementation of the alternative. The analysis described above
23 comparing Existing Conditions to the alternative does not partition the effect of implementation of
24 the alternative from those of sea level rise, climate change and future water demands using the
25 model simulation results presented in this chapter. However, the increment of change attributable
26 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
27 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLTP
28 implementation period, which does include future sea level rise, climate change, and water
29 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
30 the LLTP, both of which include sea level rise, climate change, and future water demands, isolates the
31 effect of the alternative from those of sea level rise, climate change, and water demands.

32 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
33 Conditions in the late long-term implementation period and the alternative indicates that flows and
34 reservoir storage in the locations and during the months analyzed above would generally be similar
35 between Existing Conditions and the alternative. This indicates that the differences between
36 Existing Conditions and the alternative found above would generally be due to climate change, sea
37 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
38 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
39 conclusion, and therefore would not in itself result in a significant impact on juvenile rearing habitat
40 for winter-run Chinook salmon. This impact is found to be less than significant and no mitigation is
41 required.

1 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**
2 **(Winter-Run ESU)**

3 In general, the effects of Alternative 7 winter-run Chinook salmon migration conditions relative to
4 NAA are uncertain.

5 **Upstream of the Delta**

6 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November
7 juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run
8 Chinook salmon to migrate effectively down the Sacramento River. Flows under A7_LLT would be
9 up to 14% lower than under NAA during November depending on water year type (Appendix 11C,
10 *CALSIM II Model Results utilized in the Fish Analysis*). However, flows under A7_LLT would generally
11 be similar to flows under NAA during the rest of the juvenile winter-run Chinook salmon migration
12 period (July through October).

13 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
14 examined during the July through November winter-run juvenile emigration period (Appendix 11D,
15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
16 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
17 NAA and Alternative 7 in any month or water year type throughout the period at either location.

18 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run
19 Chinook salmon upstream migration period (December through August). A reduction in flows may
20 reduce the olfactory cues needed by adult winter-run Chinook salmon to return to natal spawning
21 grounds in the upper Sacramento River. Flows under A7_LLT would generally be similar to or
22 greater than those under NAA with few exceptions.

23 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
24 examined during the December through August winter-run upstream migration period (Appendix
25 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
26 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
27 between NAA and Alternative 7 in any month or water year type throughout the period at either
28 location.

29 **Through-Delta**

30 The effects on through-Delta migration were evaluated using the approach described in Alternative
31 1A, Impact AQUA-42.

32 ***Juveniles***

33 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows
34 (up to 25% lower averaged over all water year types) below the north Delta intakes compared to
35 baseline. Predation at the north Delta would be increased at the three new intake structures. The
36 north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish around
37 the intake structures. The predation effects would be the same as those described for Alternative 4,
38 which also has three proposed intakes. Three NDD intakes would remove or modify habitat along
39 that portion of the migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline).
40 Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would
41 be less than 2% compared to the annual production estimated for the Sacramento Valley (Table 11-

1 1A-17). A conservative assumption of 5% loss per intake would yield a cumulative loss of 11.6% of
 2 juvenile winter-run Chinook that reach the north Delta. This assumption is uncertain and represents
 3 an upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative
 4 1A.

5 Through-Delta survival by emigrating juvenile winter-run Chinook salmon under Alternative 7
 6 (A7_LLТ) would average 33% across all years, ranging from 26% in drier years to 45% in wetter
 7 years. Under Alternative 7, juvenile survival would increase slightly in wetter years (1% greater
 8 survival, or 2% more in relative percentage) compared to NAA (Table 11-7-16).

9 **Table 11-7-16. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon**
 10 **under Alternative 7**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A7_LLТ	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Wetter Years	46.3	46.1	45.1	-1.2 (-3%)	-1.0 (-2%)
Drier Years	28.0	27.1	26.3	-1.7 (-6%)	-0.9 (-3%)
All Years	34.9	34.2	33.3	-1.6 (-4%)	-0.9 (-3%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

11

12 **Adults**

13 Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, decreased
 14 under Alternative 7A by no more than 10% during the December through June migration period for
 15 winter-run adults (Table 11-7-17). The proportion of Sacramento River flows in the Delta would
 16 represent 56-73% of Delta outflows, and would thus still provide strong olfactory cues. This topic is
 17 discussed in further detail in Impact AQUA-42 for Alternative 1A. Therefore, it is expected that
 18 olfactory cues for adult winter-run Chinook salmon from the Sacramento River would be adequate
 19 and not substantially affected by flow operations under Alternative 7.

1 **Table 11-7-17. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
 2 **San Joaquin River during the Adult Chinook Salmon Migration Period for Alternative 7**

Month	EXISTING CONDITIONS			EXISTING CONDITIONS vs. A7_LLT	
	NAA	A7_LLT		NAA vs. A7_LLT	
Sacramento River					
September	60	65	78	18	13
October	60	68	67	7	-1
November	60	66	62	2	-4
December	67	66	65	-2	-1
January	76	75	73	-3	-2
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	59	-10	-6
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
Shading indicates a difference of 10% or greater in flow proportion.					

3

4 **NEPA Effects:** Overall, the effect of Alternative 7 is uncertain due to absence of information
 5 regarding the near-field effects of a new intake structure in the north Delta on migrating juvenile
 6 winter-run Chinook salmon.

7 Upstream of the Delta, the effects of Alternative 7 on flows and water temperatures would not be
 8 adverse relative to the NAA. Within the Delta, effects of Alternative 7 on adult attraction flows would
 9 not be adverse relative to the NAA.

10 Adult attraction flows in the Delta under Alternative 7 would be lower than those under NAA, but
 11 adult attraction flows are expected to be adequate to provide olfactory cues for migrating adults.

12 Near-field effects of Alternative 7 NDD on winter-run Chinook salmon related to impingement and
 13 predation associated with three new intake structures could result in negative effects on juvenile
 14 migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall
 15 effects. It is expected that the level of near-field impacts would be directly correlated to the number
 16 of new intake structures in the river and thus the level of impacts associated with 3 new intakes
 17 would be considerably lower than those expected from having 5 new intakes in the river. Estimates
 18 within the effects analysis range from very low levels of effects (<1% mortality) to more significant
 19 effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the
 20 intent of providing localized and temporary reductions in predation pressure at the NDD.
 21 Additionally, several pre-construction surveys to better understand how to minimize losses
 22 associated with the three new intake structures will be implemented as part of the final NDD screen
 23 design effort. Alternative 7 also includes an Adaptive Management Program and Real-Time
 24 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide

1 adequate migration conditions for winter-run Chinook. However, at this time, due to the absence of
2 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality
3 expected from near-field effects at the NDD remains highly uncertain.

4 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
5 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
6 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7
7 predict improvements in smolt condition and survival associated with increased access to the Yolo
8 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
9 of each of these factors and how they might interact and/or offset each other in affecting salmonid
10 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

11 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
12 all of these elements of BDCP operations and conservation measures to predict smolt migration
13 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
14 migration survival under Alternative 7 would be similar to those estimated for NAA. Further
15 refinement and testing of the DPM, along with several ongoing and planned studies related to
16 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
17 future. These efforts are expected to improve our understanding of the relationships and
18 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
19 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
20 However, until these efforts are completed and their results are fully analyzed, the overall
21 cumulative effect of Alternative 7 on winter-run Chinook salmon migration remains uncertain.

22 **CEQA Conclusion:** In general, Alternative 7 would not affect migration conditions for winter-run
23 Chinook salmon relative to CEQA Existing Conditions.

24 ***Upstream of the Delta***

25 Flows in the Sacramento River upstream of Red Bluff were examined during the July through
26 November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
27 *Analysis*). Flows under A7_LLTP for juvenile migrants would generally be greater than or similar to
28 flows under Existing Conditions during all months except July, in which flows would be up to 11%
29 greater under A7_LLTP, and September, in which flows would be up to 19% lower under A7_LLTP.
30 These reductions would not be frequent enough to have biologically meaningful effects on juvenile
31 emigration conditions.

32 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
33 examined during the July through November winter-run juvenile emigration period (Appendix 11D,
34 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
35 *Fish Analysis*). Mean monthly water temperature would be up to 14% higher under Alternative 7 in
36 July through October depending on month, water year type, and location. There would be no
37 differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative
38 7 during November.

39 Flows in the Sacramento River upstream of Red Bluff were examined during the December through
40 August adult migration period. Flows under A7_LLTP would generally be similar to flows under
41 Existing Conditions, except during February, June, and July, in which flows would be up to 11%
42 greater under A7_LLTP, and during September, in which flows would be 3% to 6% lower than flows
43 under Existing Conditions.

1 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
2 examined during the December through August winter-run upstream migration period (Appendix
3 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
4 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
5 between Existing Conditions and Alternative 7 during December through June. Mean monthly water
6 temperature would be up to 14% higher under Alternative 7 in July through August depending on
7 month, water year type, and location (although in only one water year during July).

8 ***Through-Delta***

9 As described above, Alternative 7 would result in a slight reduction in through-Delta survival by
10 emigrating juvenile winter-run Chinook salmon across all water years (1.6% less survival, or 4%
11 less in relative percentage [A7_LLT]) compared to Existing Conditions. Survival under Alternative 7
12 would decrease by 1.7% in drier years and by 1.2% in wetter years. Migrating juveniles would face
13 potential predation losses, reduced flows and lost aquatic habitat at the three intake structures.

14 Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10%
15 difference) to Existing Conditions for adult winter-run Chinook salmon migrating through the Delta.

16 **Summary of CEQA Conclusion**

17 Collectively, these results indicate that the effect would be less than significant because it does not
18 have the potential to substantially reduce migration habitat or substantially interfere with the
19 movement of fish. Upstream flows and water temperatures would not be difference between
20 Alternative 7 and Existing Conditions. Similarly, Alternative 7 would result in a slight increase in
21 through-Delta juvenile survival in wetter water years compared to Existing Conditions. Based on the
22 proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to Existing
23 Conditions for adult winter-run Chinook salmon migrating through the Delta. Collectively, the
24 overall impact of Alternative 7 on winter-run Chinook salmon migration conditions would be less
25 than significant, and no mitigation would be required.

26 **Restoration Measures (CM2, CM4–CM7, and CM10)**

27 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon** 28 **(Winter-Run ESU)**

29 The potential effects of restoration construction activities under Alternative 7 would be greater than
30 that described for Alternative 1A due to the increased floodplain and channel margin habitat
31 enhancement (see Impact AQUA-43). This would include potential effects of turbidity, mercury
32 methylation, accidental spills, disturbance of contaminated sediments, underwater noise, fish
33 stranding, and predation.

34 ***NEPA Effects:*** As concluded in Alternative 1A, Impact AQUA-43, restoration construction activities
35 under Alternative 7 are not expected to adversely affect Chinook salmon.

36 ***CEQA Conclusion:*** As described in Alternative 1A, Impact AQUA-43 for Chinook salmon, the
37 potential impact of restoration construction activities is considered less than significant, and no
38 mitigation would be required.

1 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**
2 **Salmon (Winter-Run ESU)**

3 The potential effects of contaminants associated with restoration measures under Alternative 7
4 would be the same as those described for Alternative 1A (see Impact AQUA-44). This would include
5 potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides
6 and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of
7 seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects
8 would be the same as described under Alternative 1A.

9 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-44, contaminants associated with
10 restoration measures are not expected to adversely affect Chinook salmon with respect to selenium,
11 copper, ammonia and pesticides. The effects of methylmercury on Chinook salmon are uncertain.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-44 for Chinook salmon, the
13 potential impact of contaminants associated with restoration measures is considered less than
14 significant, and no mitigation would be required. The same conclusion applies to the additional
15 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20
16 additional miles of channel margin habitat).

17 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**
18 **ESU)**

19 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
20 described for Alternative 1A (see Impact AQUA-45). These would include CM2 Yolo Bypass Fisheries
21 Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated Floodplain
22 Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community Restoration, and
23 CM10 Nontidal Marsh Restoration. It would also include the additional 10,000 acres of seasonally
24 inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

25 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-45, restored habitat conditions are
26 expected to be beneficial for Chinook salmon and the additional restoration included in Alternative
27 7 provides proportionally more benefit.

28 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-45 for Chinook salmon, the
29 potential impact of restored habitat conditions on Chinook salmon is considered to be beneficial.
30 The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated
31 floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit,
32 and no mitigation would be required.

33 **Other Conservation Measures (CM12–CM19 and CM21)**

34 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**
35 **ESU) (CM12)**

36 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
37 **(Winter-Run ESU) (CM13)**

38 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**
39 **Run ESU) (CM14)**

1 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
2 **(Winter-Run ESU) (CM15)**

3 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**
4 **(CM16)**

5 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**
6 **(CM17)**

7 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**
8 **(CM18)**

9 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**
10 **ESU) (CM19)**

11 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
12 **(Winter-Run ESU) (CM21)**

13 *NEPA Effects:* Detailed discussions regarding the potential effects of these impact mechanisms on
14 winter run Chinook salmon are the same as those described under Alternative 1A (Impact AQUA-46
15 through 54). The effects range from no effect, to not adverse, to beneficial.

16 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
17 less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-46
18 through 54), and no mitigation is required.

19 **Spring-Run Chinook Salmon**

20 **Construction and Maintenance of CM1**

21 The construction- and maintenance-related effects of Alternative 7 would be identical for all four
22 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the
23 discussion of these effects for winter-run Chinook.

24 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
25 **(Spring-Run ESU)**

26 The potential effects of construction of the water conveyance facilities on spring-run Chinook
27 salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except that
28 Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the
29 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
30 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
31 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
32 shoreline and would require 27.3 acres of dredging.

33 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-55, environmental commitments and
34 mitigation measures would be available to avoid and minimize potential effects, and the effect would
35 not be adverse for spring-run Chinook salmon.

36 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-55, the impact of the construction of
37 water conveyance facilities on Chinook salmon would be less than significant except for

1 construction noise associated with pile driving. Potential pile driving impacts would be less than
2 under Alternative 1A because only three intakes would be constructed rather than five.
3 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
4 that noise impact to less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

11 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
12 **(Spring-Run ESU)**

13 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
14 the same as those described for Alternative 1A (see Impact AQUA-56) except that only three intakes
15 would need to be maintained under Alternative 7 rather than five under Alternative 1A.

16 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-56, the impact would not be adverse for
17 Chinook salmon.

18 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-56, the impact of the maintenance
19 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
20 would be required.

21 **Water Operations of CM1**

22 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**
23 **ESU)**

24 ***Water Exports from SWP/CVP South Delta Facilities***

25 Alternative 7 would substantially reduce overall entrainment of juvenile spring-run Chinook salmon
26 at the south Delta export facilities, estimated as salvage density, by about 94% (~36,000–37,000 fish
27 (Table 11-7-18) across all years compared to NAA. Pre-screen losses, typically attributed to
28 predation, would be expected to decrease commensurate with decreased entrainment at the south
29 Delta facilities. As discussed for Alternative 1A (Impact AQUA-3 for spring-run Chinook salmon),
30 entrainment is highest in wet years and lowest in below normal water years.

31 The proportion of the annual spring-run Chinook population entrained at the south Delta facilities
32 would be less under Alternative 7 compared to NAA. The annual spring-run Chinook salmon
33 population (assumed to be 750,000 juveniles approaching the Delta) lost at the south Delta facilities
34 across all years averaged 12% under NAA, and would decrease to <1% under Alternative 7.

35 ***Water Exports from SWP/CVP North Delta Intake Facilities***

36 The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook salmon.
37 Potential entrainment of juvenile salmonids at the north Delta intakes would be greater than

1 baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-
2 art screens to exclude juvenile fish.

3 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

4 The impact and conclusion is the same as for Impact AQUA-39 for winter-run Chinook salmon.
5 Potential entrainment and impingement effects for juvenile salmonids would be minimal because
6 intakes would have state-of-the-art screens installed.

7 **Table 11-7-18. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index^a at the**
8 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spring-Run Chinook Salmon		
Wet	-79,036 (-89%)	-82,664 (-90%)
Above Normal	-25,330 (-95%)	-28,398 (-95%)
Below Normal	-5,919 (-93%)	-6,714 (-94%)
Dry	-16,412 (-100%)	-17,605 (-100%)
Critical	-11,876 (-100%)	-10,255 (-100%)
All Years	-35,525 (-94%)	-37,135 (-94%)

^a Estimated annual number of fish lost, based on normalized data.

9

10 **NEPA Effects:** Overall, the effects of entrainment and entrainment-related predation would be the
11 same as concluded in Alternative 1A, Impact AQUA-57, the impact would not be adverse for spring-
12 run Chinook salmon.

13 **CEQA Conclusion:** As described above, entrainment losses of juvenile spring-run Chinook salmon at
14 the south Delta facilities would decrease under Alternative 7 compared to Existing Conditions
15 (Table 11-7-23). Overall, impacts of water operations on entrainment of juvenile Chinook salmon
16 (spring-run ESU) would be beneficial due to a reduction in entrainment and no mitigation would be
17 required.

18 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
19 **Chinook Salmon (Spring-Run ESU)**

20 In general, the effects of Alternative 7 on spawning and egg incubation habitat conditions for spring-
21 run Chinook salmon relative to NAA are uncertain.

22 **Sacramento River**

23 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook
24 salmon spawning and incubation period (September through January). Flows under A7_LLT would
25 generally be similar to or greater than flows under NAA during all months except November, in
26 which flows would be up to 14% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
27 *Analysis*).

28 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam
29 during the spring-run spawning and egg incubation period (September through January). Storage

1 volume under A7_LLT would be similar to (<5% difference) storage under NAA in all water year
2 types (Table 11-7-19).

3 **Table 11-7-19. Difference and Percent Difference in September Water Storage Volume (thousand**
4 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-585 (-18%)	-73 (-3%)
Above Normal	-611 (-19%)	4 (0%)
Below Normal	-383 (-13%)	-29 (-1%)
Dry	-517 (-21%)	-6 (0%)
Critical	-392 (-33%)	-10 (-1%)

5
6 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
7 examined during the September through January spring-run Chinook salmon spawning period
8 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
9 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
10 temperature between NAA and Alternative 7 in any month or water year type throughout the period
11 at either location.

12 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
13 determined for each month (May through September At Bend Bridge and October through April at
14 Red Bluff) and year of the 82-year modeling period (Table 11-7-10). The combination of number of
15 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in
16 Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern
17 across all months and all 82 modeled years are presented in Table 11-7-12 for Bend Bridge and in
18 Table 11-7-20 for Red Bluff. There would be no difference in levels of concern between NAA and
19 Alternative 7 at Bend Bridge. At Red Bluff, there would be 0 (0%) and -2 (-20%) fewer years with a
20 “red” and “yellow” level of concern, respectively, under Alternative 7. The level of concern in these
21 years would be reduced to an “orange” level or no level.

22 **Table 11-7-20. Differences between Baseline and Alternative 7 Scenarios in the Number of Years**
23 **in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**
24 **Sacramento River at Red Bluff, October through April**

Level of Concern ^a	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Red	36 (300%)	0 (0%)
Orange	9 (150%)	2 (13%)
Yellow	-3 (-23%)	-2 (-20%)
None	-42 (-82%)	0 (0%)

25 ^a For definitions of levels of concern, see Table 11-7-11.

26 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge
27 during May through September and at Red Bluff during October through April. At Bend Bridge, total
28 degree-days under Alternative 7 would be up to 2% lower than those under NAA during May
29 through July and up to 7% higher during August through September (Table 11-7-13). At Red Bluff,
30 total degree-days under Alternative 7 would be 3%, 9% 12%, and 6% higher during October,
31 November, March and April, respectively, than those under NAA, and similar during remaining
32 months (Table 11-7-21).

1 **Table 11-7-21. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days**
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the**
 3 **Sacramento River at Red Bluff, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LL	NAA vs. A7_LL
October	Wet	1,177 (458%)	8 (1%)
	Above Normal	487 (187%)	10 (1%)
	Below Normal	839 (401%)	133 (15%)
	Dry	1,053 (214%)	-18 (-1%)
	Critical	958 (160%)	35 (2%)
	All	4,514 (248%)	168 (3%)
November	Wet	93 (9,300%)	3 (3%)
	Above Normal	68 (NA)	7 (11%)
	Below Normal	69 (NA)	21 (44%)
	Dry	165 (2,063%)	14 (9%)
	Critical	107 (2,675%)	-3 (-3%)
	All	502 (3,862%)	42 (9%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	8 (NA)	-1 (-11%)
	Above Normal	5 (NA)	1 (25%)
	Below Normal	36 (400%)	15 (50%)
	Dry	64 (457%)	0 (0%)
	Critical	30 (3,000%)	3 (11%)
	All	143 (596%)	18 (12%)
April	Wet	261 (227%)	0 (0%)
	Above Normal	207 (148%)	-22 (-6%)
	Below Normal	289 (366%)	59 (19%)
	Dry	367 (197%)	47 (9%)
	Critical	164 (1,367%)	13 (8%)
	All	1,288 (242%)	97 (6%)

NA = could not be calculated because the denominator was 0.

1 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
 2 Sacramento River under A7_LLT would be lower than or similar to mortality under NAA in above
 3 normal, dry, and critical years, but greater in wet (11% greater) and below normal (30% greater)
 4 water years (Table 11-7-22). Increases of 3% of the spring-run population in wet water years would
 5 be negligible to the overall population. However, the 13% increase in mortality in below normal
 6 years is considered a small effect on the spring-run population. Combining all water years, there
 7 would be no effect of Alternative 7 on egg mortality (2% absolute change).

8 **Table 11-7-22. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**
 9 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	17 (173%)	3 (11%)
Above Normal	23 (170%)	1 (2%)
Below Normal	42 (353%)	13 (30%)
Dry	53 (270%)	-4 (-5%)
Critical	22 (30%)	0 (0%)
All	31 (138%)	2 (5%)

10
 11 SacEFT predicts that there would be a no difference in the percentage of years with good spawning
 12 availability, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-23).
 13 SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd
 14 scour risk under A7_LLT relative to NAA. SacEFT predicts that there would be an 8% decrease on an
 15 absolute scale (24% relative decrease) in the percentage of years with good (lower) egg incubation
 16 conditions under A7_LLT relative to NAA. SacEFT predicts that there would be a 6% decrease in the
 17 percentage of years with good (lower) redd dewatering risk under A7_LLT relative to NAA.

18 **Table 11-7-23. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
 19 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spawning WUA	-21 (-30%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-60 (-70%)	-8 (-24%)
Redd Dewatering Risk	-17 (-35%)	-2 (-6%)
Juvenile Rearing WUA	4 (18%)	4 (18%)
Juvenile Stranding Risk	-7 (-37%)	-2 (-14%)

WUA = Weighted Usable Area.

20
 21 There is an apparent discrepancy in results of the SacEFT model and Reclamation egg mortality
 22 model with regard to conditions for spring-run salmon eggs. SacEFT predicts that egg incubation
 23 habitat would decrease (8% absolute scale decrease) and the Reclamation egg mortality model
 24 predicts that overall egg mortality would be unaffected by the Alternative 7, except in below normal
 25 water years. The SacEFT uses mid-August through early March as the egg incubation period, based
 26 on Vogel and Marine (1991), and the reach between ACID Dam and Battle Creek for redd locations.
 27 The Reclamation egg mortality model uses the number of days after Julian week 33 (mid-August)

1 that it takes to accumulate 750 temperature units to hatching and another 750 temperature units to
 2 emergence. Temperatures units are calculated by subtracting 32°F from daily river temperature and
 3 are computed on a daily basis. As a result, egg incubation duration is generally mid-August through
 4 January, but is dependent on river temperature. The Reclamation model uses the reach between
 5 ACID Dam and Jelly’s Ferry (approximately 5 river miles downstream of Battle Creek), which
 6 includes 95% of Sacramento River spawning locations based on 2001–2004 redd survey data
 7 (Reclamation 2008). These differences in egg incubation period and location likely account for the
 8 difference between model results. Although the SacEFT model has been peer-reviewed, the
 9 Reclamation egg mortality model has been extensively reviewed and used in prior biological
 10 assessments and BiOps. Therefore, both results are considered valid and were considered in
 11 drawing conclusions about spring-run egg mortality in the Sacramento River.

12 **Clear Creek**

13 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
 14 (September through January) under A7_LLT would be similar to or greater than flows under NAA
 15 except in critical years during September (13% decrease) (Appendix 11C, *CALSIM II Model Results*
 16 *utilized in the Fish Analysis*).

17 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
 18 comparing the magnitude of flow reduction each month over the incubation period compared to the
 19 flow in September when spawning is assumed to occur. The greatest reduction in flows under
 20 A7_LLT would be the same or of a lower magnitude as that under NAA in all water year types (Table
 21 11-7-24).

22 Water temperatures were not modeled in Clear Creek.

23 **Table 11-7-24. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
 24 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
 25 **January Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-3 (-4%)	31 (31%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

26

27 **Feather River**

28 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)
 29 where spring-run primarily spawn during September through January (Appendix 11C, *CALSIM II*
 30 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would not differ from NAA because

1 minimum Feather River flows are included in the FERC settlement agreement and would be met for
2 all model scenarios.

3 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam
4 during the spring-run spawning and egg incubation period. Storage volume under A7_LLT would be
5 similar to or greater than storage under NAA depending on water year type (Table 11-7-25). This
6 indicates that the majority of reduction in storage volume would be due to climate change rather
7 than Alternative 7.

8 **Table 11-7-25. Difference and Percent Difference in September Water Storage Volume (thousand**
9 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-885 (-31%)	129 (7%)
Above Normal	-675 (-28%)	116 (7%)
Below Normal	-322 (-16%)	287 (20%)
Dry	162 (12%)	515 (51%)
Critical	-90 (-9%)	98 (12%)

10

11 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
12 comparing the magnitude of flow reduction each month over the egg incubation period compared to
13 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
14 during October through January were identical between A7_LLT and NAA (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 7 on
16 redd dewatering in the Feather River low-flow channel.

17 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream
18 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water*
19 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
20 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 7 in any
21 month or water year type throughout the period.

22 The percent of months exceeding the 56°F temperature threshold in the Feather River above
23 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table
24 11-7-26). The percent of months exceeding the threshold under Alternative 7 would generally be
25 lower (up to 23% lower on an absolute scale) than the percent under NAA during October and
26 November and similar during other months, except for the >4.0 and >5.0 degree categories during
27 September when they would be slightly lower (5% and 9% absolute scale decrease).

1 **Table 11-7-26. Differences between Baseline and Alternative 7 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
 3 **River above Thermalito Afterbay Exceed the 56°F Threshold, September through January**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LL1					
September	0 (0%)	0 (0%)	6 (7%)	19 (25%)	33 (82%)
October	44 (200%)	41 (550%)	30 (480%)	28 (1,150%)	16 (650%)
November	41 (1,650%)	38 (3,100%)	26 (2,100%)	17 (NA)	6 (NA)
December	2 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
NAA vs. A7_LL1					
September	0 (0%)	-1 (-1%)	-1 (-1%)	-5 (-5%)	-9 (-10%)
October	-20 (-23%)	-17 (-26%)	-20 (-36%)	-19 (-38%)	-21 (-53%)
November	-23 (-35%)	-20 (-33%)	-22 (-45%)	-15 (-46%)	-19 (-75%)
December	-1 (-33%)	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4
 5 Total degree-days exceeding 56°F were summed by month and water year type above Thermalito
 6 Afterbay (low-flow channel) during September through January (Table 11-7-27). Total degree-
 7 months would be similar between NAA and Alternative 7 during December, and January, and 9%,
 8 29%, and 34% lower during September, October and November, respectively.

1 **Table 11-7-27. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the Feather River above Thermalito Afterbay, September through January**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LL1	NAA vs. A7_LL1
September	Wet	26 (24%)	1 (1%)
	Above Normal	15 (35%)	5 (9%)
	Below Normal	26 (43%)	-5 (-5%)
	Dry	50 (72%)	-38 (-24%)
	Critical	50 (77%)	-12 (-9%)
	All	167 (48%)	-49 (-9%)
October	Wet	50 (1,000%)	-46 (-46%)
	Above Normal	30 (300%)	-5 (-11%)
	Below Normal	35 (500%)	-19 (-31%)
	Dry	64 (914%)	-16 (-18%)
	Critical	30 (375%)	-11 (-22%)
	All	208 (562%)	-98 (-29%)
November	Wet	33 (NA)	-23 (-41%)
	Above Normal	21 (700%)	-4 (-14%)
	Below Normal	18 (1,800%)	-16 (-46%)
	Dry	34 (NA)	-17 (-33%)
	Critical	21 (NA)	-7 (-25%)
	All	126 (3,150%)	-68 (-34%)
December	Wet	0 (NA)	-1 (-100%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	3 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	5 (NA)	0 (0%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Available analytical tools show conflicting results regarding the temperature effects of
 6 relatively small changes in predicted summer and fall flows in the Sacramento River. Several
 7 models (CALSIM, SRWQM, and Reclamation Egg Mortality Model) generally show no change in
 8 upstream conditions as a result of Alternative 7. However, one model, SacEFT, shows adverse effects
 9 under some conditions. After extensive investigation of these results, they appear to be a function of
 10 high model sensitivity to relatively small changes in estimated upstream conditions, which may or
 11 may not accurately predict adverse effects. The new NDD structures allow for spring time deliveries
 12 of water south of the Delta that are currently constrained under the NAA. For this reason, additional
 13 spring storage criteria may be necessary to ensure Shasta Reservoir operations similar to what was
 14 modeled. These discussions will occur in the Section 7 consultation with Reclamation on Shasta

1 Reservoir and system-wide operations, which is outside the scope of BDCP. In conclusion,
2 Alternative 7 modeling results support a finding that effects are uncertain. Modeled results are
3 mixed and operations that match the CALSIM modeling are not assured. Model results will be
4 submitted to independent peer review to confirm that adverse effects are not reasonably anticipated
5 to occur.

6 There would be no effects of Alternative 7 on spawning and egg incubation conditions in Clear
7 Creek. There would be no effects of Alternative 7 on flows and no or small beneficial effects on water
8 temperatures in the Feather River.

9 **CEQA Conclusion:** In general, Alternative 7 would not affect the quantity and quality of spawning
10 and egg incubation habitat for spring-run Chinook salmon relative to CEQA Existing Conditions.

11 **Sacramento River**

12 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook
13 salmon spawning and incubation period (September through January). Flows under A7_LLT would
14 generally be similar to or greater than flows under Existing Conditions during October, November,
15 and January (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under
16 A7_LLT would be up to 19% lower than those under Existing Conditions during September and
17 December depending on water year type.

18 Shasta Reservoir Storage volume at the end of September would be 13% to 33% lower under
19 A7_LLT relative to Existing Conditions (Table 11-7-19).

20 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
21 examined during the September through January spring-run Chinook salmon spawning period
22 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
23 *utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 7 during September and
24 October would be 7% greater, than those under Existing Conditions, but not different in other
25 months during the period. At Bend Bridge, temperatures under Alternative 7 during September and
26 October would be 9% and 6% greater, respectively, than those under Existing Conditions, but not
27 different in other months during the period.

28 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
29 determined for each month (May through September At Bend Bridge and October through April at
30 Red Bluff) and year of the 82-year modeling period (Table 11-7-10). The combination of number of
31 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in
32 Table 11-7-11. Differences between baselines and Alternative 7 in the highest level of concern
33 across all months and all 82 modeled years are presented in Table 11-7-12 for Bend Bridge and in
34 Table 11-7-20 for Red Bluff. At Bend Bridge, there would be a 67% increase in the number of years
35 with a “red” level of concern under Alternative 7 relative to Existing Conditions. At Red Bluff, there
36 would be 300% and 150% increases in the number of years with “red” and “orange” levels of
37 concern under Alternative 7 relative to Existing Conditions.

38 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge
39 during May through September and at Red Bluff during October through April. At Bend Bridge, total
40 degree-days under Alternative 7 would be up to 137% to 234% higher than those under Existing
41 Conditions depending on the month (Table 11-7-13). At Red Bluff, total degree-days under
42 Alternative 7 would be 242% to 3,862% higher than those under Existing Conditions during

1 October, November, March, and April, and similar during December through February (Table 11-7-
2 21).

3 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
4 Sacramento River under A7_LLT would be 30% to 353% greater than mortality under Existing
5 Conditions depending on water year type (Table 11-7-22).

6 SacEFT predicts that there would be a 30% decrease in the percentage of years with good spawning
7 availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table
8 11-7-23). SacEFT predicts that there would be no difference in the percentage of years with good
9 (lower) redd scour risk under A7_LLT relative to Existing Conditions. SacEFT predicts that there
10 would be a 70% decrease in the percentage of years with good (lower) egg incubation conditions
11 under A7_LLT relative to Existing Conditions, respectively. SacEFT predicts that there would be a
12 35% decrease in the percentage of years with good (lower) redd dewatering risk under A7_LLT
13 relative to Existing Conditions. These results indicate that spawning and egg incubation conditions
14 for spring-run Chinook salmon would be poor relative to Existing Conditions.

15 **Clear Creek**

16 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
17 (September through January) under A7_LLT would generally be similar to or greater than flows
18 under Existing Conditions except in critical years during September (38% reduction) and below
19 normal years during October (6% reduction) (Appendix 11C, *CALSIM II Model Results utilized in the*
20 *Fish Analysis*).

21 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
22 comparing the magnitude of flow reduction each month over the incubation period compared to the
23 flow in September when spawning is assumed to occur. The greatest reduction in flows under
24 A7_LLT would be similar to or lower magnitude than that under Existing Conditions in wet and
25 below normal water years (Table 11-7-24). The greatest reduction in flows under A7_LLT would be
26 27% to 67% lower (more negative) than Existing Conditions in above normal, dry, and critical years.

27 Water temperatures were not modeled in Clear Creek.

28 **Feather River**

29 Flows in the Feather River low-flow channel under A7_LLT are not different from Existing
30 Conditions during the spring-run spawning and egg incubation period (September through January)
31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in October through
32 January (800 cfs) would be equal to or greater than the spawning flows in September (773 cfs) for
33 all model scenarios.

34 Oroville Reservoir storage volume at the end of September would be 9% to 31% lower under
35 A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-25).

36 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
37 comparing the magnitude of flow reduction each month over the incubation period compared to the
38 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
39 during October through January were identical between A7_LLT and Existing Conditions (Appendix
40 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of
41 Alternative 7 on redd dewatering in the Feather River low-flow channel.

1 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream
2 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water*
3 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
4 Temperatures under Alternative 7 would be 7% to 10% greater than those under Existing
5 Conditions in all months during the period except September which would be 7% greater in only
6 one year.

7 The percent of months exceeding the 56°F temperature threshold in the Feather River above
8 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table
9 11-7-26). The percent of months exceeding the threshold under Alternative 7 would be similar to or
10 up to 44% higher (absolute scale) than under Existing Conditions during September through
11 November. There would be no difference in the percent of months exceeding the threshold between
12 Existing Conditions and Alternative 7 during December and January.

13 Total degree-days exceeding 56°F were summed by month and water year type above Thermalito
14 Afterbay (low-flow channel) during September through January (Table 11-7-27). Total degree-
15 months exceeding the threshold under Alternative 7 would be 48% to 3,150% greater than those
16 under Existing Conditions during September through November. There would be no difference in
17 total degree-months between Existing Conditions and Alternative 7 during December and January.

18 **Summary of CEQA Conclusion**

19 Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between
20 the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA
21 baseline, the alternative could substantially reduce suitable spawning habitat and substantially
22 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth
23 above, which is directly related to the inclusion of climate change effects in Alternative 7.

24 Reservoir storage volume and instream flows would be lower and water temperatures would be
25 greater under Alternative 7 relative to the CEQA baseline. Biological model results mirror these
26 physical model results.

27 These results are primarily caused by four factors: differences in sea level rise, differences in climate
28 change, future water demands, and implementation of the alternative. The analysis described above
29 comparing Existing Conditions to the alternative does not partition the effect of implementation of
30 the alternative from those of sea level rise, climate change and future water demands using the
31 model simulation results presented in this chapter. However, the increment of change attributable
32 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
33 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
34 implementation period, which does include future sea level rise, climate change, and water
35 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
36 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
37 effect of the alternative from those of sea level rise, climate change, and water demands.

38 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
39 Conditions in the late long-term implementation period and the alternative indicates that flows and
40 reservoir storage in the locations and during the months analyzed above would generally be similar
41 between Existing Conditions and the alternative. This indicates that the differences between
42 Existing Conditions and the alternative found above would generally be due to climate change, sea
43 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding

1 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
2 conclusion, and therefore would not in itself result in a significant impact on spawning and egg
3 incubation habitat for spring-run Chinook salmon. This impact is found to be less than significant
4 and no mitigation is required.

5 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-**
6 **Run ESU)**

7 In general, Alternative 7 would not affect the quantity and quality of rearing habitat for fry and
8 juvenile spring-run Chinook salmon relative to NAA.

9 ***Sacramento River***

10 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
11 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
12 Bluff Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Except for November, flows
13 under A7_LLT would mostly be similar to or greater than flows under NAA, although flows would be
14 up to 18% lower in some months and water year types. In November flows would be lower in all
15 water years except critical years (up to 17% lower).

16 As reported in Impact AQUA-40, May Shasta storage volume under A7_LLT would be similar to or
17 greater than storage under NAA for all water year types (Table 11-7-9).

18 As reported in Impact AQUA-58, September Shasta storage volume would be similar to or greater
19 than storage under NAA in all water year types (Table 11-7-19).

20 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
21 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,
22 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
23 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
24 NAA and Alternative 7 in any month or water year type throughout the period at either location.

25 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under
26 A7_LLT would be similar to or lower than that under NAA (Table 11-7-23). However, the percentage
27 of years with good (lower) juvenile stranding risk conditions under A7_LLT would be 14% lower
28 than under NAA. On an absolute scale, juvenile stranding risk would decrease in only 2% of years.
29 This reduction would not have a biologically meaningful effect on spring-run Chinook salmon.
30 SALMOD predicts that spring-run smolt equivalent habitat-related mortality would not differ
31 between A7_LLT and NAA.

32 ***Clear Creek***

33 Flows in Clear Creek during the November through March rearing period under A7_LLT would
34 generally be similar to or greater than flows under NAA, except for below normal water years during
35 March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Water temperatures were not modeled in Clear Creek.

1 **Feather River**

2 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
3 channel) during November through June were reviewed to determine flow-related effects on larval
4 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
5 Analysis*). Relatively constant flows in the low-flow channel throughout this period under A7_LLT
6 would not differ from those under NAA. In the high-flow channel, under A7_LLT would be mostly
7 lower (up to 27%) during December and generally similar to or greater than flows under NAA
8 during November and from January through June.

9 May Oroville storage under A7_LLT would be similar to or greater than storage under NAA (Table
10 11-7-28).

11 September Oroville storage volume would be greater than storage under NAA in all water year types
12 (Table 11-7-25).

13 **Table 11-7-28. Difference and Percent Difference in May Water Storage Volume (thousand
14 acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-56 (-2%)	-10 (0%)
Above Normal	-158 (-5%)	-2 (0%)
Below Normal	-123 (-4%)	230 (8%)
Dry	-243 (-9%)	277 (12%)
Critical	-76 (-4%)	240 (16%)

15
16 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at
17 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix
18 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in
19 the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
20 between NAA and Alternative 7 in any month or water year type throughout the period at either
21 location.

22 The percent of months exceeding the 63°F temperature threshold in the Feather River above
23 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-7-29).
24 The percent of months exceeding the threshold under Alternative 7 would generally be similar to or
25 lower (up to 20% lower on an absolute scale) than the percent under NAA.

1 **Table 11-7-29. Differences between Baseline and Alternative 7 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
 3 **River above Thermalito Afterbay Exceed the 63°F Threshold, May through August**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LL1					
May	4 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
June	26 (47%)	31 (114%)	31 (625%)	12 (NA)	4 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	46 (116%)
August	0 (0%)	12 (14%)	37 (64%)	46 (161%)	31 (313%)
NAA vs. A7_LL1					
May	-2 (-40%)	-1 (-50%)	-1 (-100%)	0 (NA)	0 (NA)
June	-7 (-8%)	-20 (-25%)	-11 (-24%)	-9 (-41%)	-1 (-25%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-9 (-9%)
August	0 (0%)	0 (0%)	-4 (-4%)	-7 (-9%)	-16 (-28%)

NA = could not be calculated because the denominator was 0.

4
 5 Total degree-days exceeding 63°F were summed by month and water year type above Thermalito
 6 Afterbay (low-flow channel) during May through August (Table 11-7-30). Total degree-months
 7 under Alternative 7 would be similar to or lower than those under NAA depending on the month.

1 **Table 11-7-30. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in**
 3 **the Feather River above Thermalito Afterbay, May through August**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	1 (NA)	0 (0%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)
	Dry	3 (NA)	1 (50%)
	Critical	3 (NA)	-1 (-25%)
	All	8 (NA)	0 (0%)
June	Wet	29 (193%)	0 (0%)
	Above Normal	16 (114%)	-1 (-3%)
	Below Normal	23 (177%)	1 (3%)
	Dry	34 (148%)	1 (2%)
	Critical	18 (300%)	-7 (-23%)
	All	119 (168%)	-7 (-4%)
July	Wet	41 (34%)	0 (0%)
	Above Normal	20 (45%)	0 (0%)
	Below Normal	26 (44%)	-2 (-2%)
	Dry	39 (55%)	3 (3%)
	Critical	35 (67%)	3 (4%)
	All	161 (47%)	4 (1%)
August	Wet	41 (46%)	8 (7%)
	Above Normal	20 (80%)	2 (5%)
	Below Normal	28 (74%)	-1 (-1%)
	Dry	46 (115%)	-7 (-8%)
	Critical	26 (62%)	-14 (-17%)
	All	160 (68%)	-13 (-3%)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because habitat would
 6 not be substantially reduced. There are some reductions in flow rates in the Sacramento River,
 7 although temperature conditions are predicted to be similar between the NEPA point of comparison
 8 and Alternative 7. In addition, rearing habitat conditions in other rivers are expected to be similar or
 9 better under Alternative 7.

10 **CEQA Conclusion:** In general, Alternative 7 would not reduce the quantity and quality of rearing
 11 habitat for fry and juvenile spring-run Chinook salmon relative to CEQA Existing Conditions.

12 **Sacramento River**

13 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
 14 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
 15 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT
 16 would be generally similar to or greater than those under Existing Conditions with some exceptions.

1 As reported in Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A7_LLT
2 would be similar to Existing Conditions in wet and above normal water years, but lower by 6% to
3 26% in below normal, dry, and critical water years (Table 11-7-9). As reported in Impact AQUA-58,
4 storage volume at the end of September under A7_LLT would be 13% to 33% lower relative to
5 Existing Conditions (Table 11-7-19).

6 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
7 examined during the year-round spring-run Chinook salmon juvenile rearing period (Appendix 11D,
8 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
9 *Fish Analysis*). At both locations, there would be no differences (<5%) in mean monthly water
10 temperature between Existing Conditions and Alternative 7 in most months, except for 5% to 10%
11 increases during August through October and in critical years during July.

12 SacEFT predicts that there would be a 21% decrease in the percentage of years with good spawning
13 availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table
14 11-7-7). SacEFT predicts that there would be no difference in the percentage of years with good
15 (lower) redd scour risk under A7_LLT relative to Existing Conditions. SacEFT predicts that there
16 would be a 70% decrease in the percentage of years with good (lower) egg incubation conditions
17 under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be a 35% decrease
18 in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to Existing
19 Conditions.

20 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A7_LLT would be
21 32% lower than under Existing Conditions.

22 **Clear Creek**

23 Flows in Clear Creek during the November through March rearing period under A7_LLT would
24 generally be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II*
25 *Model Results utilized in the Fish Analysis*).

26 Water temperatures were not model in Clear Creek.

27 **Feather River**

28 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
29 channel) during November through June were reviewed to determine flow-related effects on larval
30 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
31 *Analysis*). Relatively constant flows in the low-flow channel throughout this period under A7_LLT
32 would not differ from those under Existing Conditions. In the high-flow channel, flows under A7_LLT
33 would be mostly lower (up to 44%) during November through January and March and mostly
34 similar to or greater than flows under Existing Conditions during February and April through June
35 with few exceptions, during which flows would be up to 46% lower under A7_LLT.

36 May Oroville storage volume under A7_LLT would be similar to storage under Existing Conditions,
37 except in above normal and dry water years (5% and 9% lower, respectively) (Table 11-7-28).

38 September Oroville storage volume would be 9% to 31% lower under A7_LLT relative to Existing
39 Conditions depending on water year type (Table 11-7-25).

40 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at
41 Thermalito Afterbay (high-flow channel) were evaluated during the November through June

1 juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
2 *Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 7
3 would be 5% to 10% greater than those under Existing Conditions during November through March,
4 but similar (<5% difference) during April through June.

5 The percent of months exceeding the 63°F temperature threshold in the Feather River above
6 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-7-29).
7 The percent of months exceeding the threshold under Alternative 7 would be similar to those under
8 Existing Conditions during May, but up to 46% greater (absolute scale) during June through August.

9 Total degree-days exceeding 63°F were summed by month and water year type above Thermalito
10 Afterbay (low-flow channel) during May through August (Table 11-7-30). Total degree-months
11 under Alternative 7 would be similar to those under Existing Conditions during May, but 47% to
12 168% higher during June through August.

13 **Summary of CEQA Conclusion**

14 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between
15 the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA
16 baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA
17 conclusion set forth above, which is directly related to the inclusion of climate change effects in
18 Alternative 7.

19 Reservoir storage volume and instream flows would be lower and water temperatures would be
20 greater under Alternative 7 relative to the CEQA baseline. Biological model results mirror these
21 physical model results.

22 These results are primarily caused by four factors: differences in sea level rise, differences in climate
23 change, future water demands, and implementation of the alternative. The analysis described above
24 comparing Existing Conditions to the alternative does not partition the effect of implementation of
25 the alternative from those of sea level rise, climate change and future water demands using the
26 model simulation results presented in this chapter. However, the increment of change attributable
27 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
28 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
29 implementation period, which does include future sea level rise, climate change, and water
30 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
31 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
32 effect of the alternative from those of sea level rise, climate change, and water demands.

33 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
34 Conditions in the late long-term implementation period and the alternative indicates that flows and
35 reservoir storage in the locations and during the months analyzed above would generally be similar
36 between Existing Conditions and the alternative. This indicates that the differences between
37 Existing Conditions and the alternative found above would generally be due to climate change, sea
38 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
39 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
40 conclusion, and therefore would not in itself result in a significant impact on juvenile rearing habitat
41 for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is
42 required.

1 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**
2 **(Spring-Run ESU)**

3 In general, the effects of Alternative 7 on spring-run Chinook salmon migration conditions relative to
4 the NAA are uncertain.

5 **Upstream of the Delta**

6 ***Sacramento River***

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through
8 May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results*
9 *utilized in the Fish Analysis*). Flows under A7_LLT during December through May would be similar to
10 or greater than flows under NAA, except in above normal years during December (5% lower) and
11 dry and critical years during January (7% and 11% lower, respectively).

12 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
13 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,
14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
16 NAA and Alternative 7 in any month or water year type throughout the period.

17 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through
18 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*
19 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to or greater than
20 flows under NAA during all months and in all water year types.

21 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
22 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
25 NAA and Alternative 7 in any month or water year type throughout the period.

26 ***Clear Creek***

27 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
28 migration period under A7_LLT would generally be similar to or greater than flows under NAA
29 except in below normal water years during March (6% lower) (Appendix 11C, *CALSIM II Model*
30 *Results utilized in the Fish Analysis*).

31 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
32 migration period under A7_LLT would be similar to or greater than flows under NAA in all months
33 and water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 Water temperatures were not modeled in Clear Creek.

35 ***Feather River***

36 Flows in the Feather River at the confluence with the Sacramento River were examined during the
37 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
38 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be mostly lower
39 than under NAA during December. During January through May, flows under A7_LLT would

1 generally be similar to or greater than flows under NAA except in critical years during January (10%
2 lower) and in below normal and dry years during May (7% and 16% lower, respectively).

3 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
4 were examined during the November through May juvenile spring-run Chinook salmon migration
5 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
6 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
7 temperature between NAA and Alternative 7 in any month or water year type throughout the
8 period.

9 Flows in the Feather River at the confluence with the Sacramento River were examined during the
10 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
11 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLTP during April through June
12 would generally be similar to or greater than flows under NAA. Flows under A7_LLTP during July and
13 August would generally be lower than flows under NAA by up to 38%.

14 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
15 were examined during the April through August adult spring-run Chinook salmon upstream
16 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
17 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
18 mean monthly water temperature between NAA and Alternative 7 in any month or water year type
19 throughout the period.

20 **Through-Delta**

21 The effects on through-Delta migration were evaluated using the approach described in Alternative
22 1A, Impact AQUA-42.

23 **Juveniles**

24 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows
25 below the north Delta intakes compared to NAA. Predation at the north Delta would be increased at
26 the three new intake structures, as described for Alternative 4 (Impact AQUA-60). The north Delta
27 export facilities would replace aquatic habitat and likely attract piscivorous fish around the intake
28 structures. The predation effects would be the same as those described for Alternative 4, which also
29 has three proposed intakes. Potential predation losses at the north Delta intakes were estimated to
30 range from 0.2% (bioenergetics, Table 11-4-11) to 12.3% (fixed rate of 5% per intake), of juvenile
31 spring-run Chinook that reach the north Delta. This assumption is uncertain and represents an
32 upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

33 Through-Delta survival of migrating juvenile spring-run Chinook salmon, as estimated by DPM,
34 averaged 29% across all years, 38% in wetter years, and 24% in drier years under Alternative 7
35 (Table 11-7-31). This is similar (<5% difference) to results under NAA (about 1% lower survival
36 compared to NAA, a 5% relative decrease).

Table 11-7-31. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon under Alternative 7

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A7_LLТ	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Wetter Years	42.1	40.4	38.1	-4.1 (-10%)	-2.3 (-6%)
Drier Years	24.8	24.3	23.5	-1.3 (-5%)	-0.8 (-3%)
All Years	31.3	30.3	29.0	-2.3 (-7%)	-1.4 (-5%)

Note: Delta Passage Model results for survival to Chipps Island.
Wetter = Wet and Above Normal WYs (6 years).
Drier = Below Normal, Dry and Critical WYs (10 years).

Adults

During the overall spring-run upstream migration from March-June, the proportion of Sacramento River water in the Delta would decrease 11–16% in March-May relative to NAA, but would be similar to NAA in June (Table 11-7-17).

The reductions in percentage are small in comparison with the magnitude of change in dilution reported to cause a significant change in migration by Fretwell (1989) and, therefore, are not expected to affect winter-run migration. Furthermore, olfactory cues for spring-run adults would still be strong as the proportion of Sacramento River under Alternative 7 would still represent 53–65% of Delta outflows. This topic is discussed in further detail in Impact AQUA-42 for Alternative 1A.

NEPA Effects: Upstream of the Delta, these results indicate that the effect would not be adverse because it does not have the potential to substantially interfere with the movement of fish. Upstream migration conditions under Alternative 7 would generally be similar to or better than those under the NEPA point of comparison. Flows in the Feather River would be lower during two of five months during the adult migration period, although these reductions are not expected to be large enough or frequent enough to have a biologically meaningful effect on spring-run Chinook salmon.

Near-field effects of Alternative 7 NDD on spring-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating spring-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Alternative 7 also includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended to provide

1 adequate migration conditions for spring-run Chinook. However, at this time, due to the absence of
2 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality
3 expected from near-field effects at the NDD remains highly uncertain.

4 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
5 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
6 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7
7 predict improvements in smolt condition and survival associated with increased access to the Yolo
8 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
9 of each of these factors and how they might interact and/or offset each other in affecting salmonid
10 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

11 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
12 all of these elements of BDCP operations and conservation measures to predict smolt migration
13 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
14 migration survival under Alternative 7 would be similar to those estimated for NAA. Further
15 refinement and testing of the DPM, along with several ongoing and planned studies related to
16 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
17 future. These efforts are expected to improve our understanding of the relationships and
18 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
19 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
20 However, until these efforts are completed and their results are fully analyzed, the overall
21 cumulative effect of Alternative 7 on spring-run Chinook salmon migration remains uncertain.

22 ***CEQA Conclusion:***

23 **Upstream of the Delta**

24 In general, Alternative 7 would not affect migration conditions for spring-run Chinook salmon
25 relative to CEQA Existing Conditions.

26 ***Sacramento River***

27 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through
28 May juvenile Chinook salmon spring-run migration period (Appendix 11C, *CALSIM II Model Results*
29 *utilized in the Fish Analysis*). Flows under A7_LLTP would generally be similar to or greater than flows
30 under Existing Conditions except in wet water years during May (18% decrease), in below normal
31 water years during March, April, and May (9% to 11% decrease), and in dry years during April (6%).

32 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
33 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,
34 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
35 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
36 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

37 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through
38 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*
39 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTP would generally be similar to or
40 greater than Existing Conditions with few exceptions.

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
2 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
5 Existing Conditions and Alternative 7 during April through July except for wet years during April
6 and critical years during July. Mean monthly water temperatures under Alternative 7 would be up to
7 12% greater relative to Existing Conditions during August.

8 **Clear Creek**

9 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
10 migration period under A7_LLT would be similar to or greater than flows under Existing Conditions
11 except in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
13 migration period under A7_LLT would generally be similar to or greater than flows under Existing
14 Conditions with exceptions during August of critical water years (17% lower) (Appendix 11C,
15 *CALSIM II Model Results utilized in the Fish Analysis*).

16 Water temperatures were not modeled in Clear Creek.

17 **Feather River**

18 Flows were examined for the Feather River at the confluence with the Sacramento River during the
19 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
20 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November through January and
21 May under A7_LLT would generally be lower than flows under Existing Conditions by up to 34%.
22 Flows under A7_LLT during February through May would generally be similar to or greater than
23 flows under Existing Conditions, with few exceptions.

24 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
25 were examined during the November through May juvenile spring-run Chinook salmon migration
26 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
27 *Results utilized in the Fish Analysis*). Water temperatures under Alternative 7 would be 5% greater
28 than those under Existing Conditions in November and December, but similar during January
29 through May.

30 Flows were examined for the Feather River at the confluence with the Sacramento River during the
31 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
32 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May and July under A7_LLT would
33 generally be lower by up to 49% than flows under Existing Conditions. Flows under A7_LLT during
34 April, June, and August would generally be similar to or greater than flows under Existing Conditions
35 with few exceptions.

36 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
37 were examined during the April through August adult spring-run Chinook salmon upstream
38 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
39 *Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 7
40 would be up to 9% higher than those under Existing Conditions during July and August, and similar
41 during April through June except for dry years during June.

1 **Through-Delta**

2 Through-Delta survival by emigrating juvenile spring-run Chinook salmon under Alternative 7
3 (A7_LLT) would average 29% across all years, ranging from 24% in drier years to 38% in wetter
4 years (Table 11-7-31). Modeled juvenile survival under Alternative 7 is similar to Existing
5 Conditions (<5% difference) about 2% lower survival compared to Existing Conditions (7% relative
6 decrease). Estimates of potential predation losses at the three north Delta intakes ranged from 0.2%
7 (bioenergetics, Table 11-4-11) to 12.3% (fixed rate of 5% per intake), of juvenile spring-run Chinook
8 that reach the north Delta. This assumption is uncertain and represents an upper bound estimate.
9 For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

10 For migrating adults, the proportion of Sacramento River flows in the Delta would be reduced
11 during the adult spring-run Chinook salmon upstream migration through the Delta (up to 10%
12 relative to Existing Conditions); however Sacramento River flow olfactory cues would be strong
13 since Sacramento River water would still represent 59–78% of Delta water under Alternative 7
14 (Table 11-7-32). The reductions in percentage are small in comparison with the magnitude of
15 change in dilution (20% or more) reported to cause a significant change in migration by Fretwell
16 (1989) and, therefore, are not expected to affect adult Chinook salmon migration. However,
17 uncertainty remains with regard to adult salmon behavioral response to anticipated changes in
18 lower Sacramento River flow percentages. This topic is discussed further in Impact AQUA-42 for
19 Alternative 1A.

20 **Table 11-7-32. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
21 **San Joaquin River during the Adult Chinook Salmon Migration Period for Alternative 7**

Month	EXISTING CONDITIONS	NAA	A7_LLT	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River					
September	60	65	78	18	13
October	60	68	67	7	-1
November	60	66	62	2	-4
December	67	66	65	-2	-1
January	76	75	73	-3	-2
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	59	-10	-6
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
Shading indicates a difference of 10% or greater in flow proportion.					

22

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-60 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA
4 baseline, the alternative could substantially reduce migration conditions, contrary to the NEPA
5 conclusion set forth above, which is directly related to the inclusion of climate change effects in
6 Alternative 7.

7 Flows in the Feather River would be lower during substantial portions of the juvenile and adult
8 migration periods, elevating water temperatures and reducing olfactory cues, although the
9 importance of olfactory cues is thought to be low with low certainty. There are no effects in other
10 upstream rivers or on through-Delta migration conditions.

11 These results are primarily caused by four factors: differences in sea level rise, differences in climate
12 change, future water demands, and implementation of the alternative. The analysis described above
13 comparing Existing Conditions to the alternative does not partition the effect of implementation of
14 the alternative from those of sea level rise, climate change and future water demands using the
15 model simulation results presented in this chapter. However, the increment of change attributable
16 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
17 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
18 implementation period, which does include future sea level rise, climate change, and water
19 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
20 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
21 effect of the alternative from those of sea level rise, climate change, and water demands.

22 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
23 Conditions in the late long-term implementation period and the alternative indicates that flows and
24 reservoir storage in the locations and during the months analyzed above would generally be similar
25 between Existing Conditions and the alternative. This indicates that the differences between
26 Existing Conditions and the alternative found above would generally be due to climate change, sea
27 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
28 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
29 conclusion, and therefore would not in itself result in a significant impact on migration habitat
30 conditions for spring-run Chinook salmon. This impact is found to be less than significant and no
31 mitigation is required.

32 **Restoration Measures (CM2, CM4–CM7, and CM10)**

33 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**
34 **(Spring-Run ESU)**

35 The effects on construction of restoration measures on spring-run Chinook would be identical to
36 those on winter-run Chinook; please refer to the discussion of Impact AQUA-43 above.

37 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**
38 **Salmon (Spring-Run ESU)**

39 The effects of contaminants associated with restoration measures would be the same for all four
40 ESUs. Accordingly, please refer to the discussion of Impact AQUA-44 for winter-run Chinook salmon.

1 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

2 The overall effects of construction of restored habitat conditions would be the same for all four
3 ESUs. Accordingly, please refer to the discussion of Impact AQUA-45 for winter-run Chinook salmon.
4 Under Alternative 7 more restored floodplain habitat may occur in the south Delta. If it does, there
5 would be additional benefits expected for spring-run, fall-run, and late-fall run Chinook salmon since
6 they occupy these areas while winter-run Chinook salmon do not.

7 **Other Conservation Measures (CM12–CM19 and CM21)**

8 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**
9 **ESU) (CM12)**

10 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
11 **(Spring-Run ESU) (CM13)**

12 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**
13 **Run ESU) (CM14)**

14 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
15 **(Spring-Run ESU) (CM15)**

16 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**
17 **(CM16)**

18 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**
19 **(CM17)**

20 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**
21 **(CM18)**

22 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**
23 **ESU) (CM19)**

24 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
25 **(Spring-Run ESU) (CM21)**

26 *NEPA Effects:* Detailed discussions regarding the potential effects of these impact mechanisms on
27 spring-run Chinook salmon are the same as those described under Alternative 1A (Impact AQUA-64
28 through 72). The effects range from no effect, to not adverse, to beneficial.

29 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
30 less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-64
31 through 72), and no mitigation is required.

1 **Fall-/Late Fall–Run Chinook Salmon**

2 **Construction and Maintenance of CM1**

3 The construction- and maintenance-related effects of Alternative 7 would be identical for all four
4 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the
5 discussion of these effects for winter-run Chinook.

6 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 7 **(Fall-/Late Fall–Run ESU)**

8 The potential effects of construction of the water conveyance facilities on fall-run/late fall-run
9 Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-73) except
10 that Alternative 7 would include three intakes compared to five intakes under Alternative 1A, so the
11 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
12 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
13 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
14 shoreline and would require 27.3 acres of dredging.

15 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-73, environmental commitments and
16 mitigation measures would be available to avoid and minimize potential effects, and the effect would
17 not be adverse for fall-run/late fall-run Chinook salmon.

18 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-37, the impact of the construction of
19 water conveyance facilities on Chinook salmon would be less than significant except for
20 construction noise associated with pile driving. Potential pile driving impacts would be less than
21 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
22 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
23 less than significant.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

30 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 31 **(Fall-/Late Fall–Run ESU)**

32 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
33 the same as those described for Alternative 1A (see Impact AQUA-38), except that only three intakes
34 would need to be maintained under Alternative 7 rather than five under Alternative 1A.

35 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for
36 Chinook salmon.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance
2 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
3 would be required.

4 **Water Operations of CM1**

5 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late** 6 **Fall-Run ESU)**

7 ***Water Exports from SWP/CVP South Delta Facilities***

8 Alternative 7 would substantially reduce overall entrainment of juvenile fall-run/late fall-run
9 Chinook salmon at the south Delta export facilities. Under Alternative 7, juvenile fall-run Chinook
10 salmon, estimated as salvage density, would be reduced by 92% (~51,000 fish reduction) (Table 11-
11 7-33) and juvenile late fall-run Chinook would be reduced by 88-89% (~1,600-1,800 fish
12 reduction) (Table 11-7-34) across all years compared to NAA. As discussed for Alternative 1A
13 (Impact AQUA-39 for fall-run and late fall-run Chinook salmon), entrainment for fall-run Chinook
14 salmon is highest in wet years and lowest in below normal water years (Table 11-7-33) while
15 entrainment for late fall-run Chinook salmon is greatest in wet years and one to two orders of
16 magnitude less in other water year types (Table 11-7-34). Pre-screen losses, typically attributed to
17 predation, would be expected to decrease commensurate with decreased entrainment at the south
18 Delta facilities.

19 The proportion of the annual juvenile fall-run and late fall-run Chinook populations (assumed to be
20 23 million fall-run juveniles and 1 million late fall-run juveniles) entrained at the south Delta
21 facilities is very low (<0.6%) under NAA for all water year types, and decreased to negligible levels
22 under Alternative 7.

23 ***Water Exports from SWP/CVP North Delta Intake Facilities***

24 The effects and conclusion are the same as for Impact AQUA-39 for winter-run Chinook salmon.
25 Potential entrainment of juvenile salmonids at the north Delta intakes would be greater than
26 baseline, but the effects would be minimal because the north Delta intakes would have state-of-the-
27 art screens to exclude juvenile fish.

28 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

29 The effects and conclusion are the same as for Impact AQUA-39 for winter-run Chinook salmon.
30 Potential entrainment and impingement effects would be minimal because intakes would have state-
31 of-the-art screens installed.

32 In conclusion, Alternative 7 would significantly reduce the total number of juvenile Chinook salmon
33 of all races entrained at the south Delta facilities relative to Existing Conditions. Entrainment of
34 Chinook salmon at the proposed SWP/CVP north Delta intakes and the alternate NBA intake would
35 not be expected to occur due to the state-of-the-art fish screens; there would be a potential for
36 impingement, but this risk would be minimal for these relatively large fish due to the design and
37 operation of the facilities. Overall, effects would be beneficial because entrainment would be
38 substantially reduced. This effect is not adverse and would provide a modest benefit to the species.

1 **Table 11-7-33. Juvenile Fall-Run Chinook Salmon Annual Entrainment Index^a at the**
 2 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Fall-Run Chinook Salmon		
Wet	-111,614 (-87%)	-111,791 (-87%)
Above Normal	-29,355 (-89%)	-29,829 (-89%)
Below Normal	-12,068 (-89%)	-12,428 (-89%)
Dry	-19,616 (-100%)	-21,264 (-100%)
Critical	-40,890 (-100%)	-35,712 (-100%)
All Years	-50,579 (-92%)	-50,635 (-92%)

^a Estimated annual number of fish lost, based on normalized data.

3
 4 **Table 11-7-34. Juvenile Late Fall–Run Chinook Salmon Annual Entrainment Index^a at the**
 5 **SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 7**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Late Fall–Run Chinook Salmon		
Wet	-4,739 (-79%)	-4,652 (-79%)
Above Normal	-506 (-88%)	-492 (-88%)
Below Normal	-51 (-91%)	-47 (-90%)
Dry	-136 (-99%)	-120 (-99%)
Critical	-164 (-100%)	-151 (-100%)
All Years	-1,717 (-89%)	-1,636 (-88%)

^a Estimated annual number of fish lost, based on normalized data.

6
 7 **NEPA Effects:** The overall effects on entrainment and entrainment-related predation would not be
 8 adverse.

9 **CEQA Conclusion:** As described above (Tables 11-7-33 and 11-7-34), overall entrainment losses of
 10 juvenile fall-run and late fall–run Chinook salmon at the south Delta facilities across all water years
 11 would decrease under Alternative 7 compared to Existing Conditions. Overall, impacts of water
 12 operations on entrainment of juvenile Chinook salmon (fall- and late fall–run ESU) would be
 13 beneficial due to a reduction in entrainment and no mitigation would be required.

14 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
 15 **Chinook Salmon (Fall-/Late Fall–Run ESU)**

16 In general, Alternative 7 would have negligible effects on the quantity and quality of spawning and
 17 egg incubation habitat for fall-/late fall–run Chinook salmon relative to NAA.

1 **Sacramento River**

2 *Fall-Run*

3 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-
4 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
5 *utilized in the Fish Analysis*). Flows under A7_LLTP would generally be greater than or similar to NAA
6 during October, December, and January, and generally lower than under NAA by up to 14% during
7 November depending on water year type.

8 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning
9 and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir
10 storage would be similar to or greater than storage under NAA in all water year types (Table 11-7-
11 19).

12 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
13 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
14 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
15 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
16 between NAA and Alternative 7 in any month or water year type throughout the period.

17 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
18 increments was determined for each month during October through April and year of the 82-year
19 modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F
20 threshold were further assigned a “level of concern”, as defined in Table 11-7-11. Differences
21 between baselines and Alternative 7 in the highest level of concern across all months and all 82
22 modeled years are presented in Table 11-7-20. There would be 0 (0%) and 2 (20%) fewer years
23 with a “red” and “yellow” level of concern, respectively, under Alternative 7. The level of concern in
24 these years would be reduced to an “orange” level (from “red”) or no (from “yellow”) level.

25 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
26 October through April. Total degree-days under Alternative 7 would be 3% higher than those under
27 NAA during October, 9% higher during November, 12% higher during March, 6% higher during
28 April, and similar during remaining months (Table 11-7-21).

29 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
30 Sacramento River under A7_LLTP would be lower than or similar to mortality under NAA in all water
31 year types including below normal years (10% greater relative to NAA, but absolute increase of 2%
32 of fall-run population) (Table 11-7-35). These results indicate that Alternative 7 would have
33 negligible effects on fall-run Chinook salmon egg mortality.

1 **Table 11-7-35. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
2 **Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	11 (108%)	1 (5%)
Above Normal	11 (102%)	0 (0%)
Below Normal	13 (125%)	2 (10%)
Dry	16 (113%)	0 (-1%)
Critical	9 (32%)	0 (0%)
All	12 (88%)	1 (2%)

3
4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
5 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix
6 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
7 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
8 between NAA and Alternative 7 in any month or water year type throughout the period.

9 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
10 increments was determined for each month during October through April and year of the 82-year
11 modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F
12 threshold were further assigned a “level of concern”, as defined in Table 11-7-11. Differences
13 between baselines and Alternative 7 in the highest level of concern across all months and all 82
14 modeled years are presented in Table 11-7-20. There would be 0 (0%) and 2 (20%) fewer years
15 with a “red” and “yellow” level of concern, respectively, under Alternative 7. The level of concern in
16 these years would be reduced to an “orange” level (from “red”) or no (from “yellow”) level.

17 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
18 October through April. Total degree-days under Alternative 7 would be 3% higher than those under
19 NAA during October, 9% higher during November, 12% higher during March, 6% higher during
20 April, and similar during remaining months (Table 11-7-21).

21 SacEFT predicts that there would be a 49% increase (17% on absolute scale) in the percentage of
22 years with good spawning availability for fall-run Chinook salmon, measured as weighted usable
23 area, under A7_LLT relative to NAA (Table 11-7-36). SacEFT predicts that there would be a 12%
24 reduction (8% on absolute scale) in the percentage of years with good (lower) redd scour risk
25 under A7_LLT relative to NAA. SacEFT predicts that there would be a 6% reduction (4% on absolute
26 scale) in the percentage of years with good (lower) egg incubation conditions under A7_LLT relative
27 to NAA. SacEFT predicts that there would be a 11% reduction (3% on absolute scale) in the
28 percentage of years with good (lower) redd dewatering risk under A7_LLT relative to NAA.

1 **Table 11-7-36. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
2 **for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spawning WUA	4 (8%)	17 (49%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-29 (-31%)	-4 (-6%)
Redd Dewatering Risk	-3 (-11%)	-3 (-11%)
Juvenile Rearing WUA	5 (15%)	-2 (-5%)
Juvenile Stranding Risk	-13 (-42%)	-2 (-10%)

WUA = Weighted Usable Area.

3

4 *Late Fall–Run*

5 Sacramento River flows upstream of Red Bluff were examined for the February through May late
6 fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model*
7 *Results utilized in the Fish Analysis*). Flows under A7_LLT would be greater than or similar to flows
8 under NAA throughout the period.

9 Shasta Reservoir storage at the end of September would affect flows during the late fall–run
10 spawning and egg incubation period. As reported in Impact AQUA-58 under Alternative 1A for
11 spring–run Chinook, end of September Shasta Reservoir storage would be similar to or greater than
12 storage under NAA in all water year types (Table 11-7-19).

13 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
14 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix
15 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
16 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
17 between NAA and Alternative 7 in any month or water year type throughout the period.

18 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
19 increments was determined for each month during October through April and year of the 82-year
20 modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F
21 threshold were further assigned a “level of concern”, as defined in Table 11-7-11. Differences
22 between baselines and Alternative 7 in the highest level of concern across all months and all 82
23 modeled years are presented in Table 11-7-20. There would be 0 (0%) and 2 (20%) fewer years
24 with a “red” and “yellow” level of concern, respectively, under Alternative 7. The level of concern in
25 these years would be reduced to an “orange” level (from “red”) or no (from “yellow”) level.

26 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
27 October through April. Total degree-days under Alternative 7 would be 3% higher than those under
28 NAA during October, 9% higher during November, 12% higher during March, 6% higher during
29 April, and similar during remaining months (Table 11-7-21).

30 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the
31 Sacramento River under A7_LLT would be similar to mortality under NAA in all water years,
32 including below normal water years in which, although there would be an 19% relative increase, the
33 absolute increase would be 1% of the late fall–run population (Table 11-7-37).

1 **Table 11-7-37. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook**
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	4 (194%)	0 (-5%)
Above Normal	4 (160%)	-1 (-9%)
Below Normal	5 (342%)	1 (19%)
Dry	5 (199%)	0 (6%)
Critical	3 (145%)	0 (0%)
All	4 (201%)	0 (2%)

3
4 SacEFT predicts negligible differences between NAA and A7_LLT in the percentage of years with
5 good spawning availability, redd scour risk, egg incubation conditions, and redd dewatering risk for
6 late fall–run Chinook salmon, (Table 11-7-38).

7 **Table 11-7-38. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
8 **for Late Fall–Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spawning WUA	-6 (-12%)	-2 (-4%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	-2 (-2%)	-2 (-2%)
Redd Dewatering Risk	-3 (-5%)	2 (4%)
Juvenile Rearing WUA	6 (13%)	-12 (-19%)
Juvenile Stranding Risk	-35 (-49%)	-9 (-20%)

9 WUA = Weighted Usable Area.

10 **Clear Creek**

11 No water temperature modeling was conducted in Clear Creek.

12 **Fall-Run**

13 Clear Creek flows below Whiskeytown Reservoir were examined for the September through
14 February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would be similar to or greater than
16 flows under NAA_LLT throughout the period.

17 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
18 flow reduction each month over the incubation period compared to the flow in September when
19 spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during
20 September through February under A7_LLT would be similar to or lower magnitude than the
21 reduction under NAA for all water year types (Table 11-7-39).

1 **Table 11-7-39. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
 2 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
 3 **February Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-3 (-4%)	31 (31%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

4

5 **Feather River**

6 *Fall-Run*

7 Flows in the Feather River in the low-flow and high-flow channels were examined for the October
 8 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,
 9 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A7_LLT
 10 would be identical to those under NAA. Flows in the high-flow channel under A7_LLT would
 11 generally be similar to or greater than those under NAA during October, November, and January, but
 12 would be up to 27% lower than flows under NAA during December.

13 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
 14 comparing the magnitude of flow reduction each month over the incubation period compared to the
 15 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during
 16 November through January were identical between A7_LLT and NAA (Appendix 11C, *CALSIM II*
 17 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 7 on
 18 redd dewatering in the Feather River low-flow channel.

19 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow
 20 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October
 21 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,
 22 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
 23 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
 24 NAA and Alternative 7 in any month or water year type throughout the period at either location.

25 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley
 26 was evaluated during October through April (Table 11-7-40). The percent of months exceeding the
 27 threshold under Alternative 7 would similar to or up to 19% lower (absolute scale) than the percent
 28 under NAA.

1 **Table 11-7-40. Differences between Baseline and Alternative 7 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
 3 **River at Gridley Exceed the 56°F Threshold, October through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LL1					
October	2 (3%)	14 (16%)	21 (29%)	44 (109%)	51 (273%)
November	42 (1,133%)	27 (2,200%)	14 (NA)	7 (NA)	4 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	28 (383%)	20 (533%)	7 (600%)	6 (NA)	2 (NA)
April	12 (18%)	17 (30%)	37 (120%)	35 (200%)	23 (211%)
NAA vs. A7_LL1					
October	0 (0%)	0 (0%)	-2 (-3%)	-4 (-4%)	-9 (-11%)
November	-16 (-26%)	-12 (-30%)	-19 (-58%)	-11 (-60%)	-2 (-40%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-9 (-19%)	-5 (-17%)	-2 (-22%)	-1 (-17%)	-1 (-33%)
April	-7 (-8%)	-6 (-8%)	-5 (-7%)	-7 (-13%)	-4 (-10%)

NA = could not be calculated because the denominator was 0.

4

5 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during
 6 October through April (Table 11-7-41). Total degree-months would be similar between NAA and
 7 Alternative 7 for all months except October, November, and March, in which degree-months would
 8 be 6% to 100% lower under Alternative 7.

1 **Table 11-7-41. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the Feather River at Gridley, October through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLTT	NAA vs. A7_LLTT
October	Wet	84 (115%)	-18 (-10%)
	Above Normal	34 (77%)	-2 (-3%)
	Below Normal	41 (75%)	-8 (-8%)
	Dry	65 (123%)	-6 (-5%)
	Critical	44 (107%)	0 (0%)
	All	269 (101%)	-33 (-6%)
November	Wet	26 (NA)	-11 (-30%)
	Above Normal	18 (900%)	-1 (-5%)
	Below Normal	16 (1,600%)	-5 (-23%)
	Dry	18 (NA)	-13 (-42%)
	Critical	19 (1,900%)	1 (5%)
	All	96 (2,400%)	-30 (-23%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	-2 (-100%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	-2 (-100%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	0 (0%)
	Dry	1 (NA)	1 (NA)
	Critical	2 (NA)	0 (0%)
	All	3 (NA)	0 (0%)
March	Wet	6 (NA)	1 (20%)
	Above Normal	3 (300%)	1 (33%)
	Below Normal	19 (1,900%)	-2 (-9%)
	Dry	25 (625%)	2 (7%)
	Critical	17 (425%)	0 (0%)
	All	70 (700%)	2 (3%)
April	Wet	38 (271%)	0 (0%)
	Above Normal	25 (109%)	-2 (-4%)
	Below Normal	27 (68%)	2 (3%)
	Dry	44 (90%)	3 (3%)
	Critical	30 (103%)	-1 (-2%)
	All	164 (106%)	2 (1%)

NA = could not be calculated because the denominator was 0.

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
2 Feather River under A7_LLTP would be similar to or lower than mortality under NAA in all water
3 years (Table 11-7-42).

4 **Table 11-7-42. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
5 **Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A7_LLTP	NAA vs. A7_LLTP
Wet	15 (1,041%)	-5 (-23%)
Above Normal	9 (769%)	-4 (-27%)
Below Normal	8 (445%)	-5 (-35%)
Dry	11 (478%)	-8 (-39%)
Critical	20 (411%)	-3 (-12%)
All	13 (590%)	-5 (-26%)

6

7 **American River**

8 *Fall-Run*

9 Flows in the American River at the confluence with the Sacramento River were examined during the
10 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTP would generally be similar to or
12 greater than flows under NAA, except for above and below normal water years during October (13%
13 and 12% lower, respectively) and critical water years during November (6% lower).

14 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
15 during the October through January fall-run Chinook salmon spawning and egg incubation period
16 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
17 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
18 temperature between NAA and Alternative 7 in any month or water year type throughout the
19 period.

20 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
21 Avenue Bridge was evaluated during November through April (Table 11-7-43). The percent of
22 months exceeding the threshold under Alternative 7 would similar to or up to 60% lower (absolute
23 scale) than the percent under NAA.

1 **Table 11-7-43. Differences between Baseline and Alternative 7 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**
 3 **River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LL1					
November	0 (0%)	1 (5%)	0 (0%)	5 (200%)	2 (200%)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	23 (190%)	16 (217%)	6 (250%)	5 (400%)	2 (NA)
April	12 (18%)	12 (20%)	22 (49%)	20 (62%)	7 (27%)
NAA vs. A7_LL1					
November	-47 (-51%)	-57 (-67%)	-60 (-82%)	-49 (-87%)	-37 (-91%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-2 (-67%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
March	-14 (-28%)	-9 (-27%)	-7 (-46%)	-6 (-50%)	-2 (-50%)
April	-14 (-14%)	-19 (-20%)	-12 (-15%)	-20 (-28%)	-22 (-39%)
NA = could not be calculated because the denominator was 0.					

4
 5 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
 6 Avenue Bridge during November through April (Table 11-7-44). Total degree-months would be
 7 similar between NAA and Alternative 7 for all months.

1 **Table 11-7-44. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the American River at the Watt Avenue Bridge, November through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
November	Wet	78 (312%)	-4 (-4%)
	Above Normal	34 (309%)	-2 (-4%)
	Below Normal	42 (525%)	-1 (-2%)
	Dry	48 (369%)	-3 (-5%)
	Critical	33 (206%)	-5 (-9%)
	All	235 (322%)	-15 (-5%)
December	Wet	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	3 (NA)	1 (50%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	4 (NA)	0 (0%)
	All	4 (NA)	0 (0%)
March	Wet	10 (500%)	-2 (-14%)
	Above Normal	9 (NA)	0 (0%)
	Below Normal	11 (367%)	0 (0%)
	Dry	23 (575%)	-2 (-7%)
	Critical	22 (220%)	2 (7%)
	All	74 (389%)	-3 (-3%)
April	Wet	57 (204%)	-1 (-1%)
	Above Normal	33 (150%)	-1 (-2%)
	Below Normal	40 (111%)	-1 (-1%)
	Dry	47 (62%)	2 (2%)
	Critical	37 (63%)	2 (2%)
	All	214 (97%)	1 (0.2%)

NA = could not be calculated because the denominator was 0.

4
 5 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
 6 comparing the magnitude of flow reduction each month over the incubation period compared to the
 7 flow in October when spawning is assumed to occur. The greatest reduction under A7_LLТ would be
 8 similar to or lower magnitude than under NAA in all months except critical years, in which the

1 greatest reduction under A7_LLT would be 35% greater magnitude than that under NAA (Table 11-
2 7-45).

3 **Table 11-7-45. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
4 **in Instream Flow in the American River at Nimbus Dam during the October through January**
5 **Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-14 (-64%)	11 (23%)
Above Normal	10 (33%)	20 (50%)
Below Normal	-29 (-151%)	-2 (-4%)
Dry	2 (5%)	0 (0%)
Critical	-2 (-5%)	-14 (-35%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

6

7 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
8 American River under A7_LLT would be similar to mortality under NAA in all water years (Table 11-
9 7-46).

10 **Table 11-7-46. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
11 **Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	24 (158%)	0 (1%)
Above Normal	22 (211%)	0 (-1%)
Below Normal	22 (178%)	0 (0%)
Dry	16 (96%)	-1 (-2%)
Critical	9 (45%)	0 (-1%)
All	19 (128%)	0 (-1%)

12

13 ***Stanislaus River***

14 *Fall-Run*

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
16 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
17 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally not differ from
18 flows under NAA.

19 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 7
20 throughout the October through January fall-run spawning and egg incubation period (Appendix
21 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
22 *the Fish Analysis*).

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
3 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
4 *utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to flows under NAA
5 throughout the period.

6 Water temperature modeling was not conducted in the San Joaquin River.

7 **Mokelumne River**

8 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
9 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
10 *utilized in the Fish Analysis*). Flows under Alternative 7 would be similar to flows under NAA
11 throughout the period.

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **NEPA Effects:** Collectively, it is concluded that the effect is not adverse because habitat conditions
14 are not substantially reduced. There are no reductions in reservoir storage volume or instream
15 flows or increases in temperatures under Alternative 7 that would translate into adverse biological
16 effects on fall-run Chinook salmon spawning and egg incubation habitat.

17 **CEQA Conclusion:** In general, under Alternative 7 water operations, the quantity and quality of
18 spawning and egg incubation habitat for fall-/late fall-run Chinook salmon would not be reduced
19 relative to the CEQA baseline.

20 **Sacramento River**

21 **Fall-Run**

22 Flows in the Sacramento River upstream of Red Bluff were examined during the October through
23 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
24 *Model Results utilized in the Fish Analysis*). Flows under A7_LL1T would generally be greater than or
25 similar to Existing Conditions during October, November, and January, except in dry years during
26 November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During December,
27 flows under A7_LL1T would be 3% to 6% lower than under Existing Conditions depending on water
28 year type.

29 Storage volume at the end of September would be 13% to 33% lower under A7_LL1T relative to
30 Existing Conditions (Table 11-7-19).

31 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
32 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
33 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
34 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
35 between Existing Conditions and Alternative 7 during the period, except during October, in which
36 temperatures would be 6% higher under Alternative 7.

37 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
38 increments was determined for each month during October through April and year of the 82-year
39 modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F

1 threshold were further assigned a “level of concern”, as defined in Table 11-7-11. Differences
2 between baselines and Alternative 7 in the highest level of concern across all months and all 82
3 modeled years are presented in Table 11-7-20. There would be 300% and 150% increases in the
4 number of years with “red” and “orange” levels of concern under Alternative 7 relative to Existing
5 Conditions.

6 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
7 October through April. Total degree-days under Alternative 7 would be 242% to 3,862% higher than
8 those under Existing Conditions during October, November, March, and April, and similar during
9 December through February (Table 11-7-21).

10 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
11 Sacramento River under A7_LLT would be 32% to 125% greater than mortality under Existing
12 Conditions (Table 11-7-35).

13 SacEFT predicts that there would be an 8% increase in the percentage of years with good spawning
14 availability, measured as weighted usable area, under A7_LLT relative to Existing Conditions (Table
15 11-7-36). SacEFT predicts that there would be a 5% reduction in the percentage of years with good
16 (lower) redd scour risk under A7_LLT relative to Existing Conditions. SacEFT predicts that there
17 would be a 31% decrease in the percentage of years with good (lower) egg incubation conditions
18 under A7_LLT relative to Existing Conditions. SacEFT predicts that there would be an 11% decrease
19 in the percentage of years with good (lower) redd dewatering risk under A7_LLT relative to Existing
20 Conditions.

21 *Late Fall–Run*

22 Flows in the Sacramento River upstream of Red Bluff were examined during the February through
23 May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
24 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be greater than or
25 similar to flows under Existing Conditions, except in wet years during May (18% lower), below
26 normal years during March (11% lower), April (9% lower), and May (11% lower), and dry years
27 during April (6% lower).

28 Shasta Reservoir storage volume at the end of September would be 13% to 33% lower under
29 A7_LLT relative to Existing Conditions (Table 11-7-19).

30 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
31 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix
32 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
33 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
34 between Existing Conditions and Alternative 7 in any month or water year type throughout the
35 period except for 5% higher during wet years in May.

36 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
37 increments was determined for each month during October through April and year of the 82-year
38 modeling period (Table 11-7-10). The combination of number of days and degrees above the 56°F
39 threshold were further assigned a “level of concern”, as defined in Table 11-7-11. Differences
40 between baselines and Alternative 7 in the highest level of concern across all months and all 82
41 modeled years are presented in Table 11-7-20. There would be 300% and 150% increases in the
42 number of years with “red” and “orange” levels of concern under Alternative 7 relative to Existing
43 Conditions.

1 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
2 October through April. Total degree-days under Alternative 7 would be 143% to 4,514% higher than
3 those under Existing Conditions during October, November, March, and April, and similar during
4 December through February (Table 11-7-21).

5 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the
6 Sacramento River under A7_LLT would be 145% to 342% greater than mortality under Existing
7 Conditions (Table 11-7-37). However, absolute differences in the percent of the late-fall population
8 subject to mortality would be minimal in all but below normal and dry years, in which there is a 5%
9 increase

10 SacEFT predicts that there would be a 12% decrease in the percentage of years with good spawning
11 availability for late fall-run Chinook salmon, measured as weighted usable area, under A7_LLT
12 relative to Existing Conditions (Table 11-7-38). SacEFT predicts that there would be a 7% decrease
13 in the percentage of years with good (lower) redd scour risk under A7_LLT relative to Existing
14 Conditions. SacEFT predicts that there would be a 2% reduction in the percentage of years with
15 good (lower) egg incubation conditions under A7_LLT relative to Existing Conditions. SacEFT
16 predicts that there would be a 5% decrease in the percentage of years with good (lower) redd
17 dewatering risk under A7_LLT relative to Existing Conditions.

18 **Clear Creek**

19 No water temperature modeling was conducted in Clear Creek.

20 *Fall-Run*

21 Flows in Clear Creek below Whiskeytown Reservoir were reviewed during the September through
22 February fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
23 *utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows
24 under Existing Conditions, except in below normal water years during October (6% lower).

25 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
26 flow reduction each month over the incubation period compared to the flow in September when
27 spawning occurred. The greatest monthly reduction in Clear Creek flows during September through
28 February under A7_LLT would be similar to or lower magnitude than those under Existing
29 Conditions in wet below normal, and critical water years, but the reduction would be 27% and 67%
30 greater (absolute, not relative, differences) under A7_LLT in above normal and dry water years,
31 respectively (Table 11-7-39).

32 **Feather River**

33 *Fall-Run*

34 Flows in the Feather River in the low-flow and high-flow channels were examined for the October
35 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,
36 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel A7_LLT would be
37 identical to those under Existing Conditions. Flows in the high-flow channel under A7_LLT would be
38 similar to or greater than flows under Existing Conditions during October. During November
39 through January, flows would generally be lower by up to 43% than flows under Existing Conditions.

1 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
2 comparing the magnitude of flow reduction each month over the incubation period compared to the
3 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were
4 identical between A7_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in*
5 *the Fish Analysis*). Therefore, there would be no effect of Alternative 7 on redd dewatering in the
6 Feather River low-flow channel.

7 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
8 Feather River under A7_LLT would be 411% to 1,041% greater than mortality under Existing
9 Conditions (Table 11-7-42).

10 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow
11 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October
12 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
14 *Fish Analysis*). Mean monthly water temperatures would be under Alternative 7 relative to Existing
15 Conditions by 5% to 10% higher in the low-flow channel and 5% to 8% higher in the high-flow
16 channel depending on month.

17 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley
18 was evaluated during October through April (Table 11-7-40). The percent of months exceeding the
19 threshold under Alternative 7 would be similar to or up to 51% higher (absolute scale) than the
20 percent under Existing Conditions during all months except December through February, during
21 which there would be no difference in the percent of months exceeding the threshold.

22 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during
23 October through April (Table 11-7-41). Total degree-months under Alternative 7 would be 101% to
24 2,400% higher than total degree-months under Existing Conditions, except during December
25 through February, in which there would be no difference between Existing Conditions and
26 Alternative 7 in total degree-months exceeding the 56°F threshold.

27 **American River**

28 *Fall-Run*

29 Flows in the American River at the confluence with the Sacramento River were examined during the
30 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
31 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be lower by up to
32 31% than flows under NAA during November through January.

33 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
34 during the October through January fall-run Chinook salmon spawning and egg incubation period
35 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
36 *utilized in the Fish Analysis*). Mean monthly temperatures under Alternative 7 would be 5% to 13%
37 greater than those under Existing Conditions depending on month.

38 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
39 Avenue Bridge was evaluated during November through April (Table 11-7-43). The percent of
40 months exceeding the threshold under Alternative 7 would be up to 23% greater (absolute scale)
41 than the percent under Existing Conditions during November, March, and April and similar to the
42 percent under Existing Conditions during December through February.

1 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
2 Avenue Bridge during November through April (Table 11-7-44). Total degree-months under
3 Alternative 7 would be 97% to 389% greater than total degree-months under Existing Conditions
4 during November, March and April and similar to total degree months under Existing Conditions
5 during December through February.

6 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
7 comparing the magnitude of flow reduction each month over the incubation period compared to the
8 flow in October when spawning is assumed to occur. The greatest monthly reduction in American
9 River flows under A7_LLT during November through January would be lower magnitude than or
10 similar to that under Existing Conditions in above normal, dry, and critical water years, but 64% and
11 151% greater magnitude under A7_LLT in wet and below normal years, respectively (Table 11-7-
12 45).

13 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
14 American River under A7_LLT would be 45% to 211% greater than mortality under Existing
15 Conditions (Table 11-7-46).

16 **Stanislaus River**

17 *Fall-Run*

18 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
19 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
20 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be lower than flows
21 under Existing Conditions in all months and water year types by up to 18%.

22 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were
23 examined during the October through January fall-run spawning and egg incubation period
24 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
25 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would not be
26 different from those under Existing Conditions during October except in wet and critical years, but
27 5% to 7% higher during November through January.

28 **San Joaquin River**

29 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
30 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
31 *utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be similar to those
32 under Existing Conditions throughout the period.

33 Water temperature modeling was not conducted in the San Joaquin River.

34 **Mokelumne River**

35 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
36 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
37 *utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be similar to those
38 under Existing Conditions during October and December, 10% lower during November, and 14%
39 higher during January.

40 Water temperature modeling was not conducted in the Mokelumne River.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce the amount of suitable habitat of fish. There would be flow
5 reductions in the Sacramento, Feather, American, and Stanislaus Rivers that would affect the fall-
6 /late fall-run ESU, contrary to the NEPA conclusion set forth above. Further, the Reclamation egg
7 mortality model and SacEFT predict moderate to substantial negative effects of Alternative 7.

8 These results are primarily caused by four factors: differences in sea level rise, differences in climate
9 change, future water demands, and implementation of the alternative. The analysis described above
10 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
11 alternative from those of sea level rise, climate change and future water demands using the model
12 simulation results presented in this chapter. However, the increment of change attributable to the
13 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
14 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
15 implementation period, which does include future sea level rise, climate change, and water
16 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
17 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
18 effect of the alternative from those of sea level rise, climate change, and water demands.

19 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
20 term implementation period and Alternative 7 indicates that flows in the locations and during the
21 months analyzed above would generally be similar between Existing Conditions during the LLT and
22 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
23 found above would generally be due to climate change, sea level rise, and future demand, and not
24 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
25 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
26 result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact
27 is found to be less than significant and no mitigation is required.

28 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon** 29 **(Fall-/Late Fall-Run ESU)**

30 In general, Alternative 7 would reduce the quantity and quality of larval and juvenile rearing habitat
31 for fall-/late fall-run Chinook salmon relative to NAA.

32 ***Sacramento River***

33 *Fall-Run*

34 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
35 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
36 *Analysis*). Flows under A7_LLТ would be greater than or similar to flows under NAA throughout the
37 period, except in dry and critical water years during January (9% to 11% lower, respectively).

38 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and
39 juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage
40 would be similar to or greater than storage under NAA in all water year types (Table 11-7-19).

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
2 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
3 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
4 There would be no differences (<5%) in mean monthly water temperature between NAA and
5 Alternative 7 in any month or water year type throughout the period.

6 SacEFT predicts that there would be a 5% decrease in the percentage of years with good juvenile
7 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A7_LLT
8 relative to NAA (Table 11-7-36). SacEFT predicts that there would be a 10% increase in the
9 percentage of years with “good” (lower) juvenile stranding risk under A7_LLT relative to NAA.

10 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A7_LLT would be
11 similar to mortality under NAA.

12 *Late Fall-Run*

13 Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon
14 juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*
15 *Fish Analysis*). Flows during this period under A7_LLT were generally similar to or greater than
16 those under NAA.

17 Shasta Reservoir storage at the end of September and May would affect flows during the late fall–
18 run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta
19 Reservoir storage would be similar to or greater than storage under NAA in all water year types
20 (Table 11-7-19).

21 As reported in Impact AQUA-40 for winter-run Chinook salmon, Shasta storage at the end of May
22 under A7_LLT would be similar to or greater than storage under NAA for all water year types (Table
23 11-7-9).

24 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
25 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
26 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
27 There would be no differences (<5%) in mean monthly water temperature between NAA and
28 Alternative 7 in any month or water year type throughout the period.

29 SacEFT predicts that there would be a 19% decrease in the percentage of years with good juvenile
30 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under
31 A7_LLT relative to NAA (Table 11-7-38). Further, SacEFT predicts that there would be a 20%
32 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A7_LLT
33 relative to NAA.

34 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A7_LLT would
35 be similar to mortality under NAA.

36 **Clear Creek**

37 No water temperature modeling was conducted in Clear Creek.

1 *Fall-Run*

2 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-
3 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A7_LL T would generally be similar to or greater than flows under NAA,
5 except in below normal years during March (6% reduction).

6 ***Feather River***

7 *Fall-Run*

8 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
9 channel) during December through June were reviewed to determine flow-related effects on larval
10 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
11 *Analysis*). Relatively constant flows in the low-flow channel throughout this period under A7_LL T
12 would not differ from those under NAA. In the high-flow channel, flows under A7_LL T would be
13 mostly lower (up to 27%) during December and generally similar to or greater than flows under
14 NAA from January through June.

15 As reported in Impact AQUA-59, May Oroville storage under A7_LL T would be similar to or greater
16 than storage under NAA (Table 11-7-28).

17 As reported in Impact AQUA-58, September Oroville storage volume under A7_LL T would be greater
18 than storage under NAA in all water year types (Table 11-7-25).

19 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
20 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run
21 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*
22 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences
23 (<5%) in mean monthly water temperature between NAA and Alternative 7 in any month or water
24 year type throughout the period at either location.

25 ***American River***

26 *Fall-Run*

27 Flows in the American River at the confluence with the Sacramento River were examined for the
28 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
29 *Results utilized in the Fish Analysis*). Flows under A7_LL T would generally be similar to or greater
30 than flows under NAA, except in dry years during March and April (6% and 15%, respectively) and
31 in critical years during February through March (7% to 17% lower).

32 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
33 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,
34 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
35 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
36 NAA and Alternative 7 in any month or water year type throughout the period.

1 **Stanislaus River**

2 *Fall-Run*

3 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
4 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
5 *Results utilized in the Fish Analysis*). Flows under A7_LLTP would be similar to flows under NAA
6 throughout the period, regardless of water year type.

7 Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA
8 and Alternative 7 throughout the January through May fall-run rearing period (Appendix 11D,
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
10 *Fish Analysis*).

11 **San Joaquin River**

12 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run
13 larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
14 *Analysis*). Flows under A7_LLTP would be similar to flows under NAA throughout the period,
15 regardless of water year type.

16 Water temperature modeling was not conducted in the San Joaquin River.

17 **Mokelumne River**

18 Flows in the Mokelumne River at the Delta were examined for the January through May fall-run
19 larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
20 *Analysis*). Flows under A7_LLTP would be similar to flows under NAA throughout the period,
21 regardless of water year type.

22 Water temperature modeling was not conducted in the Mokelumne River.

23 **NEPA Effects:** Taken together, these results indicate that the effect is adverse because it has the
24 potential to substantially reduce the amount of suitable habitat of fish. Late fall-run Chinook salmon
25 in the Sacramento River under Alternative 7 experience small to moderate reductions relative to the
26 NEPA point of comparison during September and November in most water year types. These
27 reductions in flows would reduce the quantity and quality of larval and juvenile rearing habitat
28 under Alternative 7. SacEFT results corroborate this effect by predicting that there would be a 19%
29 reduction in years with good juvenile rearing habitat availability and a 20% reduction in years with
30 good juvenile stranding risk for late fall-run Chinook salmon. Despite small or intermittent flow
31 reductions, there are no effects of Alternative 7 on late-fall-run in other waterways or on fall-run in
32 any waterways examined that would rise to the level of adverse. This effect is a result of the specific
33 reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g.,
34 changing reservoir operations in order to alter the flows) to the extent necessary to reduce this
35 effect to a level that is not adverse would fundamentally change the alternative, thereby making it a
36 different alternative than that which has been modeled and analyzed. As a result, this would be an
37 unavoidable adverse effect because there is no feasible mitigation available. Even so, proposed
38 mitigation (Mitigation Measure AQUA-77a through AQUA-77c) has the potential to reduce the
39 severity of impact, although not necessarily to a not adverse level.

40 **CEQA Conclusion:** In general, Alternative 7 would reduce the quantity and quality of larval and
41 juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to CEQA Existing Conditions.

1 **Sacramento River**

2 *Fall-Run*

3 Flow Sacramento River flows upstream of Red Bluff were examined for the January through May
4 fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*
5 *the Fish Analysis*). Flows under A7_LLТ would generally be greater than or similar to flows under
6 Existing Conditions, except in wet years during May (18% lower), below normal years during March
7 through May (9% to 11% lower), and dry years during April (6% lower).

8 As reported in Impact AQUA-58 for spring-run Chinook salmon, end of September Shasta Reservoir
9 storage would be 13% to 33% lower under A7_LLТ relative to Existing Conditions depending on
10 water year type (Table 11-7-19).

11 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
12 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
13 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
14 There would be no differences (<5%) in mean monthly water temperature between Existing
15 Conditions and Alternative 7 in any month or water year type throughout the period.

16 SacEFT predicts that there would be an 15% increase in the percentage of years with good juvenile
17 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A7_LLТ
18 relative to Existing Conditions (Table 11-7-36). SacEFT predicts that there would be a 42%
19 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A7_LLТ
20 relative to Existing Conditions.

21 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A7_LLТ would be
22 11% lower than mortality under Existing Conditions.

23 *Late Fall-Run*

24 Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon
25 juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*
26 *Fish Analysis*). Flows under A7_LLТ during most months would generally be similar to or greater
27 than those under Existing Conditions.

28 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 13% to 33%
29 lower under A7_LLТ relative to Existing Conditions depending on water year type (Table 11-7-19).

30 As reported in Impact AQUA-40, end of May Shasta storage under A7_LLТ would be similar to
31 Existing Conditions in wet and above normal water years, but lower by 6% to 26% in below normal,
32 dry, and critical water years (Table 11-7-9).

33 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
34 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
35 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
36 There would be no differences (<5%) in mean monthly water temperature between Existing
37 Conditions and Alternative 7 in any month or water year type throughout the period except for wet
38 years during April and critical years during July.

39 SacEFT predicts that there would be an 13% increase in the percentage of years with good juvenile
40 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under

1 A7_LLT relative to Existing Conditions (Table 11-7-38). SacEFT predicts that there would be a 46%
2 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A7_LLT
3 relative to Existing Conditions.

4 SALMOD predicts that late fall-run smolt equivalent habitat-related mortality under A7_LLT would
5 be 8% higher than mortality under Existing Conditions.

6 **Clear Creek**

7 No temperature modeling was conducted in Clear Creek.

8 *Fall-Run*

9 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-
10 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
11 *Analysis*). Flows under A7_LLT would be similar to or greater than flows under Existing Conditions
12 for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 **Feather River**

14 *Fall-Run*

15 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
16 channel) during December through June were reviewed to determine flow-related effects on larval
17 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
18 *Analysis*). Relatively constant flows in the low-flow channel throughout the period under A7_LLT
19 would not differ from those under Existing Conditions. In the high-flow channel, flows under A7_LLT
20 would be mostly lower (up to 38%) during December and mostly similar to or greater than flows
21 under NAA during January through June with few exceptions during which flows would be up to
22 46% lower under A7_LLT.

23 As reported under Impact AQUA-59, May Oroville storage volume under A7_LLT would be similar to
24 storage under Existing Conditions, except in above normal and dry water years (5% and 9% lower,
25 respectively) (Table 11-7-28). Storage would not be different between Existing Conditions and
26 A7_LLT in other water year types.

27 As reported in Impact AQUA-58, September Oroville storage volume would be 9% to 31% lower
28 under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-25).

29 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
30 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run
31 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*
32 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean
33 monthly water temperatures under Alternative 7 would be 5% to 10% lower than those under
34 Existing Conditions during December through March, but not different from those under Existing
35 Conditions during April through June. In the high-flow channel, mean monthly water temperatures
36 under Alternative 7 would be 5% to 8% lower than those under Existing Conditions during
37 December through March, but not different from those under Existing Conditions during April
38 through June.

1 **American River**

2 *Fall-Run*

3 Flows in the American River at the confluence with the Sacramento River were examined for the
4 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
5 *Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater
6 than flows under Existing Conditions during March and April, except in critical years during
7 February (24% lower) and March (20% lower). Flows under A7_LLT would be mostly lower (by up
8 to 31%) than flows under Existing Conditions during January, April, and May.

9 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
10 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,
11 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
12 *Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 5% to 8% lower
13 than those under Existing Conditions in all months during the period. Stanislaus River

14 *Fall-Run*

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
16 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
17 *Results utilized in the Fish Analysis*). Flows under A7_LLT would be mostly lower than flows under
18 Existing Conditions by up to 36%. Mean monthly water temperatures in the Stanislaus River at the
19 confluence with the San Joaquin River were examined during the January through May fall-run
20 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*
21 *Model Results utilized in the Fish Analysis*). Mean monthly temperatures under Alternative 7 would
22 be 6% lower than those under Existing Conditions throughout the period.

23 **San Joaquin River**

24 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run
25 larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
26 *Analysis*). Mean monthly flows under A7_LLT would be similar to flows under Existing Conditions
27 throughout the period, regardless of water year type.

28 Water temperature modeling was not conducted in the San Joaquin River

29 **Mokelumne River**

30 Flows in the Mokelumne River at the Delta were examined for the January through May fall-run
31 larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
32 *Analysis*). Mean monthly flows under A7_LLT would be similar to flows under Existing Conditions
33 throughout the period, regardless of water year type.

34 Water temperature modeling was not conducted in the Mokelumne River.

35 Collectively, these results indicate that the impact would be significant because it has the potential
36 to substantially reduce the amount of suitable habitat of fish. Changes in Sacramento River flows
37 under Alternative 7 would substantially increase (42% to 46%) the risk of stranding for late fall-
38 and fall-run Chinook salmon relative to CEQA Existing Conditions. There are moderate flow
39 reductions in the Sacramento River that would negatively affect late fall-run rearing. Flows and
40 water temperatures in the American, Feather, and Stanislaus rivers would be negatively affected by

1 Alternative 7 during portions of the fall-run rearing period, reducing the habitat quantity and quality
2 for rearing fall-run. This impact is a result of the specific reservoir operations and resulting flows
3 associated with this alternative. Applying mitigation (e.g., changing reservoir operations in order to
4 alter the flows) to the extent necessary to reduce this impact to a less-than-significant level would
5 fundamentally change the alternative, thereby making it a different alternative than that which has
6 been modeled and analyzed. As a result, this impact is significant and unavoidable because there is
7 no feasible mitigation available. Even so, proposed below is mitigation that has the potential to
8 reduce the severity of impact though not necessarily to a less-than-significant level.

9 **Mitigation Measure AQUA-77a: Following Initial Operations of CM1, Conduct Additional**
10 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**
11 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

12 Although analysis conducted as part of the EIR/EIS determined that Alternative 7 would have
13 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the
14 best available scientific information at the time and may prove to have been overstated. Upon
15 the commencement of operations of CM1 and continuing through the life of the permit, the
16 BDCP proponents will monitor effects on rearing habitat in order to determine whether such
17 effects would be as extensive as concluded at the time of preparation of this document and to
18 determine any potentially feasible means of reducing the severity of such effects. This mitigation
19 measure requires a series of actions to accomplish these purposes, consistent with the
20 operational framework for Alternative 7.

21 The development and implementation of any mitigation actions shall be focused on those
22 incremental effects attributable to implementation of Alternative 7 operations only.
23 Development of mitigation actions for the incremental impact on spawning habitat attributable
24 to climate change/sea level rise are not required because these changed conditions would occur
25 with or without implementation of Alternative 7.

26 **Mitigation Measure AQUA-77b: Conduct Additional Evaluation and Modeling of Impacts**
27 **on Fall-/Late Fall-Run Chinook Salmon Rearing Habitat Following Initial Operations of**
28 **CM1**

29 Following commencement of initial operations of CM1 and continuing through the life of the
30 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
31 modified operations could reduce impacts to rearing habitat under Alternative 7. The analysis
32 required under this measure may be conducted as a part of the Adaptive Management and
33 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

34 **Mitigation Measure AQUA-77c: Consult with NMFS, USFWS, and CDFW to Identify and**
35 **Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook**
36 **Salmon Rearing Habitat Consistent with CM1**

37 In order to determine the feasibility of reducing the effects of CM1 operations on Chinook
38 salmon habitat, the BDCP proponents will consult with [NMFS/FWS] and the Department of Fish
39 and Wildlife to identify and implement any feasible operational means to minimize effects on
40 rearing habitat. Any such action will be developed in conjunction with the ongoing monitoring
41 and evaluation of habitat conditions required by Mitigation Measure AQUA-77a.

1 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall
2 operational framework of Alternative 7 without causing new significant adverse impacts on
3 other covered species, such means shall be implemented. If sufficient operational flexibility to
4 reduce effects on fall-run and late fall-run Chinook salmon habitat is not feasible under
5 Alternative 7 operations, achieving further impact reduction pursuant to this mitigation
6 measure would not be feasible under this Alternative, and the impact on fall-run and late fall-
7 run Chinook salmon would remain significant and unavoidable.

8 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon** 9 **(Fall-/Late Fall-Run ESU)**

10 In general, the effects of Alternative 7 on fall- and late fall-run Chinook salmon migration conditions
11 relative to the NAA are uncertain.

12 **Upstream of the Delta**

13 ***Sacramento River***

14 *Fall-Run*

15 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants
16 during February through May. Flows under A7_LLTP would be similar to or greater than flows under
17 NAA throughout the juvenile fall-run migration period in all water year types (Appendix 11C,
18 *CALSIM II Model Results utilized in the Fish Analysis*).

19 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
20 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,
21 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
22 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
23 NAA and Alternative 7 in any month or water year type throughout the period.

24 Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run
25 Chinook salmon upstream migration period (September through October). Flows under A7_LLTP
26 would generally be similar to or greater than those under NAA except during above normal years
27 during September (7% lower) and below normal years during September and October (18% and 6%
28 lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
30 September through October adult fall-run Chinook salmon upstream migration period (Appendix
31 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
32 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
33 between NAA and Alternative 7 in any month or water year type throughout the period.

34 *Late Fall-Run*

35 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January
36 through March) under A7_LLTP would generally be similar to or greater than flows under NAA except
37 in dry and critical water years during January (7% and 11% lower, respectively) (Appendix 11C,
38 *CALSIM II Model Results utilized in the Fish Analysis*).

1 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
2 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
5 NAA and Alternative 7 in any month or water year type throughout the period.

6 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon
7 upstream migration period (December through February) under A7_LLT would generally be similar
8 to or greater than flows under NAA except in above normal water years during December (5%
9 lower) and in dry and critical water years during January (7% and 11% lower, respectively)
10 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
12 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
15 NAA and Alternative 7 in any month or water year type throughout the period.

16 **Clear Creek**

17 Water temperature modeling was not conducted in Clear Creek.

18 *Fall-Run*

19 Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run
20 migrants during February through May. Flows under A7_LLT would generally be similar to or
21 greater than those under NAA, except in below normal years during March (6% lower) (Appendix
22 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon
24 upstream migration period (September through October) under A7_LLT would be similar to or
25 greater than those under NAA, except in critical water years during September (Appendix 11C,
26 *CALSIM II Model Results utilized in the Fish Analysis*).

27 **Feather River**

28 *Fall-Run*

29 Flows in the Feather River at the confluence with the Sacramento River were reviewed during the
30 February through May fall-run juvenile migration period Appendix 11C, *CALSIM II Model Results*
31 *utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows
32 under NAA except in below normal and dry water years during May (7% and 16% lower,
33 respectively).

34 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
35 were examined during the February through May juvenile fall-run Chinook salmon migration period
36 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
37 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
38 temperature between NAA and Alternative 7 in any month or water year type throughout the
39 period.

1 Flows in the Feather River at the confluence with the Sacramento River during the September
2 through October fall-run Chinook salmon adult migration period under A7_LLTP would generally be
3 lower by up to 25% lower than flows under NAA during September and similar to or greater than
4 flows under NAA during October (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
5 *Analysis*).

6 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
7 were examined during the September through October fall-run Chinook salmon adult upstream
8 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
9 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
10 mean monthly water temperature between NAA and Alternative 7 in any month or water year type
11 throughout the period.

12 **American River**

13 *Fall-Run*

14 Flows in the American River at the confluence with the Sacramento River were examined during the
15 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
16 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTP would be generally similar to or
17 greater than flows under NAA, except for dry years during March and April (6% and 15% lower,
18 respectively) and critical years during February, March, and April (7% to 17% lower).

19 Mean monthly water temperatures in the American River at the confluence with the Sacramento
20 River were examined during the February through May juvenile fall-run Chinook salmon migration
21 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
22 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
23 temperature between NAA and Alternative 7 in any month or water year type throughout the
24 period.

25 Flows in the American River at the confluence with the Sacramento River were examined during the
26 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
27 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during September under A7_LLTP would
28 be mostly lower by up to 15% than those under NAA. Flows during October would be generally
29 similar to or greater than flows under NAA, except during above and below normal water years
30 (13% and 12% lower, respectively).

31 Mean monthly water temperatures in the American River at the confluence with the Sacramento
32 River were examined during the September and October adult fall-run Chinook salmon upstream
33 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
34 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
35 mean monthly water temperature between NAA and Alternative 7 in any month or water year type
36 throughout the period.

1 **Stanislaus River**

2 *Fall-Run*

3 Flows in the Sacramento River at the confluence with the San Joaquin River were examined during
4 the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C,
5 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLTT would be similar to flows
6 under NAA throughout the period. This indicates that climate change would affect juvenile migration
7 flows in the Stanislaus River, but Alternative 7 would not.

8 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
9 River were examined during the September and October adult fall-run Chinook salmon upstream
10 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
11 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
12 mean monthly water temperature between NAA and Alternative 7 in any month or water year type
13 throughout the period.

14 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
15 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
16 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLTT would be similar to flows
17 under NAA throughout the period. This indicates that climate change would affect adult migration
18 flows in the Stanislaus River, but Alternative 7 would not.

19 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
20 River were examined during the September and October adult fall-run Chinook salmon upstream
21 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
22 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
23 mean monthly water temperature between NAA and Alternative 7 in any month or water year type
24 throughout the period.

25 **San Joaquin River**

26 *Fall-Run*

27 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
28 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months and water
30 year types throughout the period.

31 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
32 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
33 *in the Fish Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months
34 and water year types throughout the period.

35 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 *Fall-Run*

3 Flows in the Mokelumne River at the Delta were examined during the February through May
4 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
5 *the Fish Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months and
6 water year types throughout the period.

7 Flows in the Mokelumne River at the Delta were examined during the September and October adult
8 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
9 *in the Fish Analysis*). Flows under Alternative 7 would be similar to those under NAA in all months
10 and water year types throughout the period.

11 Water temperature modeling was not conducted in the Mokelumne River.

12 **Through-Delta**

13 **Sacramento River**

14 The effects on through-Delta migration were evaluated using the approach described in Alternative
15 1A, Impact AQUA-42.

16 *Fall-Run*

17 *Juveniles*

18 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows
19 below the north Delta intakes compared to baseline. The north Delta export facilities would replace
20 aquatic habitat and likely attract piscivorous fish around the three intake structures. The predation
21 effects would be the same as those described for Alternative 4 (Impact AQUA-78). Estimates of
22 potential predation losses at the north Delta intakes range from about 0.25% to 13% of those
23 migrating juveniles that reach the Delta. This topic is further discussed in Impact AQUA-42 for
24 Alternative 1A. The overall effect of the predation and habitat loss associated with the three intake
25 structures is not considered substantial.

26 Through-Delta average survival by emigrating juvenile fall-run Chinook salmon under Alternative 7
27 (A7_LL7) would be similar for the Sacramento River, slightly greater for the Mokelumne River (1.8%
28 greater survival, or 11% more in relative percentage), compared to NAA (Table 11-7-47). In drier
29 years, mean survival would be slightly greater in the Mokelumne River (1.2% more, or 7% more in
30 relative percentage).

1 **Table 11-7-47. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**
2 **Alternative 7**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A7_LLТ	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Sacramento River					
Wetter Years	34.5	31.1	29.2	-5.3 (-15%)	-1.9 (-6%)
Drier Years	20.6	20.8	20.5	-0.1 (1%)	-0.3 (-1%)
All Years	25.8	24.7	23.7	-2.1 (-8%)	-0.9 (-4%)
Mokelumne River					
Wetter Years	17.2	15.7	18.5	1.3 (8%)	2.8 (18%)
Drier Years	15.6	15.9	17.1	1.5 (10%)	1.2 (7%)
All Years	16.2	15.9	17.6	1.4 (9%)	1.8 (11%)

Note: Delta Passage Model results for survival to Chipps Island.

Results for San Joaquin River runs may be anomalous when applying DPM to operations scenarios with low or no south Delta exports.

Wetter = Wet and Above Normal WYs (6 years).

Drier = Below Normal, Dry and Critical WYs (10 years).

3

4 *Adults*

5 The adult fall-run migration extends from September-December. The proportion of Sacramento
6 River water in the Delta under Alternative 7 would be similar (<10% change) to (NAA during the
7 adult-Fall-Run migration (Table 11-7-32).

8 Flows at Rio Vista would be similar (<5% difference) between Alternative 7 and Alternative 1A in
9 December, but substantially changed from September-November depending on year type. In Wet
10 and above normal years Rio Vista flows would be substantially increased in September relative to
11 Alternative 1A but would be decreased 33–46% in all years in October and November.

12 *Late Fall-Run*

13 *Juveniles*

14 During the late fall–run juvenile Chinook salmon migration occurs from December-May, flows at Rio
15 Vista under Alternative 7 would be similar (<5% difference) to those predicted for Alternative 1A.
16 Based on DPM results for Alternative 1A, juvenile late fall–run survival would decrease less than
17 0.5%.

1 **Table 11-7-48. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon**
2 **under Alternative 7**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A7_LLТ	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Wetter Years	28.8	27.3	27.2	-1.6 (-6%)	-0.2 (-1%)
Drier Years	18.8	20.2	20.4	1.6 (9%)	0.2 (1%)
All Years	22.5	22.9	22.9	0.4 (2%)	0.0 (0%)

Note: Delta Passage Model results for survival to Chipps Island.
Wetter = Wet and Above Normal WYs (6 years).
Drier = Below Normal, Dry and Critical WYs (10 years).

3

4 *Adults*

5 The adult late fall–run migration is from November through March, peaking in January through
6 March. The proportion of Sacramento River water in the Delta would be similar to NAA from
7 November–February, and decreased slightly in March (11%). Rio Vista flows under Alternative 7
8 would be similar Alternative 1A from December–March, which overlaps with the peak migration
9 months; however Rio Vista flows would decrease 33% relative to Alternative 1A in November.
10 Based on the similarity in Sacramento River olfactory cues and Rio Vista flows during the vast
11 majority of the adult late fall–run migration, it is assumed that adult migration success through the
12 Delta would be similar to those described for Alternative 1A.

13 ***San Joaquin River***

14 *Fall-Run*

15 *Juveniles*

16 As discussed for Alternative 6A (Impact AQUA-78), the DPM can produce anomalous results for
17 certain Alternatives and operations scenarios with highly reduced south Delta exports, such as
18 Alternative 7. A qualitative assessment is therefore more appropriate given this modeling limitation.

19 There is a beneficial effect of Alternative 7 to all San Joaquin River basin fish due to positive Old and
20 Middle River flows during migratory months resulting in San Joaquin water moving westward and
21 contributing to Delta outflow. This is expected to decrease entrainment at South Delta facilities and
22 reduce predation hotspots to promote greater survival to Chipps Island. Furthermore under
23 Alternative 7, entrainment and entrainment-related mortality at the South Delta Facilities would be
24 reduced.

25 Additionally, under Alternative 7, the reduction of entrainment at the South Delta Facilities would
26 alleviate one of the primary concerns related to potential Old and Middle River corridor habitat
27 restoration. Successful restoration in this area would be expected to enhance rearing habitat, food
28 availability, and overall salmonid fitness and survival.

29 *Adults*

30 Alternative 7 would slightly increase the proportion of San Joaquin River water in the Delta in
31 September through December by 0.8 to 7.5% compared to NAA. The proportion of San Joaquin River

1 water would be similar or slightly more than to NAA. Therefore migration conditions under
2 Alternative 7 would be similar to slightly improved to those described for Alternative 1A.
3 Alternative 7 would have no effect to a slight beneficial effect on the fall-run adult migration.

4 **NEPA Effects:** Upstream of the Delta, the results indicate that the effect of Alternative 7 on upstream
5 flow conditions is not adverse because it does not have the potential to substantially interfere with
6 the movement of fish. Reservoir storage volume, instream flows, and water temperatures under
7 Alternative 7 in all rivers in which these parameters were predicted generally be similar to those
8 under the NAA.

9 Near-field effects of Alternative 7 NDD on fall- and late fall-run Chinook salmon related to
10 impingement and predation associated with three new intake structures could result in negative
11 effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high
12 uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be
13 directly correlated to the number of new intake structures in the river and thus the level of impacts
14 associated with 3 new intakes would be considerably lower than those expected from having 5 new
15 intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1%
16 mortality) to more significant effects (~ 13% mortality above current baseline levels). CM15 would
17 be implemented with the intent of providing localized and temporary reductions in predation
18 pressure at the NDD. Additionally, several pre-construction surveys to better understand how to
19 minimize losses associated with the three new intake structures will be implemented as part of the
20 final NDD screen design effort. Alternative 7 also includes an Adaptive Management Program and
21 Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended
22 to provide adequate migration conditions for fall- and late fall-run Chinook. However, at this time,
23 due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the
24 degree of mortality expected from near-field effects at the NDD remains highly uncertain.

25 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
26 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
27 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7
28 predict improvements in smolt condition and survival associated with increased access to the Yolo
29 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
30 of each of these factors and how they might interact and/or offset each other in affecting salmonid
31 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

32 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
33 all of these elements of BDCP operations and conservation measures to predict smolt migration
34 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
35 migration survival under Alternative 7 would be similar to those estimated for NAA. Further
36 refinement and testing of the DPM, along with several ongoing and planned studies related to
37 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
38 future. These efforts are expected to improve our understanding of the relationships and
39 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
40 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.
41 However, until these efforts are completed and their results are fully analyzed, the overall
42 cumulative effect of Alternative 7 on fall- and late fall-run Chinook salmon migration remains
43 uncertain. Similarly, the impact on the fall-run Chinook salmon commercial fishery would be
44 uncertain.

1 **CEQA Conclusion:** In general, Alternative 7 would not affect migration conditions for fall-/late fall-
2 run Chinook salmon relative to Existing Conditions.

3 **Upstream of the Delta**

4 **Sacramento River**

5 *Fall-Run*

6 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants were evaluated
7 during February through May under A7_LLTP would generally be similar to or greater than those
8 under Existing Conditions, except in wet years during May (18% lower), below normal water years
9 during March, April, and May (9% to 11% lower), and dry years during April (6% lower) (Appendix
10 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
12 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
15 Existing Conditions and Alternative 7 in any month or water year type throughout the period except
16 for wet years during May.

17 Flows in the Sacramento River upstream of Red Bluff were evaluated during the adult fall-run
18 Chinook salmon upstream migration period (September through October). Flows during September
19 under A7_LLTP would generally be lower than those under Existing Conditions by 16% to 19%
20 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during October under
21 A7_LLTP would be similar to or greater than flows under Existing Conditions.

22 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
23 September through October adult fall-run Chinook salmon upstream migration period (Appendix
24 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
25 *the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 9% and 6%
26 greater than those under Existing Conditions during September and October, respectively.

27 *Late Fall-Run*

28 Flows in the Sacramento River upstream of Red Bluff were examined for juvenile late fall-run
29 migrants (January through March). Flows under A7_LLTP would generally be similar to or greater
30 than flows under Existing Conditions, except in below normal water years during March (11%
31 reduction) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
33 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,
34 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
35 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
36 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

37 Flows in the Sacramento River upstream of Red Bluff were examined during the adult late fall-run
38 Chinook salmon upstream migration period (December through February). Flows during January
39 and February under A7_LLTP would be similar to or greater than those under Existing Conditions.

1 Flows during December under A7_LLT would be mostly lower than under Existing Conditions (up to
2 6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
4 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
7 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

8 **Clear Creek**

9 *Fall-Run*

10 Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall-run Chinook salmon
11 upstream migration period (February through May) under A7_LLT would be similar to or greater
12 than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*
13 *utilized in the Fish Analysis*).

14 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon
15 upstream migration period (September through October) under A7_LLT would generally be similar
16 to or greater than those under Existing Conditions except in critical years (38% lower) during
17 September and below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model*
18 *Results utilized in the Fish Analysis*).

19 Water temperature modeling was not conducted in Clear Creek.

20 **Feather River**

21 *Fall-Run*

22 Flows in the Feather River at the confluence with the Sacramento River were evaluated during the
23 fall-run juvenile migration period (February through May) (Appendix 11C, *CALSIM II Model Results*
24 *utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to or greater than flows
25 under Existing Conditions during February through April, except in below normal years during
26 February and March (12% and 8% lower, respectively) and in critical years during March and April
27 (8% and 6% lower, respectively). Flows during May under A7_LLT were generally lower by up to
28 27% than flows under Existing Conditions.

29 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
30 were examined during the February through May juvenile fall-run Chinook salmon migration period
31 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
32 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
33 temperature between Existing Conditions and Alternative 7 in any month or water year type
34 throughout the period.

35 Flows in the Feather River at the confluence with the Sacramento River during the September
36 through October fall-run Chinook salmon adult migration period under A7_LLT would generally be
37 similar to or greater than flows under Existing Conditions except in below normal and dry water
38 years during September (75 and 33% lower, respectively) and in wet years during October (6%
39 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
2 were examined during the September through October fall-run Chinook salmon adult upstream
3 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
4 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
5 mean monthly water temperature between Existing Conditions and Alternative 7 during October
6 and generally during September except in dry and critical years.

7 **American River**

8 *Fall-Run*

9 Flows in the American River at the confluence with the Sacramento River were examined during the
10 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT during February and March would
12 generally be similar to or greater than flows under Existing Conditions, except for critical years
13 (24% and 20% lower in February and March, respectively). Flows under A7_LLT during April and
14 May would generally be lower than flows under Existing Conditions by up to 33%.

15 Mean monthly water temperatures in the American River at the confluence with the Sacramento
16 River were examined during the February through May juvenile fall-run Chinook salmon migration
17 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
18 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would
19 be 5% to 8% higher than under Existing Conditions in all month except April, in which there would
20 be no difference.

21 Flows in the American River at the confluence with the Sacramento River were examined during the
22 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
23 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during September would
24 be 25% to 46% lower than flows under Existing Conditions. Flows under A7_LLT during October
25 would be similar to or great than those under Existing Conditions in wet, below normal and critical
26 water years and lower than those under Existing Conditions in above normal and dry years.

27 Mean monthly water temperatures in the American River at the confluence with the Sacramento
28 River were examined during the September and October adult fall-run Chinook salmon upstream
29 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
30 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under
31 Alternative 7 would be 6% and 11% higher than those under Existing Conditions during September
32 and October, respectively.

33 **Stanislaus River**

34 *Fall-Run*

35 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
36 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
37 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would predominantly be lower than
38 flows under Existing Conditions by up to 36%.

39 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
40 River were examined during the February through May juvenile fall-run Chinook salmon migration
41 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*

1 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would
2 be up to 7% higher than those under Existing Conditions in every month of the period.

3 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
4 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
5 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during September would
6 generally be similar to flows under Existing Conditions, except during wet and above normal years
7 (17% and 6% lower, respectively). Flows under A7_LLT during October would be 5% to 11% lower
8 than flows under Existing Conditions.

9 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
10 River were examined during the September and October adult fall-run Chinook salmon upstream
11 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
12 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under
13 Alternative 7 would be 6% higher than those under Existing Conditions during September but there
14 would be no difference in mean monthly water temperatures between Alternative 7 and Existing
15 Conditions during October except in wet and critical years.

16 ***San Joaquin River***

17 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
18 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
19 *Analysis*). Mean monthly flows under Alternative 7 would generally be similar to flows under
20 Existing Conditions in all months. Wetter water years under Alternative 7 would have similar or
21 greater flows than those under Existing Conditions, whereas drier years would have lower flows
22 under H3.

23 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
24 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
25 *in the Fish Analysis*). Mean monthly flows under Alternative 7 would be 8% lower than those under
26 Existing Conditions in September and similar in October.

27 Water temperature modeling was not conducted in the San Joaquin River.

28 ***Mokelumne River***

29 Flows in the Mokelumne River at the Delta were examined during the February through May
30 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
31 *the Fish Analysis*). Flows under Alternative 7 would be 12% greater than those under Existing
32 Conditions during February, similar during March, and 8% and 12% lower during April and May,
33 respectively.

34 Flows in the Mokelumne River at the Delta were examined during the September and October adult
35 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
36 *in the Fish Analysis*). Flows under Alternative 7 would be 27% lower than under Existing Conditions
37 during September but would be similar during October.

38 Water temperature modeling was not conducted in the Mokelumne River.

1 **Through-Delta**

2 The north Delta export facilities would replace aquatic habitat and likely attract piscivorous fish
3 around the three intake structures. The predation effects would be the same as those described for
4 Alternative 4 (Impact AQUA-78). Estimates of potential predation losses at the north Delta intakes
5 range from about 0.25% to 13% of those migrating fall-run Chinook salmon juveniles that reach the
6 Delta. This topic is further discussed in Impact AQUA-42 for Alternative 1A. The overall effect of the
7 predation and habitat loss associated with the three intake structures is not considered substantial.

8 As described above, DPM results for Alternative 7 found a slight increase (1.4% more) in average
9 through-Delta survival by emigrating juvenile fall-run Chinook salmon for the Mokelumne River
10 (1.4% greater survival compared to Existing Conditions, or a 9% more in relative percentage) and
11 decrease in the Sacramento (2.1 to 5.3% reduced average survival, or 8-15% less in relative
12 percentage), compared to Existing Conditions.

13 Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10%
14 difference) to Existing Conditions for fall- and late fall-run Chinook salmon (Table 11-7-49). Rio
15 Vista flows under Alternative 7 would be similar or increased relative to Alternative 1A for nearly all
16 months, except for October and November when flows would be reduced. Reduced flows in October
17 and November, relative to Alternative 1A, would overlap with the migration timings for fall-run
18 Chinook salmon. For late fall-run adults, flows at Rio Vista would be similar to Alternative 1A during
19 the majority of their upstream migration period. Because the impact under Alternative 1A, Impact
20 AQUA-78, was determined to be not substantial, the Alternative 7 impact on adult Chinook salmon
21 upstream migration through the Delta would also not be substantial. Fall-run adults Chinook salmon
22 would experience reduced flows at Rio Vista during their migration, but would also benefit from
23 improved olfactory cues. San Joaquin River flows would not be substantially impacted (<10%)
24 (Table 11-7-49) compared to Existing Conditions.

1 **Table 11-7-49. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
 2 **San Joaquin River during the Adult Chinook Salmon Migration Period for Alternative 7**

Month	EXISTING CONDITIONS	NAA	A7_LLТ	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Sacramento River					
September	60	65	78	18	13
October	60	68	67	7	-1
November	60	66	62	2	-4
December	67	66	65	-2	-1
January	76	75	73	-3	-2
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	59	-10	-6
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
Shading indicates a difference of 10% or greater in flow proportion.					

3

4 **Summary of CEQA Conclusion**

5 In the Delta on the Sacramento River, Alternative 7 would not substantially reduce olfactory cues for
 6 Sacramento River Chinook salmon and Mokelumne River flows would be slightly increased.
 7 Alternative 7 also would not substantially increase predation and remove important instream
 8 habitat as the result of the presence of three NDD structures. Through-Delta survival of emigrating
 9 juveniles would not be expected to be reduced, compared to Existing Conditions. Therefore, it is
 10 concluded that the through-delta impact on the Sacramento River is less than significant and no
 11 mitigation is required.

12 In the Delta on the San Joaquin River, because of similar and olfactory attraction cues, Alternative 7
 13 would be less than significant for fall-run Chinook salmon and no mitigation is required.

14 For upstream of the Delta, collectively, the results of the Impact AQUA-78 CEQA analysis indicate
 15 that the difference between the CEQA baseline and Alternative 7 could be significant because, under
 16 the CEQA baseline, the alternative could substantially reduce migration habitat. There would be
 17 substantial flow reductions under Alternative 7 in the Feather, American, and Stanislaus rivers
 18 during the fall-run juvenile and adult migration periods relative to CEQA Existing Conditions. Flow
 19 reductions during juvenile migration could reduce the downstream migratory ability of juveniles,
 20 which could delay smoltification and reduce survival. Flow reductions during adult migration could
 21 reduce olfactory cues from natal streams and increase straying. Further, water temperatures in the
 22 Feather and Stanislaus Rivers would be higher under Alternative 7 relative to CEQA Existing

1 Conditions, which would further increase stress and mortality of juvenile and adult fall-run
2 migrants.

3 These results are primarily caused by four factors: differences in sea level rise, differences in climate
4 change, future water demands, and implementation of the alternative. The analysis described above
5 comparing Existing Conditions to the alternative does not partition the effect of implementation of
6 the alternative from those of sea level rise, climate change and future water demands using the
7 model simulation results presented in this chapter. However, the increment of change attributable
8 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
9 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
10 implementation period, which does include future sea level rise, climate change, and water
11 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
12 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
13 effect of the alternative from those of sea level rise, climate change, and water demands.

14 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
15 Conditions in the late long-term implementation period and the alternative indicates that flows and
16 reservoir storage in the locations and during the months analyzed above would generally be similar
17 between Existing Conditions and the alternative. This indicates that the differences between
18 Existing Conditions and the alternative found above would generally be due to climate change, sea
19 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
20 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
21 conclusion, and therefore would not in itself result in a significant impact on migration habitat
22 conditions for fall-/late fall-run Chinook salmon. This impact is found to be less than significant and
23 no mitigation is required.

24 **Restoration Measures (CM2, CM4–CM7, and CM10)**

25 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon** 26 **(Fall-/Late Fall-Run ESU)**

27 The effects on construction of restoration measures on fall-/late-fall-run Chinook would be identical
28 to those on winter-run Chinook; please refer to the discussion of Impact AQUA-43 above.

29 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook** 30 **Salmon (Fall-/Late Fall-Run ESU)**

31 The effects of contaminants associated with restoration measures would be the same for all four
32 ESUs. Accordingly, please refer to the discussion of Impact AQUA-44 for winter-run Chinook salmon.

33 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall-** 34 **Run ESU)**

35 The overall effects of construction of restored habitat conditions would be the same for all four
36 ESUs. Accordingly, please refer to the discussion of Impact AQUA-45 for winter-run Chinook salmon.
37 Under Alternative 7 more restored floodplain habitat may occur in the south Delta. If it does, there
38 would be additional benefits expected for spring-run, fall-run, and late-fall run Chinook salmon since
39 they occupy these areas while winter-run Chinook salmon do not.

1 **Other Conservation Measures (CM12–CM19 and CM21)**

2 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-**
3 **Run ESU) (CM12)**

4 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
5 **(Fall-/Late Fall–Run ESU) (CM13)**

6 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**
7 **/Late Fall–Run ESU) (CM14)**

8 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
9 **(Fall-/Late Fall–Run ESU) (CM15)**

10 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**
11 **Run ESU) (CM16)**

12 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall–Run**
13 **ESU) (CM17)**

14 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall–Run**
15 **ESU) (CM18)**

16 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**
17 **Fall–Run ESU) (CM19)**

18 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
19 **(Fall-/Late Fall–Run ESU) (CM21)**

20 *NEPA Effects:* Detailed discussions regarding the potential effects of these impact mechanisms on
21 fall-late fall-run Chinook salmon are the same as those described under Alternative 1A (Impact
22 AQUA-82 through 90). The effects range from no effect, to not adverse, to beneficial.

23 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
24 less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-82
25 through 90), and no mitigation is required.

26 **Steelhead**

27 **Construction and Maintenance of CM1**

28 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

29 The potential effects of construction of the water conveyance facilities on steelhead would be similar
30 to those described for Alternative 1A (Impact AQUA-91) except that Alternative 7 would include
31 three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally
32 less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat
33 into intake facility structures and would require about 17.1 acres of dredge and channel reshaping.
34 In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and would require 27.3
35 acres of dredging.

1 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-91, environmental commitments and
2 mitigation measures would be available to avoid and minimize potential effects, and the effect would
3 not be adverse for steelhead.

4 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-91, the impact of the construction of
5 water conveyance facilities on steelhead would be less than significant except for construction noise
6 associated with pile driving. Potential pile driving impacts would be less than Alternative 1A
7 because only three intakes would be constructed rather than five. Implementation of Mitigation
8 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
9 significant.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

13 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
14 **and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

16 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

17 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
18 the same as those described for Alternative 1A (see Impact AQUA-92) except that only three intakes
19 would be maintained under Alternative 7 rather than five under Alternative 1A.

20 **NEPA Effects:** As concluded in Impact AQUA-92, the effect would not be adverse for steelhead.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance
22 of water conveyance facilities on steelhead would be less than significant and no mitigation would
23 be required.

24 **Water Operations of CM1**

25 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

26 **Water Exports from SWP/CVP South Delta Facilities**

27 Alternative 7 would reduce overall entrainment of juvenile steelhead at the south Delta export
28 facilities, estimated as salvage density, by about 82% (~7,200 fish; Table 11-7-50) across all years
29 compared to NAA. Under Alternative 7, entrainment reduction of juvenile steelhead is anticipated to
30 be lowest, approximately 76%, 79% and 80% (~4,800, 8,800 and 10,700 fish, respectively), during
31 wet, below normal and above normal water years, respectively. The greatest relative reductions
32 would occur in dry (~6,700 fish; decrease 97%) and critical water years (~5,500 fish; decrease
33 99%) compared to NAA (Table 11-7-50). Pre-screen losses, typically attributed to predation, would
34 be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

1 **Table 11-7-50. Juvenile Steelhead Annual Entrainment Index^a at the SWP and CVP Salvage**
 2 **Facilities—Differences between Model Scenarios for Alternative**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-4,727 (-76%)	-4,820 (-76%)
Above Normal	-10,360 (-80%)	-10,704 (-80%)
Below Normal	-9,557 (-80%)	-8,827 (-79%)
Dry	-7,330 (-97%)	-6,739 (-97%)
Critical	-5,817 (-99%)	-5,466 (-99%)
All Years	-7,363 (-82%)	-7,222 (-82%)

^a Estimated annual number of fish lost, based on non-normalized data.

3

4 ***Water Exports from SWP/CVP North Delta Intake Facilities***

5 The impact and conclusion is similar as for Alternative 1A, Impact AQUA-93 for steelhead. Potential
 6 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the
 7 effects would be minimal because the north Delta intakes would have state-of-the-art screens to
 8 exclude juvenile fish.

9 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

10 The impact and conclusion are the same as for Impact AQUA-93 for steelhead under Alternative 1A
 11 for NBA. Potential entrainment and impingement effects for juvenile salmonids would be minimal
 12 because intakes would have state-of-the-art screens installed.

13 ***NEPA Effects:*** Overall, under Alternative 7 potential entrainment of juvenile steelhead would be
 14 substantially reduced compared to Existing Conditions. This effect is not adverse and would provide
 15 a small incremental benefit to the species.

16 ***CEQA Conclusion:*** As described above, entrainment losses of juvenile steelhead would be less under
 17 Alternative 7 compared to Existing Conditions. Overall, impacts would be beneficial to steelhead
 18 because of the reduction in entrainment loss and no mitigation would be required.

19 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
 20 **Steelhead**

21 In general, Alternative 7 would have negligible effects on spawning and egg incubation habitat for
 22 steelhead relative to NAA. There would be beneficial effects on water temperatures in the Feather
 23 River based on increased cold-water pool availability from increased reservoir storage.

24 ***Sacramento River***

25 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
 26 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
 27 and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized*
 28 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
 29 incubation, and rapid reductions in flow can expose redds leading to mortality. Flows under A7_LLT
 30 throughout the period would generally be similar to those under NAA except during January in dry

1 and critical water years (7% and 11% lower, respectively) and during February during below
2 normal and critical water years (11% and 9% higher, respectively).

3 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were
4 examined during the January through April primary steelhead spawning and egg incubation period
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
6 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
7 temperature between NAA and Alternative 7 in any month or water year type throughout the period
8 at either location

9 SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning
10 availability, measured as weighted usable area, under A7_LLT relative to NAA (Table 11-7-51).
11 SacEFT predicts negligible (4%) differences between NAA and A7_LLT in the percentage of years
12 with good (lower) redd scour risk and no (0%) difference in the percentage of years with good
13 (lower) egg incubation conditions. These results indicate that there would be a low effect of
14 Alternative 7 on spawning habitat quantity but no difference in redd scour risk or temperature-
15 related egg incubation conditions.

16 Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg
17 incubation habitat in the Sacramento River would be negligible.

18 **Table 11-7-51. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
19 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-6 (-7%)	-3 (-4%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	0 (0%)	3 (6%)
Juvenile Rearing WUA	4 (10%)	0 (0%)
Juvenile Stranding Risk	-19 (-56%)	-5 (-25%)

WUA = Weighted Usable Area.

20

21 **Clear Creek**

22 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
23 (January through April). Flows under A7_LLT would generally be similar to flows under NAA
24 throughout the period, except in critical years during January (6% higher) and below normal years
25 during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
27 monthly flow reduction would be identical between NAA and A7_LLT for all water year types (Table
28 11-7-52).

29 No water temperature modeling was conducted in Clear Creek.

30 Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg
31 incubation habitat in Clear Creek would be negligible.

1 **Table 11-7-52. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**
 2 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**
 3 **Incubation Period^a**

Water Year Type	A7_LLT vs. EXISTING CONDITIONS	A7_LLT vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

4

5 **Feather River**

6 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
 7 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
 8 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
 9 Steelhead spawning and egg incubation on the Feather River occurs primarily in Hatchery Ditch and
 10 the low-flow channel in the general vicinity of the Feather River Hatchery, but a small number can
 11 spawn downstream of Thermalito Afterbay. Instream flows affect physical habitat quality and
 12 availability through changes in wetted channel width, water depth, and water velocities. Results of
 13 IFIM studies (WUA versus flow relationships) provide information on the spawning habitat
 14 conditions in the low-flow channel. Results of CALSIM modeling show that instream flows in the
 15 Feather River low-flow channel were the same between NAA and Alternative 7, and range from 700
 16 to 800 cfs under all conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
 17 Flows in the low-flow channel under A7_LLT would not differ from NAA because minimum Feather
 18 River flows are included in the FERC settlement agreement and would be met for all model
 19 scenarios (California Department of Water Resources 2006). Therefore, Alternative 7 is not
 20 expected to affect physical habitat conditions for steelhead spawning and egg incubation within the
 21 Feather River low-flow channel.

22 Flows under A7_LLT at Thermalito Afterbay would generally be similar to or greater than flows
 23 under NAA, except in critical years during January and March (24% and 7% lower, respectively) and
 24 in dry water years during February (5% lower). Oroville Reservoir storage volume at the end of
 25 September and end of May influences flows downstream of the dam during the steelhead spawning
 26 and egg incubation period. Storage volume at the end of September under A7_LLT would be up to
 27 51% greater than storage under NAA depending on water year type (Table 11-7-25). May Oroville
 28 storage under A7_LLT would be similar to storage or up to 16% greater than storage under NAA
 29 (Table 11-7-28).

30 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito
 31 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January
 32 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*
 33 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There

1 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 7
2 in any month or water year type throughout the period at either location.

3 The percent of months exceeding the 56°F temperature threshold in the Feather River above
4 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-7-
5 53). The percent of months exceeding the threshold under Alternative 7 would generally be similar
6 to or lower (up to 9% lower on an absolute scale) than the percent under NAA depending on month
7 and degrees above the threshold.

8 **Table 11-7-53. Differences between Baseline and Alternative 7 Scenarios in Percent of Months**
9 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
10 **River above Thermalito Afterbay Exceed the 56°F Threshold, January through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	7 (600%)	2 (NA)	1 (NA)	1 (NA)	1 (NA)
April	36 (414%)	19 (375%)	14 (NA)	5 (NA)	1 (NA)
NAA vs. A7_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-1 (-13%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
April	-9 (-16%)	-9 (-27%)	-4 (-21%)	-1 (-20%)	0 (0%)

11
12 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
13 Afterbay (low-flow channel) during January through April (Table 11-7-54). Total degree-months
14 would be similar between NAA and Alternative 7 in January and February and higher in March and
15 April (31% and 6%, respectively).

1 **Table 11-7-54. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the Feather River above Thermalito Afterbay, January through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	3 (NA)	1 (50%)
	Dry	4 (NA)	2 (100%)
	Critical	10 (1,000%)	2 (22%)
	All	16 (1,600%)	4 (31%)
April	Wet	5 (NA)	2 (67%)
	Above Normal	12 (600%)	1 (8%)
	Below Normal	17 (425%)	1 (5%)
	Dry	27 (540%)	1 (3%)
	Critical	23 (NA)	0 (0%)
	All	0 (NA)	5 (6%)

NA = could not be calculated because the denominator was 0.

4

5 Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg
 6 incubation habitat in the Feather River would be negligible.

7 ***American River***

8 Flows in the American River at the confluence with the Sacramento River were examined for the
 9 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
 10 *Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be similar to flows
 11 under NAA during the period except in dry and critical years during March (6% and 17% lower,
 12 respectively) and during April (15% and 9% lower, respectively) and in critical years in February
 13 (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated
 15 during the January through April steelhead spawning and egg incubation period ((Appendix 11D,
 16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
 17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
 18 NAA and Alternative 7 in any month or water year type throughout the period.

1 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
2 Avenue Bridge was evaluated during November through April (Table 11-7-43). Steelhead spawn and
3 eggs incubate in the American River between January and April. During this period, the percent of
4 months exceeding the threshold under Alternative 7 would be similar to or up to 22% lower (absolute
5 scale) than the percent under NAA.

6 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
7 Avenue Bridge during November through April (Table 11-7-44). During the January through April
8 steelhead spawning and egg incubation period, total degree-months would be similar between NAA
9 and Alternative 7.

10 Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg
11 incubation habitat in the American River would be negligible.

12 ***Stanislaus River***

13 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
14 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*). Flows under Alternative 7 throughout this period would
16 generally be identical to flows under NAA.

17 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 7
18 throughout the January through April steelhead spawning and egg incubation period (Appendix
19 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
20 *the Fish Analysis*).

21 ***San Joaquin River***

22 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

23 ***Mokelumne River***

24 Flows in the Mokelumne River at the Delta were examined during the January through April
25 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
26 *Fish Analysis*). Flows under Alternative 7 throughout this period would generally be identical to
27 flows under NAA.

28 Water temperature modeling was not conducted in the Mokelumne River.

29 ***NEPA Effects:*** Collectively, these results indicate that the effects of Alternative 7 on flow would not
30 be adverse because they would not substantially reduce suitable spawning habitat or substantially
31 reduce the number of fish as a result of egg development. Changes in flow and water temperatures
32 during steelhead spawning and egg incubation period in each waterway would be small and
33 inconsistent.

34 ***CEQA Conclusion:*** In general, Alternative 7 would not affect the quantity and quality of steelhead
35 spawning habitat relative to Existing Conditions.

36 ***Sacramento River***

37 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
38 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
39 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*

1 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
2 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows
3 under A7_LLTT would generally be similar to or greater than flows under Existing Conditions during
4 January and February except for dry water years (10% and 8% lower, respectively), similar to
5 Existing Conditions during March except in below normal years (20% lower) and lower than
6 Existing Conditions in April (up to 14% lower). Upstream of Red Bluff Diversion Dam, flows under
7 NAA and Alternative 7 would generally be similar to those at Keswick except there would be no
8 lower flows during January and February.

9 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were
10 examined during the January through April primary steelhead spawning and egg incubation period
11 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
12 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
13 temperature between Existing Conditions and Alternative 7 in any month or water year type
14 throughout the period at either location.

15 SacEFT predicts no changes (0% difference) in spawning habitat, egg incubation, and redd
16 dewatering risk for Alternative 7 compared to Existing Conditions, and a small change (-7%) in redd
17 scour risk (Table 11-7-51) that would not be considered significant.

18 Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg
19 incubation habitat in the Sacramento River would be small to negligible.

20 **Clear Creek**

21 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
22 (January through April). Flows under A7_LLTT would be similar to or greater than flows under
23 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*
24 *Fish Analysis*).

25 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
26 monthly flow reduction would be identical between Existing Conditions and A7_LLTT for all water
27 year types except wet, in which the greatest reduction would be 38% lower (worse) under A7_LLTT
28 than under Existing Conditions (Table 11-7-52).

29 No water temperature modeling was conducted in Clear Creek.

30 Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg
31 incubation habitat in Clear Creek would be negligible.

32 **Feather River**

33 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
34 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
35 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
36 Flows in the low-flow channel under A7_LLTT would not differ from Existing Conditions because
37 minimum Feather River flows are included in the FERC settlement agreement and would be met for
38 all model scenarios (California Department of Water Resources 2006). Flows under A7_LLTT at
39 Thermalito Afterbay would be variable depending on the specific month and water year type. There
40 would be primarily decreases in mean monthly flows in January (-13% to -43%) for all but wet
41 water years, which would increase by 16%. February and March would experience substantial

1 decreases (-7% to -46%) in drier water year types that could significantly affect spawning
2 conditions, and increases in wetter water year types (13% to 33%). April would experience
3 primarily negligible effects (<5%) with the exception of a small decrease (-6%) in critical years and
4 an increase (16%) in dry years.

5 Oroville Reservoir storage volume at the end of September and end of May influences flows
6 downstream of the dam during the steelhead spawning and egg incubation period. Oroville
7 Reservoir storage volume at the end of September would be 9% to 31% lower under A7_LLT
8 relative to Existing Conditions depending on water year type except for dry years when it would be
9 12% higher (Table 11-7-25). May Oroville storage volume under A7_LLT would be lower than
10 Existing Conditions by 2% to 9% depending on water year type (Table 11-7-28).

11 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito
12 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January
13 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River
14 Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the
15 low-flow channel, mean monthly water temperatures under Alternative 7 would be 5% to 7%
16 greater than those under Existing Conditions during January through March and similar to
17 temperatures under Existing Conditions during April. In the high-flow channel, mean monthly water
18 temperatures under Alternative 7 would be 5% to 7% greater than those under Existing Conditions
19 during January through March and similar to temperatures under Existing Conditions during April.

20 The percent of months exceeding the 56°F temperature threshold in the Feather River above
21 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-7-
22 53). The percent of months exceeding the threshold under Alternative 7 would generally be similar
23 to the percent under Existing Conditions during January and February and similar to or up to 36%
24 greater (absolute scale) than the percent under Existing Conditions depending on month and
25 degrees above the threshold.

26 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
27 Afterbay (low-flow channel) during January through April (Table 11-7-54). Total degree-months
28 would be similar between Existing Conditions and Alternative 7 during January, February and April,
29 and 1,600% higher under Alternative 7 compared to Existing Conditions during March.

30 Overall, these results indicate that there would be negligible effects of Alternative 7 on mean
31 monthly flows in the low-flow channel, but that flows in the high-flow channel would be
32 substantially lower in some water year types and months. Alternative 7 would substantially increase
33 exposure of spawning steelhead and their eggs to critical water temperatures, a result of reduced
34 coldwater pools availability in Oroville Reservoir.

35 **American River**

36 Flows in the American River at the confluence with the Sacramento River were examined for the
37 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II
38 Model Results utilized in the Fish Analysis*). Flows under A7_LLT would generally be lower than flows
39 under Existing Conditions during January and April and greater than flows under Existing
40 Conditions during February and March with some exceptions.

41 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated
42 during the January through April steelhead spawning and egg incubation period (Appendix 11D,
43 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). Mean monthly water temperature under Alternative 7 would be 5% to 6% lower than
2 those under Existing Conditions during January through April.

3 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
4 Avenue Bridge was evaluated during November through April (Table 11-7-43). Steelhead spawn and
5 eggs incubate in the American River between January and April. During January and February, the
6 percent of month exceeding the threshold under Existing Conditions and Alternative 7 would be
7 identical. During March and April, the percent of months exceeding the threshold under Alternative
8 7 would be up to 23% greater (absolute scale) than the percent under Existing Conditions.

9 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
10 Avenue Bridge during November through April (Table 11-7-44). During January and February, there
11 would be no difference in total degree-months above the threshold between Existing Conditions and
12 Alternative 7. During March and April, total degree-months under Alternative 7 would be 389% and
13 97% greater than those under Existing Conditions, respectively.

14 Overall, these results indicate that the effects of Alternative 7 on steelhead spawning and egg
15 incubation habitat in the American River would be moderately negative.

16 ***Stanislaus River***

17 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
18 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
19 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTT throughout this period would be up
20 to 14% lower flows under Existing Conditions in all months with few exceptions.

21 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was
22 evaluated during the January through April steelhead spawning and egg incubation period
23 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
24 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 6%
25 higher than those under Existing Conditions in all months.

26 ***San Joaquin River***

27 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

28 ***Mokelumne River***

29 Flows in the Mokelumne River at the Delta were examined during the January through April
30 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
31 *Fish Analysis*). Flows under A7_LLTT would generally be similar to flows under Existing Conditions
32 during January through March and up to 14% lower during April.

33 Water temperature modeling was not conducted in the Mokelumne River.

34 **Summary of CEQA Conclusion**

35 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between
36 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
37 alternative could substantially reduce suitable spawning habitat and substantially reduce the
38 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above.
39 Alternative 7 would reduce steelhead spawning conditions through reduced flows and increased

1 water temperatures in the Feather River, and through reduced flows in the American River,
2 particularly during drier water years. This reduction in spawning conditions would reduce
3 spawning success and increase egg mortality. Alternative 7 would not substantially affect steelhead
4 spawning conditions in the Sacramento River and Clear Creek.

5 These results are primarily caused by four factors: differences in sea level rise, differences in climate
6 change, future water demands, and implementation of the alternative. The analysis described above
7 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
8 alternative from those of sea level rise, climate change and future water demands using the model
9 simulation results presented in this chapter. However, the increment of change attributable to the
10 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
11 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
12 implementation period, which does include future sea level rise, climate change, and water
13 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
14 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
15 effect of the alternative from those of sea level rise, climate change, and water demands.

16 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
17 term implementation period and Alternative 7 indicates that flows in the locations and during the
18 months analyzed above would generally be similar between Existing Conditions during the LLT and
19 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
20 found above would generally be due to climate change, sea level rise, and future demand, and not
21 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
22 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
23 result in a significant impact on spawning and egg incubation habitat for steelhead. This impact is
24 found to be less than significant and no mitigation is required.

25 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

26 In general, Alternative 7 would not affect the quantity and quality of steelhead rearing habitat
27 relative to NAA.

28 ***Sacramento River***

29 Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream
30 to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in
31 flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the
32 reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to
33 upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
34 *Analysis*). Flows under Alternative 7 would generally be similar to or greater (up to 11%) than flows
35 under NAA during February through August and October, and lower than flows under NAA (up to
36 18% lower) during January, September and November.

37 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
38 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*
39 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There
40 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 7
41 in any month or water year type throughout the period at either location.

1 SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions
2 under A7_LLТ would be the same as under NAA (Table 11-7-51).The percentage of years with good
3 (lower) juvenile stranding risk conditions under A7_LLТ would 25% lower as under NAA, although
4 this is only 5% lower on an absolute scale.

5 Overall in the Sacramento River, Alternative 7 would have negligible effects on juvenile steelhead
6 rearing conditions based on negligible effects (<5%) on mean monthly flows with the exception of a
7 moderate reduction (-15%) in wet years, a small decrease (5%) in the percent of years classified as
8 “good” rearing habitat, and no effect on juvenile stranding risk, which collectively are not expected
9 to contribute to biologically meaningful effects in the Sacramento River.

10 **Clear Creek**

11 Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under
12 A7_LLТ would generally be similar to or sometimes greater than flows under NAA, except for below
13 normal years in March and critical years in September in which flows would be 6% and 13% lower,
14 respectively (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).Water
15 temperatures were not modeled in Clear Creek.

16 It was assumed that habitat for juvenile steelhead rearing would be constrained by the month
17 having the lowest instream flows. Juvenile rearing habitat is assumed to increase as instream flows
18 increase, and therefore the lowest monthly instream flow was used as an index of habitat
19 constraints for juvenile rearing. Results of the analysis indicate that juvenile steelhead rearing
20 habitat, based on minimum instream flows, is comparable for Alternative 7 relative to NAA in all
21 water years except in critical years when they would be 10% higher (Table 11-7-55).

22 **Table 11-7-55. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during**
23 **the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	A7_LLТ vs. EXISTING CONDITIONS	A7_LLТ vs. NAA
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	0 (0%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	-7 (-8%)	7 (10%)

Note: Minimum flows occurred between October and March.

24
25 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-
26 1A-4). The current Clear Creek management regime uses flows slightly lower than those
27 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being
28 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We
29 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.
30 No change in effect on steelhead in Clear Creek is anticipated.

31 Overall, these results indicate that Alternative 7 would not affect juvenile rearing conditions in Clear
32 Creek

1 **Feather River**

2 Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay
3 (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing
4 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is
5 the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al.
6 2003). Relatively constant flows in the low flow channel throughout the year under A7_LLTT would
7 not differ from those under NAA. In the high flow channel, flows under A7_LLTT would be mostly
8 lower (up to 32%) during April, July, August, September and December, mostly greater (up to 36%)
9 than flows under NAA during January, February, March, June and October, and mixed in May and
10 November.

11 May Oroville storage under A7_LLTT would be similar to or up to 16% higher under NAA (Table 11-7-
12 28). September Oroville storage volume would be 7% to 17% greater than under NAA depending on
13 water year type (Table 11-7-25). Mean monthly water temperatures in the Feather River in both
14 above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the
15 year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model
16 and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no
17 differences (<5%) in mean monthly water temperature between NAA and Alternative 7 in any
18 month or water year type throughout the period at either location.

19 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in
20 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and
21 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-
22 flow channel, the percent of months exceeding the threshold under Alternative 7 would generally be
23 similar to or lower (up to 20% lower on an absolute scale) than the percent under NAA (Table 11-7-
24 29). At Gridley, the percent of months exceeding the threshold under Alternative 7 would similar to
25 or up to 19% lower (absolute scale) than the percent under NAA (Table 11-7-40).

26 Total degree-months exceeding 56°F were summed by month and water year type in the Feather
27 River above Thermalito Afterbay (low-flow channel) and at Gridley during November through April.
28 In the low-flow channel, total degree-months under Alternative 7 would be similar to or lower than
29 those under NAA depending on the month (Table 11-7-30). At Gridley, total degree-months would
30 be similar between NAA and Alternative 7 for all months except October, November, and December,
31 in which degree-months would be 6% to 100% lower under Alternative 7 (Table 11-7-41).

32 Overall, despite some flow reductions in the high-flow channel during late summer, there would be
33 no substantial effects of Alternative 7 on steelhead rearing conditions in the Feather River.

34 **American River**

35 Flows in the American River at the confluence with the Sacramento River were examined for the
36 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
37 Analysis*). Flows under A7_LLTT would generally be similar to flows under NAA during January,
38 February, November and December, greater than flows under NAA during May, June and July, and
39 lower than flows under NAA during March, and August through September, and with both higher
40 and lower flows in October and November.

41 Mean monthly water temperatures in the American River at the confluence with the Sacramento
42 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period
43 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*

1 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
2 temperature between NAA and Alternative 7 in any month or water year type throughout the
3 period.

4 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt
5 Avenue Bridge was evaluated during May through October (Table 11-7-56). Except for the 3, 4, and
6 5 degree categories in June and July, the other months and degree categories under Alternative 7
7 would be similar or lower (up to 69% on the absolute scale) under NAA. The periods with higher
8 values range from 2% to 32% (absolute scale).

9 **Table 11-7-56. Differences between Baseline and Alternative 7 Scenarios in Percent of Months**
10 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**
11 **River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LL					
May	22 (113%)	9 (58%)	2 (22%)	6 (100%)	0 (0%)
June	31 (48%)	37 (70%)	43 (106%)	42 (136%)	36 (171%)
July	0 (0%)	1 (1%)	37 (59%)	57 (159%)	70 (407%)
August	0 (0%)	0 (0%)	14 (17%)	42 (87%)	51 (164%)
September	-17 (-20%)	2 (5%)	10 (31%)	9 (54%)	9 (117%)
October	6 (125%)	6 (250%)	6 (NA)	1 (NA)	0 (NA)
NAA vs. A7_LL					
May	-22 (-35%)	-26 (-53%)	-26 (-66%)	-20 (-62%)	-12 (-71%)
June	-4 (-4%)	-1 (-1%)	2 (3%)	7 (11%)	9 (18%)
July	0 (0%)	0 (0%)	2 (3%)	21 (29%)	32 (58%)
August	0 (0%)	-2 (-2%)	-5 (-5%)	-6 (-6%)	-9 (-10%)
September	-32 (-32%)	-42 (-43%)	-43 (-51%)	-49 (-67%)	-44 (-73%)
October	-69 (-86%)	-57 (-87%)	-40 (-86%)	-28 (-96%)	-11 (-100%)

NA = could not be calculated because the denominator was 0.

12
13 Total degree-months exceeding 65°F were summed by month and water year type at the Watt
14 Avenue Bridge during May through October (Table 11-7-57). During May, June, July and October,
15 total degree-months would be similar between NAA and Alternative 7 or up to 8% lower under
16 Alternative 7. During August and September, there would be a 1% to 3% increases in total degree-
17 months exceeding the threshold.

1 **Table 11-7-57. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 65°F in**
 3 **the Feather River at the Watt Avenue Bridge, May through October**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLTT	NAA vs. A7_LLTT
May	Wet	21 (350%)	0 (0%)
	Above Normal	23 (NA)	-4 (-15%)
	Below Normal	22 (733%)	-1 (-4%)
	Dry	30 (136%)	-4 (-7%)
	Critical	29 (153%)	-3 (-6%)
	All	125 (250%)	-12 (-6%)
June	Wet	51 (300%)	-17 (-20%)
	Above Normal	21 (88%)	-11 (-20%)
	Below Normal	32 (110%)	-6 (-9%)
	Dry	44 (65%)	4 (4%)
	Critical	47 (94%)	-3 (-3%)
	All	195 (104%)	-33 (-8%)
July	Wet	52 (67%)	3 (2%)
	Above Normal	12 (44%)	6 (18%)
	Below Normal	19 (56%)	-2 (-4%)
	Dry	36 (58%)	-15 (-13%)
	Critical	37 (46%)	-9 (-7%)
	All	156 (55%)	-17 (-4%)
August	Wet	103 (130%)	-5 (-3%)
	Above Normal	33 (80%)	0 (0%)
	Below Normal	39 (70%)	2 (2%)
	Dry	85 (125%)	4 (3%)
	Critical	67 (85%)	3 (2%)
	All	328 (102%)	5 (1%)
September	Wet	79 (329%)	5 (5%)
	Above Normal	40 (250%)	4 (8%)
	Below Normal	53 (189%)	6 (8%)
	Dry	84 (200%)	-2 (-2%)
	Critical	55 (112%)	2 (2%)
	All	311 (196%)	15 (3%)
October	Wet	54 (5,400%)	0 (0%)
	Above Normal	27 (NA)	1 (4%)
	Below Normal	37 (NA)	-2 (-5%)
	Dry	36 (NA)	-1 (-3%)
	Critical	29 (580%)	-1 (-3%)
	All	183 (3,050%)	-3 (-2%)

NA = could not be calculated because the denominator was 0.

4
 5 These results indicate that effects of Alternative 7 on flow and water temperatures would not reduce
 6 juvenile rearing conditions in the American River.

1 **Stanislaus River**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
3 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under Alternative 7 would be similar to flows under NAA throughout the period.

5 Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and
6 Alternative 7 throughout the year-round period (Appendix 11D, *Sacramento River Water Quality*
7 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

8 **San Joaquin River**

9 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing
10 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative
11 7 would be similar to flows under NAA throughout the period.

12 Water temperature modeling was not conducted in the San Joaquin River.

13 **Mokelumne River**

14 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing
15 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative
16 7 would be similar to flows under NAA throughout the period.

17 Water temperature modeling was not conducted in the Mokelumne River.

18 **NEPA Effects:** Collectively, these results indicate that the effect of Alternative 7 is not adverse
19 because it does not have the potential to substantially reduce rearing habitat. Effects of Alternative 7
20 on flows and water temperatures would be small and infrequent in the Sacramento, American,
21 Stanislaus, San Joaquin, and Mokelumne Rivers, and Clear Creek. Flow reductions in the Feather
22 River high-flow channel would be moderate in some months, but there would be no effect on flows
23 in the low-flow channel or on water temperatures in the low-flow and high-flow channels.

24 **CEQA Conclusion:** In general, Alternative 7 would not affect the quantity and quality of steelhead
25 rearing habitat for steelhead relative to CEQA Existing Conditions.

26 **Sacramento River**

27 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and
28 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM*
29 *II Model Results utilized in the Fish Analysis*). Flows during January through March, June, July and
30 October under A7_LLT would generally be similar to or greater than those under Existing
31 Conditions. Flows during May and August would be mixed with some water years below and some
32 water years above Existing Conditions. Flows during April, September, November and December
33 would generally be lower under A7_LLT than under Existing Conditions.

34 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
35 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*
36 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At
37 both locations, mean monthly water temperatures under Alternative 7 would generally be similar to
38 those under Existing Conditions, except during August through December, in which there would be
39 5% to 6% higher temperatures under Alternative 7.

1 SacEFT predicts that there would be a 10% increase in the percentage of years with good juvenile
2 rearing habitat under Alternative 7 compared to Existing Conditions (Table 11-7-51). SacEFT
3 predicts there would be a decrease of 56% in occurrence of years with “good” conditions for juvenile
4 stranding risk (Table 11-7-51). This would contribute incrementally to decreased juvenile habitat
5 conditions and would increase the potential for mortality due to stranding.

6 Based on the incremental effects of reductions in mean monthly flows (up to 21% lower) for some
7 months during drier water year types, and increased risk of juvenile stranding (56%), effects of
8 Alternative 7 on flows would have biologically meaningful effects on juvenile rearing conditions in
9 the Sacramento River.

10 **Clear Creek**

11 Flows in Clear Creek during the year-round rearing period under A7_LLT would generally be similar
12 to or greater than flows under Existing Conditions, except for critical years in August through
13 October in which flows would be 6% to 38% lower and in below normal years in October when
14 flows would be 6% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 No water temperature modeling was conducted in Clear Creek.

16 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and
17 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile
18 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream
19 flows affecting juvenile rearing habitat are shown in Table 11-7-55. Results indicate that Alternative
20 7 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to
21 Existing Conditions in all water years except for that they would be 8% lower in critical water years.

22 Based on the infrequency and relatively small magnitude (single occurrences of -17% and -38%) of
23 flow reductions under Alternative 7, and only small-scale effects on minimum instream flows (-8%),
24 Alternative 7 would not have biologically meaningful effects on juvenile steelhead rearing
25 conditions in Clear Creek.

26 **Feather River**

27 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and
28 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 7 relative to Existing
29 Conditions in the low-flow channel during the year-round steelhead juvenile rearing period
30 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at
31 Thermalito Afterbay), flows under A7_LLT would be mostly lower (up to 46% lower) during
32 January, May, November and December, mostly similar to or higher (up to 205% higher) in May,
33 June, August, and October, and mixed with some water years higher and some lower in March, April
34 and September.

35 As reported under Impact AQUA-59, May Oroville storage volume under A7_LLT would be similar to
36 storage under Existing Conditions, except in above normal and dry water years (5% and 9% lower,
37 respectively) (Table 11-7-28). Storage would not be different between Existing Conditions and
38 A7_LLT in other water year types.

39 As reported in Impact AQUA-58, September Oroville storage volume would be 9% to 31% lower
40 under A7_LLT relative to Existing Conditions depending on water year type (Table 11-7-25).

1 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
2 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile
3 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature
4 Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water
5 temperatures under Alternative 7 would be similar to those under Existing Conditions between
6 April and September, but would be 5% to 10% higher between October and March. In the high-flow
7 channel, mean monthly water temperatures under Alternative 7 would be similar to those under
8 Existing Conditions between March through July and in September, but would be 5% to 8% in the
9 remaining six months.

10 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in
11 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and
12 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-
13 flow channel, the percent of months exceeding the threshold under Alternative 7 would generally be
14 similar to the percent under Existing Conditions during May, and similar or up to 46% (absolute
15 scale) higher than the percent under Existing Conditions during June through August (Table 11-7-
16 29). At Gridley, the percent of months exceeding the threshold under Alternative 7 would similar to
17 the percent under Existing Conditions during December through February, but similar to or up to
18 51% greater (absolute scale) than the percent under Existing Conditions in the remaining 4 months
19 (Table 11-7-40).

20 Total degree-months exceeding 56°F were summed by month and water year type in the Feather
21 River above Thermalito Afterbay (low-flow channel) (May through August) at Gridley during
22 October through April. In the low-flow channel, total degree-months under Alternative 7 would be
23 similar to those under Existing Conditions during May and 47% to 168% higher during June through
24 August (Table 11-7-30). At Gridley, total degree-months under Alternative 7 would be similar to
25 those under Existing Conditions during December through February and 101% to 2,400% greater
26 than those under Existing Conditions in the remaining months of the period (Table 11-7-41).

27 These results indicate that the effects of Alternative 7 on water temperatures in the Feather River
28 would have biologically meaningful effects on juvenile rearing success.

29 **American River**

30 Flows in the American River at the confluence with the Sacramento River were examined for the
31 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
32 Analysis*). Flows under A7_LL7 would be generally lower than flows under Existing Conditions (up to
33 66% lower) in April through December (although there are individual water years with high flows
34 in May and June, up to 32% higher), generally higher flows in February and March (up to 32%
35 higher), and mixed higher and lower flows depending on water year in January.

36 Mean monthly water temperatures in the American River at the confluence with the Sacramento
37 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period
38 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results
39 utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
40 temperature between Existing Conditions and Alternative 7 during June and July but Alternative 7
41 temperatures would be higher in all other months by 5% to 12%.

42 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt
43 Avenue Bridge was evaluated during May through October (Table 11-7-54). During most months

1 and degree categories Alternative 7 temperatures are higher by up to 70% on the absolute scale.
2 Temperatures under Alternative 7 are similar to Existing Conditions in some degree categories
3 during July, August, and October.

4 Total degree-months exceeding 65°F were summed by month and water year type at the Watt
5 Avenue Bridge during May through October (Table 11-7-57). During all months there would be
6 increases in total-degree months under Alternative 7 compared to Existing Conditions. The
7 increases range from 55% to 3,050%.

8 These results indicate that effects of Alternative 7 on flows would affect juvenile steelhead rearing
9 conditions in the American River throughout most of the year, particularly during drier water years.

10 ***Stanislaus River***

11 Flows in the Stanislaus River for Alternative 7 are generally lower than Existing Conditions in most
12 water years in all months except that they are higher in above normal years in January, in wet years
13 in March and June and in below normal years in December. Mean monthly water temperatures in
14 the Stanislaus River at the confluence with the San Joaquin River were evaluated during the year-
15 round juvenile steelhead rearing period (Appendix 11D, *Sacramento River Water Quality Model and*
16 *Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water
17 temperatures under Alternatives 7 would be 6% greater than those under Existing Conditions
18 during all months except during June and July when they would be similar to those under Existing
19 Conditions.

20 ***San Joaquin River***

21 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing
22 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows
23 under Alternative 7 would be similar to flows under Existing Conditions during January through
24 May and October through December and lower during June through September. However, flows
25 would be lower during majority of water year types within each month from February through May
26 and during October.

27 Water temperature modeling was not conducted in the San Joaquin River.

28 ***Mokelumne River***

29 Mean monthly flows in the Mokelumne River for Alternative 7 are generally lower than Existing
30 Conditions during all months except during March, in which flows would be similar and during
31 January, February and December, in which they would be up to 18% higher depending on water
32 year type.

33 Water temperature modeling was not conducted in the Mokelumne River.

34 ***Summary of CEQA Conclusion***

35 Collectively, the results Impact AQUA-95 CEQA analysis indicate that the impact would be significant
36 because it has the potential to substantially reduce rearing habitat y. Juvenile rearing conditions in
37 the Sacramento, Trinity, Feather and American rivers would be affected under Alternative 7.
38 Degraded rearing conditions for juvenile steelhead would reduce their survival and growth in these
39 waterways.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate
2 change, future water demands, and implementation of the alternative. The analysis described above
3 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
4 alternative from those of sea level rise, climate change and future water demands using the model
5 simulation results presented in this chapter. However, the increment of change attributable to the
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
8 implementation period, which does include future sea level rise, climate change, and water
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
13 term implementation period and Alternative 7 indicates that flows in the locations and during the
14 months analyzed above would generally be similar between Existing Conditions during the LLT and
15 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
16 found above would generally be due to climate change, sea level rise, and future demand, and not
17 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
19 result in a significant impact on rearing habitat for steelhead. This impact is found to be less than
20 significant and no mitigation is required.

21 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

22 In general, the effects of Alternative 7 on steelhead migration conditions relative to the NAA are
23 uncertain.

24 ***Sacramento River***

25 *Juveniles*

26 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
27 May juvenile steelhead migration period. Flows under A7_LL7 would be higher than NAA in some
28 water years during February and May (up to 11% higher), similar to NAA during October through
29 January, March, and April, and lower than NAA (up to 14% lower) during November (Appendix 11C,
30 *CALSIM II Model Results utilized in the Fish Analysis*).

31 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
32 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento
33 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
34 There would be no differences (<5%) in mean monthly water temperature between NAA and
35 Alternative 7 in any month or water year type throughout the period.

36 *Adults*

37 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
38 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in
39 the Fish Analysis*). Flows under A7_LL7 would be higher than NAA in some water years during
40 February (up to 11% higher), similar to NAA during September through January, and March, and
41 lower than NAA (up to 14% lower) during, November.

1 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
2 during the September through March steelhead adult upstream migration period (Appendix 11D,
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
5 NAA and Alternative 7 in any month or water year type throughout the period.

6 ***Kelt***

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
8 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
9 *Fish Analysis*). Flows during these two months would be minimally different between NAA and
10 A7_LL.T.

11 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
12 during the March through April steelhead kelt downstream migration period (Appendix 11D,
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
15 NAA and Alternative 7 in any month or water year type throughout the period.

16 Overall in the Sacramento River, these results indicate that Alternative 7 would not have biologically
17 meaningful effects on steelhead kelt migration, but would have biologically meaningful effects on
18 juvenile and adult steelhead migration.

19 ***Clear Creek***

20 Water temperatures were not modeled in Clear Creek.

21 ***Juveniles***

22 Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period
23 under A7_LL.T would generally be similar to or greater than flows under NAA except in below
24 normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
25 *Analysis*).

26 ***Adults***

27 Flows in Clear Creek during the September through March adult steelhead migration period under
28 A7_LL.T would generally be similar to or greater than flows under NAA except in critical years in
29 September (13% lower) and below normal years in March (6% lower) (Appendix 11C, *CALSIM II*
30 *Model Results utilized in the Fish Analysis*).

31 ***Kelt***

32 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
33 under A7_LL.T would generally be similar to flows under NAA except in below normal years in
34 March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 Overall in Clear Creek, these results indicate that effects of Alternative 7 on flows would not affect
36 juvenile, adult, or kelt steelhead migration.

1 **Feather River**

2 *Juveniles*

3 Flows in the Feather River at the confluence with the Sacramento River were examined during the
4 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
5 *utilized in the Fish Analysis*). Flows under A7_LLTP would generally be similar to or greater than flows
6 under NAA in all months and water years except during November in above normal years (8%
7 lower) and dry years during December (17% lower) while flows during May would be mixed with
8 similar flows, lower flows during below normal and critical years (7% and 16% lower, respectively)
9 but higher in critical years (13% higher).

10 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
11 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
13 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
14 NAA and Alternative 7 in any month or water year type throughout the period.

15 *Adults*

16 Flows in the Feather River at the confluence with the Sacramento River were examined during the
17 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
18 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTP would generally be similar to or
19 greater than flows under NAA in all months and water years except during November in above
20 normal years (8% lower) and dry years during December (17% lower) while flows in September
21 would generally be lower (13%, 25% and 17%, lower in wet, above normal, and below normal
22 water years) and 15% higher in critical water years.

23 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
24 were evaluated during the September through March steelhead adult upstream migration period
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
26 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
27 temperature between NAA and Alternative 7 in any month or water year type throughout the
28 period.

29 *Kelt*

30 Flows in the Feather River at the confluence with the Sacramento River were examined during the
31 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
32 *Results utilized in the Fish Analysis*). Flows under A7_LLTP would be similar to those under NAA in
33 March although 8% greater in below normal water years and similar to flows under NAA in April.

34 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
35 were evaluated during the March through April steelhead kelt downstream migration period
36 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
37 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
38 temperature between NAA and Alternative 7 in any month or water year type throughout the
39 period.

40 Overall in the Feather River, the effects of Alternative 7 on flows would not have biologically
41 meaningful effects on juvenile, adult, or kelt steelhead migration.

1 **American River**

2 *Juveniles*

3 Flows in the American River at the confluence with the Sacramento River were evaluated during the
4 October through May juvenile steelhead migration period. Flows under A7_LLTP would be lower than
5 under NAA during October (12% lower in below normal years although 8% higher in dry years),
6 March (up to 17% lower in critical years) and April (up to 15% lower in dry years), generally similar
7 to flows under NAA during November, December, January and February, and higher than under NAA
8 during May (20% higher in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
9 *Analysis*).

10 Mean monthly water temperatures in the American River at the confluence with the Sacramento
11 River were evaluated during the October through May juvenile steelhead migration period
12 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
13 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
14 temperature between NAA and Alternative 7 in any month or water year type throughout the
15 period.

16 *Adults*

17 Flows in the American River at the confluence with the Sacramento River were evaluated during the
18 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
19 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTP would be variable in September (up
20 to 15% lower in below normal years but up to 27% higher in critical years), lower than under NAA
21 during October (12% lower in below normal years although 8% higher in dry years) and March (up
22 to 17% lower in critical years), generally similar to flows under NAA during November, December,
23 January and February.

24 Mean monthly water temperatures in the American River at the confluence with the Sacramento
25 River were evaluated during the September through March steelhead adult upstream migration
26 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
27 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
28 temperature between NAA and Alternative 7 in any month or water year type throughout the period

29 *Kelt*

30 Flows in the American River at the confluence with the Sacramento River were evaluated for the
31 March and April kelt migration period. Flows under A7_LLTP would generally be lower during March
32 (up to 17% lower in critical years) and April (up to 15% lower in dry years and 9% lower in critical
33 years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 Mean monthly water temperatures in the American River at the confluence with the Sacramento
35 River were evaluated during the March through April steelhead kelt downstream migration period
36 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
37 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
38 temperature between NAA and Alternative 7 in any month or water year type throughout the
39 period.

40 Overall in the American River, the effects of Alternative 7 on flows would affect kelt migration in dry
41 and critical years but would not affect juvenile and adult migration.

1 **Stanislaus River**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 7 are not
3 different from flows under NAA for any month except for higher flows in below normal, dry and
4 critical water years during June. Therefore, there would be no effect of Alternative 7 on juvenile,
5 adult, or kelt migration in the Stanislaus River.

6 Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San
7 Joaquin River for Alternative 7 are not different from flows under NAA for any month. Therefore,
8 there would be no effect of Alternative 7 on juvenile, adult, or kelt migration in the Stanislaus River.

9 **San Joaquin River**

10 Flows in the San Joaquin River at Vernalis for Alternative 7 are not different from flows under NAA
11 for any month. Therefore, there would be no effect of Alternative 7 on juvenile, adult, or kelt
12 migration in the San Joaquin River.

13 Water temperature modeling was not conducted in the San Joaquin River.

14 **Mokelumne River**

15 Flows in the Mokelumne River at the Delta for Alternative 7 are not different from flows under NAA
16 for any month. Therefore, there would be no effect of Alternative 7 on juvenile, adult, or kelt
17 migration in the Mokelumne River.

18 Water temperature modeling was not conducted in the Mokelumne River.

19 **Through-Delta**

20 The methodology for assessing steelhead Delta migration habitat conditions is fully described in the
21 analysis of Alternative 1A.

22 **Sacramento River**

23 *Juveniles*

24 DPM results for Alternative 7 for fall-run Chinook salmon from the Sacramento River (Impact AQUA-
25 78 for Alternative 7) predict decreases in survival of less than 0.5%. Juvenile steelhead are not
26 expected to be negatively affected by predation at the three NDD intakes because of their size and
27 strong swimming ability.

28 *Adults*

29 The upstream adult steelhead migration occurs from September-March, peaking during December-
30 February. The steelhead kelt downstream migration occurs from January-April. For Sacramento
31 River steelhead, straying rates of adult hatchery-origin Chinook salmon that were released upstream
32 of the Delta are low (Marston et al. 2012). Although straying rates for hatchery-origin steelhead
33 apparently have not been examined in detail, for this analysis of effects, it was assumed with high
34 certainty (based on Chinook salmon rates), that Plan Area flows in relation to straying have low
35 importance under Existing Conditions for adult Sacramento River region steelhead.

36 The proportion of Sacramento River water in the Delta under Alternative 7 during the adult
37 migration period would be increased 13% in September and slightly reduced (1% to 9% decrease)

1 during October to March compared to NAA (Table 11-7-58). The proportion of Sacramento River
 2 flow would still comprise 62% to 78% of flows, which would maintain strong olfactory cues for
 3 migrating adults under Alternative 7.

4 **Table 11-7-58. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
 5 **San Joaquin River during the Steelhead Migration Period for Alternative 7**

Month	EXISTING CONDITIONS	NAA	A7_LLТ	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Sacramento River					
September	60	65	78	18	13
October	60	68	67	7	-1
November	60	66	62	2	-4
December	67	66	65	-2	-1
January	76	75	73	-3	-2
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	59	-10	-6
June	64	62	56	-8	-6
San Joaquin River					
September	0.3	0.1	1.1	0.8	1.0
October	0.2	0.3	4.5	4.3	4.2
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.2	5.3	5.2
January	1.6	1.7	7.0	5.4	5.3
February	1.4	1.5	7.1	5.7	5.6
March	2.6	2.8	8.8	6.2	6.0
April	6.3	6.6	14.0	7.7	7.4
Shading indicates a difference of 10% of greater in flow proportion.					

6

7 **San Joaquin River**

8 *Juveniles*

9 The only changes on San Joaquin River flows at Vernalis would result from the modeled effects of
 10 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. As
 11 discussed for fall-run Chinook (Impact AQUA-78), there is a beneficial effect of Alternative 7 to all
 12 San Joaquin River basin fish due to positive Old and Middle River flows during migratory months
 13 resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected
 14 to decrease entrainment at South Delta facilities and reduce predation hotspots to promote greater
 15 survival to Chipps Island. Furthermore under Alternative 7, entrainment and entrainment-related
 16 mortality at the South Delta Facilities would be reduced.

17 Additionally, under Alternative 7, the reduction of entrainment at the South Delta Facilities would
 18 alleviate one of the primary concerns related to potential Old and Middle River corridor habitat

1 restoration. Successful restoration in this area would be expected to enhance rearing habitat, food
2 availability, and overall salmonid fitness and survival.

3 *Adults*

4 The proportion of San Joaquin River water in the Delta in September through December under
5 Alternative 7 (1.1% to 7.9%) would increase appreciably by 1% to 6.9% compared to NAA (Table
6 11-7-58). Little information apparently currently exists as to the importance of Plan Area flows on
7 the straying of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run
8 Chinook salmon (Marston et al. 2012). It was assumed with moderate certainty that the attribute of
9 Plan Area flows (including olfactory cues associated with such flows) is of high importance to adult
10 San Joaquin River region steelhead adults as well. Therefore migration conditions would be
11 improved, and Alternative 7 would have a slight beneficial effect on the adult steelhead and kelt
12 migration.

13 **NEPA Effects:** Upstream of the Delta, these results indicate that the effect is not adverse because it
14 would not substantially reduce the amount of suitable habitat or substantially interfere with the
15 movement of fish. Effects of Alternative 4 in all locations analyzed would consist primarily of
16 negligible effects on mean monthly flow and water temperatures for the juvenile, adult, and kelt
17 migration periods.

18 Near-field effects of Alternative 7 NDD on Sacramento River steelhead related to impingement and
19 predation associated with three new intake structures could result in negative effects on juvenile
20 migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected
21 that the level of near-field impacts would be directly correlated to the number of new intake
22 structures in the river and thus the level of impacts associated with 3 new intakes would be
23 considerably lower than those expected from having 5 new intakes in the river. Estimates within the
24 effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~
25 12% mortality above current baseline levels). CM15 would be implemented with the intent of
26 providing localized and temporary reductions in predation pressure at the NDD. Additionally,
27 several pre-construction surveys to better understand how to minimize losses associated with the
28 three new intake structures will be implemented as part of the final NDD screen design effort.
29 Alternative 7 also includes an Adaptive Management Program and Real-Time Operational Decision-
30 Making Process to evaluate and make limited adjustments intended to provide adequate migration
31 conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere
32 in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the
33 NDD remains highly uncertain.

34 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
35 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
36 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 7
37 predict improvements in smolt condition and survival associated with increased access to the Yolo
38 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
39 of each of these factors and how they might interact and/or offset each other in affecting salmonid
40 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

41 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
42 all of these elements of BDCP operations and conservation measures to predict smolt migration
43 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
44 migration survival under Alternative 7 would be similar to those estimated for NAA. Further

1 refinement and testing of the DPM, along with several ongoing and planned studies related to
2 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
3 future. These efforts are expected to improve our understanding of the relationships and
4 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
5 around the potential effects of BDCP implementation on migration conditions for steelhead.
6 However, until these efforts are completed and their results are fully analyzed, the overall
7 cumulative effect of Alternative 7 on steelhead migration remains uncertain.

8 For through Delta San Joaquin River flows there would be not any project-related flow changes at
9 Vernalis for juvenile steelhead. For adult steelhead through Delta flow would be similar or slightly
10 improved. The through-Delta effect for the San Joaquin River would not be adverse.

11 **CEQA Conclusion:** In general, Alternative 7 would not affect the quantity and quality of migration
12 habitat for steelhead relative to CEQA Existing Conditions.

13 **Upstream of the Delta**

14 ***Sacramento River***

15 *Juveniles*

16 May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
17 *Analysis*). Flows under A7_LLTP would be generally similar during October, November, January and
18 March with some higher and lower individual water years, generally lower during December (7%
19 lower in below normal and dry water years) and April (9% lower in below normal years), greater
20 flows than Existing Conditions in February, and mixed flows in May with both lower flows (17% and
21 11% lower in wet and below normal water years, respectively) and higher flows (8% and 14%
22 higher in above normal and critical years, respectively).

23 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
24 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*
25 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
26 There would be no differences (<5%) in mean monthly water temperature between Existing
27 Conditions and Alternative 7 in all months but October, in which temperatures under Alternative 7
28 would be 5% greater than those under Existing Conditions.

29 *Adults*

30 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
31 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*
32 *the Fish Analysis*). Flows under A7_LLTP would be generally similar during October, November,
33 January and March with some higher and lower individual water years, generally lower during
34 December (7% lower in below normal and dry water years) and April (9% lower in below normal
35 years), greater flows than Existing Conditions in February, and mixed higher and lower flows in
36 September (up to 52% higher in above normal years and 16%, 18% and 19% lower in below
37 normal, dry and critical years, respectively) and May (17% and 11% lower in wet and below normal
38 water years, respectively; and 8% and 14% higher in above normal and critical years, respectively).

39 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
40 during the September through March steelhead adult upstream migration period (Appendix 11D,
41 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
2 Existing Conditions and Alternative 7 in all months except September and October, in which
3 temperatures under Alternative 7 would be 5% to 6% greater than those under Existing Conditions.

4 *Kelts*

5 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
6 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
7 *Fish Analysis*). Flows under A7_LLТ would generally be similar to those under Existing Conditions
8 during March except in below normal water years (11% lower) and lower than under Existing
9 Conditions in April (9% and 6% lower in below normal and dry water years, respectively).

10 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
11 during the March through April steelhead kelt downstream migration period (Appendix 11D,
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
13 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
14 Existing Conditions and Alternative 7 in any month or water year type throughout the period

15 Overall in the Sacramento River, the impacts of Alternative 7 on flows would not affect juvenile,
16 adult, or kelt steelhead migration.

17 **Clear Creek**

18 Water temperatures were not modeled in Clear Creek.

19 *Juveniles*

20 Flows in Clear Creek during the October through May juvenile steelhead migration period under
21 A7_LLТ would generally be similar to or greater than flows under Existing Conditions (up to 54%
22 greater) except in below normal years during October (6% lower) (Appendix 11C, *CALSIM II Model*
23 *Results utilized in the Fish Analysis*).

24 *Adults*

25 Flows in Clear Creek during the September through March adult steelhead migration period under
26 A7_LLТ would generally be similar to flows under Existing Conditions (up to 54% greater) except in
27 critical years during September (38% lower) and below normal years during October (6% lower)
28 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 *Kelt*

30 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
31 under A7_LLТ would generally be similar to or greater than flows under Existing Conditions (up to
32 8% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 Overall in Clear Creek, the impacts of Alternative 7 on flows would not affect juvenile, adult, or kelt
34 steelhead migration.

1 **Feather River**

2 *Juveniles*

3 Flows in the Feather River at the confluence with the Sacramento River were examined during the
4 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
5 *utilized in the Fish Analysis*). Flows under A7_LLTP would be generally lower than flows under
6 Existing Conditions during November, December, January, and May (up to 34% lower) although May
7 would have higher flows in critical water years (9% higher), higher flows during October (e.g., 13%
8 higher in critical years), similar or greater flows in February (although 12% lower in below normal
9 water years), and mixed flows during March with lower flows in below normal and critical water
10 years (8% each) and greater in wet and above normal (10% and 13%, respectively).

11 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
12 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,
13 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
14 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
15 Existing Conditions and Alternative 7 in all months except November and December, in which
16 temperatures under Alternative 7 would be 5% greater than temperatures under Existing
17 Conditions.

18 *Adults*

19 Flows in the Feather River at the confluence with the Sacramento River were examined during the
20 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
21 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTP would be generally lower than flows
22 under Existing Conditions during November, December, January, and May (up to 34% lower)
23 although May would have higher flows in critical water years (9% higher), higher flows during
24 October (e.g., 13% higher in critical years), similar or greater flows in February (although 12%
25 lower in below normal water years), and mixed flows during September (10%, 57%, and 10%
26 higher in wet, above normal and critical water years, respectively; and 7%, 33% lower in below
27 normal and dry water years, respectively) and March (8% lower flows in below normal and critical
28 water years; and 10% and 13% greater in wet and above normal respectively).

29 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
30 were evaluated during the September through March steelhead adult upstream migration period
31 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
32 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
33 temperature between Existing Conditions and Alternative 7 in all months except November and
34 December, in which temperatures under Alternative 7 would be 5% greater than temperatures
35 under Existing Conditions.

36 *Kelt*

37 Flows in the Feather River at the confluence with the Sacramento River were examined during the
38 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
39 *Results utilized in the Fish Analysis*). Flows under A7_LLTP would be mixed during March (8% lower
40 flows in below normal and critical water years; and 10% and 13% greater in wet and above normal
41 respectively) and generally similar during April with slightly lower flows during critical years (6%
42 lower).

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
2 were evaluated during the March through April steelhead kelt downstream migration period
3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
5 temperature between Existing Conditions and Alternative 7 in any month or water year type
6 throughout the period.

7 Overall in the Feather River, the impact of Alternative 7 on flows would affect juvenile, adult, and
8 kelt migration conditions.

9 **American River**

10 *Juveniles*

11 Flows in the American River at the confluence with the Sacramento River were evaluated during the
12 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
13 *utilized in the Fish Analysis*). Flows under A7_LLTP would generally be lower during October,
14 November, December, January, April and May (up to 33% lower in dry water years during
15 November and above normal water years in May). Flows during February and March would
16 generally be higher (up to 27%) except that they would be 24% and 20% lower, respectively, in
17 critical water years for both months.

18 Mean monthly water temperatures in the American River at the confluence with the Sacramento
19 River were evaluated during the October through May juvenile steelhead migration period
20 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
21 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 5% to
22 11% higher than those under Existing Conditions in all months during the period except December
23 and April, in which there would be no difference in water temperatures between Existing Conditions
24 and Alternative 7.

25 *Adults*

26 Flows in the American River at the confluence with the Sacramento River were evaluated during the
27 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
28 *Model Results utilized in the Fish Analysis*). Flows under A7_LLTP would generally be lower during
29 September, October, November, December, and January (up to 46% lower in critical water years
30 during September). Flows during February and March would generally be higher (up to 27%) except
31 that they would be 24% and 20% lower, respectively, in critical water years for both months.

32 Mean monthly water temperatures in the American River at the confluence with the Sacramento
33 River were evaluated during the September through March steelhead adult upstream migration
34 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
35 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 1A would
36 be 5% to 11% higher than those under Existing Conditions in all months during the period except
37 December, in which there would be no difference in water temperatures between Existing
38 Conditions and Alternative 7.

39 *Kelt*

40 Flows in the American River at the confluence with the Sacramento River were evaluated for the
41 March and April kelt migration period. Flows during March would generally be higher (up to 15%)

1 than under Existing Conditions except that they would be 20% lower in critical water years. Flows
2 during April would be lower (up to 15% lower in dry water years) than under Existing Conditions.

3 Mean monthly water temperatures in the American River at the confluence with the Sacramento
4 River were evaluated during the March through April steelhead kelt downstream migration period
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
6 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 5%
7 higher than those under Existing Conditions in March but temperatures would be similar between
8 Existing Conditions and Alternative 7 during April.

9 Overall in the American River, the impacts of Alternative 7 on flows would affect juvenile, adult and
10 kelt steelhead migration in drier water years.

11 **Stanislaus River**

12 *Juveniles*

13 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
14 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be 6% to
16 16% lower than flows under Existing Conditions depending on month except during January, in
17 which there would be no difference.

18 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
19 River were evaluated during the October through May steelhead juvenile downstream migration
20 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
21 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would
22 be 6% higher than those under Existing Conditions in all months during the period except October,
23 in which temperature would be similar between Existing Conditions and Alternative 7.

24 *Adults*

25 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
26 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
27 *Model Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be 6% to
28 16% lower than flows under Existing Conditions depending on month, except during January, in
29 which there would be no differences.

30 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
31 River were evaluated during the September through March steelhead adult upstream migration
32 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
33 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be
34 6% higher than those under Existing Conditions in all months during the period except October, in
35 which temperature would be similar between Existing Conditions and Alternative 7.

36 *Kelt*

37 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
38 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
39 *Results utilized in the Fish Analysis*). Mean monthly flows under Alternative 7 would be 8% to 11%
40 lower than flows under Existing Conditions during March and April, respectively.

1 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
2 River were evaluated during the March and April steelhead kelt downstream migration period
3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
4 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 7 would be 6%
5 higher than those under Existing Conditions during March and April.

6 ***San Joaquin River***

7 Water temperature modeling was not conducted in the San Joaquin River.

8 *Juveniles*

9 Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead
10 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
11 *Analysis*). Mean monthly flows under Alternative 7 would be 6% greater than flows under Existing
12 Conditions during January, and similar in the remaining 7 months of the period.

13 *Adults*

14 Flows in the San Joaquin River at Vernalis were evaluated for the September through March
15 steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
16 *Fish Analysis*). Mean monthly flows under Alternative 7 would be 6% greater than flows under Existing
17 Conditions during January, 8% lower during September, and similar in the remaining 5 months of
18 the period.

19 *Kelt*

20 Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt
21 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
22 Mean monthly flows under Alternative 7 similar to flows under Existing Conditions in both March
23 and April.

24 ***Mokelumne River***

25 Water temperature modeling was not conducted in the Mokelumne River.

26 *Juveniles*

27 Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead
28 juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*). Mean monthly flows under Alternative 7 would be similar to flows under Existing
30 Conditions during October and March, 8% to 12% lower than flows under Existing Conditions
31 during November, April, and May, and 12% to 14% higher than flows under Existing Conditions
32 during December through February.

33 *Adults*

34 Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead
35 adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
36 *Analysis*). Mean monthly flows under Alternative 7 would be similar to flows under Existing
37 Conditions during October and March, 9% to 27% lower than flows under Existing Conditions

1 during September and November, and 12% to 14% higher than flows under Existing Conditions
2 during December through February.

3 *Kelt*

4 Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt
5 downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
6 Mean monthly flows under Alternative 7 would be similar to flows under Existing Conditions during
7 March and 8% lower during April.

8 **Through-Delta**

9 ***Sacramento River***

10 Based on DPM results for Chinook salmon (Impact AQUA-42), survival of migrating juvenile
11 steelhead under Alternative 7, would be no lower than survival under NAA. Juvenile steelhead are
12 not expected to be negatively impacted by predation at the three NDD intakes because of their size
13 and strong swimming ability. Therefore the impact on juvenile steelhead migration through the
14 Delta would be substantial.

15 Although straying rates for hatchery-origin steelhead apparently have not been examined in detail,
16 for this analysis of effects, it was assumed with high certainty (based on Chinook salmon rates), that
17 Plan Area flows in relation to straying have low importance under Existing Conditions for adult
18 Sacramento River region steelhead. The proportion of January-March Sacramento River flows in the
19 Delta under Alternative 7 would be slightly reduced compared to Existing Conditions (Table 11-7-
20 49). The proportion of Sacramento River flows would still predominate the flow at Collinsville, thus
21 providing strong olfactory cues during the entire migration period. Alternative 7 would not
22 significantly affect adult migration.

23 ***San Joaquin River***

24 *Juveniles*

25 There would be no impact on flows in the San Joaquin River at Vernalis under Alternative 7. As
26 discussed for fall-run Chinook (Impact AQUA-78), there is a beneficial effect of Alternative 7 to all
27 San Joaquin River basin fish due to positive Old and Middle River flows during migratory months
28 resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected
29 to decrease entrainment at South Delta facilities and reduce predation hotspots to promote greater
30 survival to Chippis Island. Furthermore under Alternative 7, entrainment and entrainment-related
31 mortality at the South Delta Facilities would be reduced.

32 Additionally, under Alternative 7, the reduction of entrainment at the South Delta Facilities would
33 alleviate one of the primary concerns related to potential Old and Middle River corridor habitat
34 restoration. Successful restoration in this area would be expected to enhance rearing habitat, food
35 availability, and overall salmonid fitness and survival.

36 *Adults*

37 The proportion of San Joaquin River-origin water in the flows at Collinsville during the migration
38 period would be 1.1% to 8.9% under Alternative 7, compared to 0.2% to 2.6% under Existing

1 Conditions (Table 11-7-58). This change would substantially increase olfactory cues from San
2 Joaquin River basin, and improve migration conditions.

3 **Summary of CEQA Conclusion**

4 The results of the Impact AQUA-96 analysis indicate generally similar impacts between Alternative 7
5 and Existing Conditions on locations upstream of the Delta, through Delta conditions on the
6 Sacramento River and through Delta conditions on the San Joaquin River.

7 Through the Delta, Alternative 7 would result in some effects on flow conditions, during steelhead
8 migration periods (juvenile, adult and kelt), although these effects would not be substantial in both
9 the Sacramento River and San Joaquin River. Similarly, olfactory effects are not expected to be
10 substantial in both locations. Consequently, the through the Delta impacts of Alternative 7 in the
11 both the Sacramento River and the San Joaquin River would be less than significant and no
12 mitigation is required.

13 Collectively, upstream of the Delta, the results of Impact AQUA-96 CEQA analysis indicate that the
14 effect would be significant because it has the potential to substantially reduce the amount of suitable
15 habitat and substantially interfere with the movement of fish, relative to CEQA Existing Conditions.
16 Flows would be substantially lower in all upstream waterways except in Clear Creek and the San
17 Joaquin River. Reduced migration conditions would delay or eliminate successful migration
18 necessary to complete the steelhead life cycle. Flows and water temperature conditions would not
19 affect migration conditions for steelhead.

20 These results are primarily caused by four factors: differences in sea level rise, differences in climate
21 change, future water demands, and implementation of the alternative. The analysis described above
22 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
23 alternative from those of sea level rise, climate change and future water demands using the model
24 simulation results presented in this chapter. However, the increment of change attributable to the
25 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
26 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
27 implementation period, which does include future sea level rise, climate change, and water
28 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
29 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
30 effect of the alternative from those of sea level rise, climate change, and water demands.

31 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
32 term implementation period and Alternative 7 indicates that flows in the locations and during the
33 months analyzed above would generally be similar between Existing Conditions during the LLT and
34 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
35 found above would generally be due to climate change, sea level rise, and future demand, and not
36 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
37 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
38 result in a significant impact on migration conditions for steelhead. This impact is found to be less
39 than significant and no mitigation is required.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

3 **NEPA Effects:** The potential effects of restoration construction activities under Alternative 7 would
4 be greater than that described for Alternative 1A due to the increased floodplain and channel
5 margin habitat enhancement (see Impact AQUA-97). This would include potential effects of
6 turbidity, mercury methylation, accidental spills, disturbance of contaminated sediments
7 underwater noise, fish stranding, and predation elements. However, as concluded in Alternative 1A,
8 Impact AQUA-97, restoration construction activities are not expected to adversely affect steelhead.

9 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-97 for steelhead, the potential
10 impact of restoration construction activities is considered less than significant, and no mitigation
11 would be required.

12 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

13 The potential effects of contaminants associated with restoration measures under Alternative 7
14 would be the same as those described for Alternative 1A (see Impact AQUA-98). This would include
15 potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate pesticides
16 and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000 acres of
17 seasonally inundated floodplain and additional 20 miles of channel margin habitat but the effects
18 would be the same as described under Alternative 1A.

19 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-98, contaminants associated with
20 restoration measures are not expected to adversely affect steelhead with respect to selenium,
21 copper, ammonia and pesticides. The effects of methylmercury on steelhead are uncertain.

22 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-98 for steelhead, the potential
23 impact of contaminants associated with restoration measures is considered less than significant, and
24 no mitigation would be required. The same conclusion applies to the additional restoration in
25 Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of
26 channel margin habitat).

27 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

28 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
29 described for Alternative 1A (see Impact AQUA-99). These would include *CM2 Yolo Bypass Fisheries*
30 *Enhancements*, *CM4 Tidal Natural Communities Restoration*, *CM5 Seasonally Inundated Floodplain*
31 *Restoration*, *CM6 Channel Margin Enhancement*, *CM7 Riparian Natural Community Restoration*, and
32 *CM10 Nontidal Marsh Restoration*. It would also include the additional 10,000 acres of seasonally
33 inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

34 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-99, restored habitat conditions are
35 expected to be beneficial for steelhead and the additional restoration included in Alternative 7
36 provides proportionally more benefit.

37 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-99 for steelhead, the potential
38 impact of restored habitat conditions on steelhead is considered to be beneficial. The additional
39 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20

1 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation
2 would be required.

3 **Other Conservation Measures (CM12–CM19 and CM21)**

4 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

5 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

6 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

7 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

8 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

9 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

10 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

11 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

12 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**
13 **(CM21)**

14 **NEPA Effects:** Detailed discussions regarding the potential effects of these impact mechanisms on
15 steelhead are the same as those described under Alternative 1A (Impact AQUA-100 through 108).
16 The effects range from no effect, to not adverse, to beneficial.

17 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
18 less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-100
19 through 108), and no mitigation is required.

20 **Sacramento Splittail**

21 **Construction and Maintenance of CM1**

22 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**
23 **Splittail**

24 The potential effects of construction of the water conveyance facilities on Sacramento splittail would
25 be similar to those described for Alternative 1A (Impact AQUA-109) except that Alternative 7 would
26 include three intakes compared to five intakes under Alternative 1A, so the effects would be
27 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
28 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
29 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
30 would require 27.3 acres of dredging.

31 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-109, environmental commitments and
32 mitigation measures would be available to avoid and minimize potential effects, and the effect would
33 not be adverse for Sacramento splittail.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-109, the impact of the construction
2 of water conveyance facilities on Sacramento splittail would be less than significant except for
3 construction noise associated with pile driving. Potential pile driving impacts would be less than
4 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
5 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
6 less than significant.

7 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
8 **of Pile Driving and Other Construction-Related Underwater Noise**

9 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

10 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
11 **and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

13 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**
14 **Splittail**

15 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
16 the same as those described for Alternative 1A (see Impact AQUA-110) except that only three
17 intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

18 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-110, the effect would not be adverse for
19 Sacramento splittail.

20 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance
21 of water conveyance facilities on Sacramento splittail would be less than significant and no
22 mitigation would be required.

23 **Water Operations of CM1**

24 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

25 ***Water Exports from SWP/CVP South Delta Facilities***

26 Total salvage of juvenile splittail at the south Delta facilities (estimated from Yolo Bypass
27 inundation) averaged across all water years is predicted to be 53% greater under Alternative 7
28 compared to NAA (Table 11-7-59). The greatest increase in total salvage would be in below normal
29 (512-581%) and above normal (922-65% more) water years. However, this effect is related to the
30 expected increase in overall juvenile splittail abundance resulting from additional floodplain habitat
31 in wetter years. The per capita juvenile splittail salvage averaged across all years would be 69%
32 lower under Alternative 7 compared to NAA (Table 11-7-60). Per capita juvenile salvage would be
33 less for all water year types under Alternative 7. Potential adult entrainment (salvage density)
34 would be 80-81% less for adults across all water year types (Table 11-7-61). The decrease in per
35 capita salvage of splittail is due to strict reductions in south Delta exports, especially during the
36 winter and spring months. The relative impact of entrainment on the splittail population would be
37 less under Alternative 7 because the per capita entrainment risk would be lower compared to NAA.

1 **Table 11-7-59. Juvenile Sacramento Splittail Entrainment Index^a (Yolo Bypass Inundation Method)**
2 **at the SWP and CVP Salvage Facilities Differences between Model Scenarios for Alternative 7**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	631,597 (66%)	444,938 (39%)
Above Normal	350,188 (765%)	358,793 (965%)
Below Normal	16,917 (495%)	17,349 (581%)
Dry	1,874 (65%)	2,219 (87%)
Critical	-181 (-12%)	270 (25%)
All Years	254,783 (82%)	197,073 (53%)

Shading indicates entrainment increased 10% or more.

^a Average May-July salvage number, based on normalized data, estimated from Yolo Bypass Inundation Method.

3

4 **Table 11-7-60. Juvenile Sacramento Splittail Entrainment Index^a (per Capita Method) at the**
5 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 7**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-1,516,642 (-76%)	-1,192,323 (-71%)
Above Normal	-122,909 (-93%)	-105,077 (-91%)
Below Normal	-9,213 (-92%)	-8,895 (-92%)
Dry	-1,511 (-75%)	-1,020 (-67%)
Critical	-1,125 (-85%)	-868 (-81%)
All Years	-410,833 (-75%)	-309,285 (-69%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

6

7 **Table 11-7-61. Adult Sacramento Splittail Entrainment Index^a (Salvage Density Method) at the**
8 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 7**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-2,752 (-70%)	-2,900 (-71%)
Above Normal	-3,839 (-80%)	-3,838 (-79%)
Below Normal	-2,733 (-81%)	-2,541 (-82%)
Dry	-2,382 (-97%)	-2,220 (-97%)
Critical	-3,324 (-99%)	-3,103 (-99%)
All Years	-2,796 (-80%)	-2,732 (-80%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost, based on normalized data. Average (December-March).

9

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 The impact and conclusion for entrainment of splittail to the proposed SWP/CVP north Delta intakes
3 is the same as for Impact AQUA-111 for splittail under Alternative 1A. Splittail larvae would be
4 vulnerable to entrainment to these intakes and there would be a risk of impingement for juvenile
5 and adult splittail. Little is known about splittail densities around the vicinity of the proposed north
6 Delta intakes, therefore monitoring will be implanted to study the potential effects of impingement
7 and larval entrainment at the north Delta intakes

8 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

9 The effect of implementing dual conveyance for the NBA with an alternative Sacramento River
10 intake would be the same as described under Alternative 1A (Impact AQUA-111).

11 **Predation Associated with Entrainment**

12 Splittail predation loss at the south Delta facilities is assumed to be proportional to entrainment
13 loss. Per capita splittail entrainment would be reduced under Alternative 7 at the south Delta by
14 69% compared to NAA; predation losses would decrease a similar proportion.

15 Predation at the north Delta would be increased due to the construction of the proposed water
16 export facilities on the Sacramento River, as described for Alternative 1A (Impact AQUA-111).
17 Potential predation at the north Delta would be partially offset by reduced predation loss at the
18 SWP/CVP south Delta intakes and the increased production of juvenile splittail resulting from CM2
19 actions (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that
20 predation was not a factor currently limiting splittail abundance. **NEPA Effects:** In conclusion, the
21 impact from entrainment and predation loss would not be adverse, because the increase in
22 predation losses at the north Delta under Alternative 7 would be offset by the substantial reduction
23 in per capita south Delta entrainment losses and the increased production of juvenile splittail from
24 CM2 Yolo Bypass Fisheries Enhancement.

25 **CEQA Conclusion:** Under Alternative 7 total juvenile salvage (based on Yolo Bypass inundation)
26 would be 82% greater averaged across all years compared to Existing Conditions. However,
27 operational activities associated with reduced south Delta water exports would result in an overall
28 decrease in the proportion of splittail population entrained for all water year types. Estimated
29 juvenile entrainment (Per Capita method) and hence pre-screen predation losses would be 75%
30 lower and adult entrainment and pre-screen predation losses would be 80% lower than Existing
31 Conditions. Entrainment of splittail would be reduced at the NBA. The impact and conclusion for
32 predation associated with entrainment would be the same as described above.

33 In conclusion, the impact of entrainment and associated predation loss under Alternative 7 would be
34 less than significant, because of improvements in overall entrainment and the increased production
35 of juvenile splittail from CM2 actions. No mitigation would be required.

36 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
37 **Sacramento Splittail**

38 In general, Alternative 7 would have beneficial effects on splittail spawning habitat relative to NAA
39 increasing the quantity and quality of spawning habitat in the Yolo Bypass. There would be
40 negligible effects on channel margin and side-channel habitats in the Sacramento River at Wilkins

1 Slough and the Feather River, and negligible effects on water temperatures in the Feather River,
2 relative to NAA.

3 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream
4 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning
5 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not
6 inundated, spawning in side channels and channel margins would be much more critical.

7 ***Floodplain Habitat***

8 Effects of Alternative 7 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased
9 flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the
10 Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects
11 in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m
12 threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored
13 because flow velocity was generally very low throughout the modeled area for most conditions, with
14 generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a
15 reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

16 The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo
17 Bypass inundation events compared to NAA, especially for dry and critical year types; the changes
18 are attributable to the influence of the Fremont Weir notch at lower flows. Only the inundation
19 events lasting more than 30 days are considered biologically beneficial to splittail, so are the focus of
20 the analyses provided here. For wet year types, Alternative 7 results in a reduced frequency of
21 shorter-duration events and an increased frequency of the longer-duration events (≥ 70 days) and an
22 increased frequency in inundation events ≥ 50 days for above normal years (Figure 11-7-4). For the
23 drier type years (below normal, dry, and critical), Alternative 7 results in no change or an increase in
24 frequency for events greater than 30 days compared to NAA. For below normal years, Alternative 7
25 would result in occurrence of one inundation event ≥ 70 days, compared to 0 such events for NAA.
26 For dry and critical years, project-related increases are for 30-49 day duration events as there are
27 no events of longer duration for either scenario. These results indicate that overall project-related
28 effects on occurrence of various duration inundation events would be beneficial for splittail
29 spawning by creating better spawning habitat conditions.

30 There would be increases in area of suitable splittail habitat in Yolo Bypass under Alternative 7
31 ranging from 5 to 832 acres relative to NAA. Areas under A7_LLTP would be 49%, 56%, and 193%
32 greater than areas under NAA in wet, above normal, and below normal water years, respectively
33 (Table 11-7-64). There would be increases in area under A7_LLTP for dry and critical years relative to
34 NAA, but they would be minimal (7 and 5 acres, respectively). These results indicate that increases in
35 inundated acreage in each water year type would result in increased habitat and have a beneficial
36 effect on splittail spawning.

37 A potential adverse effect of Alternative 7 that is not included in the modeling is reduced inundation
38 of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The Fremont Weir
39 notch with gates opened would increase the amount Sacramento River flow diverted from the river
40 into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers. comm.). As
41 much as about 6,000 cfs more flow would be diverted from the river with the opened notch than
42 without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir. A decrease
43 of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont Weir,
44 could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although

1 understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In
2 any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of
3 inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the
4 river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass
5 inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to
6 reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects
7 on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the
8 Yolo Bypass.

9 ***Channel Margin and Side-Channel Habitat***

10 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel
11 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,
12 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are
13 affected by changes in flow because greater flows cause more flooding, thereby increasing
14 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially
15 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are
16 expected to be most important to the splittail population because in years of high-flows, when most
17 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively
18 little production.

19 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions
20 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the
21 Sacramento River for the time-frame February through June. These are the most important months
22 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from
23 the side-channel habitats during May and June if conditions become unfavorable.

24 Differences between model scenarios for monthly average flows during February through June by
25 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather
26 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 For the Sacramento River at Wilkins Slough (Appendix 11C, *CALSIM II Model Results utilized in the*
28 *Fish Analysis*) flows during February through June under A7_LLTP would be similar to flows under
29 NAA with the exception of isolated occurrences of flow increases for several months and water year
30 types ranging from 7% to 15%. Therefore, the effect on spawning habitat for Sacramento splittail is
31 not adverse. These results indicate that there would be some increases in flow (up to 15%) that
32 would have beneficial effects on splittail rearing conditions in the Sacramento River.

33 For the Feather River at the confluence flows during February, March and April would be similar to
34 or with small increased flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
35 *Analysis*). During May there would be flow reductions in dry (-7%) and critical (-16%) years while in
36 June flows under A7_LLTP would be up to 50% greater with the exception of a 19% decrease in dry
37 years, resulting in an overall beneficial effect.

38 Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather
39 River at the confluence with the Sacramento River, respectively were used to investigate the
40 potential effects of Alternative 7 on the suitability of water temperatures for splittail spawning and
41 egg incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and
42 egg incubation.

1 There would be no biologically meaningful difference (>5% absolute scale) between NAA and
 2 Alternative 7 in the frequency of water temperatures in the Sacramento and Feather Rivers being
 3 within the suitable 45°F to 75°F regardless of water year type.

4 **Table 11-7-62. Difference (Percent Difference) in Percent of Days or Months^a during February to**
 5 **June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at**
 6 **Hamilton City and Feather River at the Confluence with the Sacramento River^b**

	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Sacramento River at Hamilton City		
<i>Temperatures below 45°F</i>		
Wet	-4 (-86%)	0 (0%)
Above Normal	-4 (-86%)	0 (0%)
Below Normal	-4 (-79%)	0 (0%)
Dry	-2 (-68%)	0 (0%)
Critical	-1 (-49%)	1 (NA)
All	-3 (-76%)	0 (0%)
<i>Temperatures above 75°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
Feather River at Sacramento River Confluence		
<i>Temperatures below 45°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<i>Temperatures above 75°F</i>		
Wet	4 (NA)	-1 (-19%)
Above Normal	7 (NA)	-2 (-22%)
Below Normal	13 (NA)	2 (18%)
Dry	16 (360%)	2 (11%)
Critical	5 (300%)	-8 (-53%)
All	9 (729%)	-1 (-9%)

NA = could not be calculated because the denominator was 0.

^a Days were used in the Sacramento River and months were used in the Feather River.

^b Based on the modeling period of 1922 to 2003.

7

8 ***Stranding Potential***

9 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,
 10 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and

1 historical data to evaluate possible stranding effects, the following provides a narrative summary of
 2 potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture,
 3 which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the
 4 bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial
 5 ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al.
 6 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding
 7 by allowing water to inundate certain areas of the bypass to maximize biological benefits, while
 8 keeping water away from other areas to reduce stranding in isolated ponds. Actions under
 9 Alternative 7 to increase the frequency of Yolo Bypass inundation would increase the frequency of
 10 potential stranding events. For splittail, an increase in inundation frequency would also increase the
 11 production of Sacramento splittail in the bypass. While total stranding losses may be greater under
 12 Alternative 7 than under NAA, the total number of splittail would be expected to be greater under
 13 Alternative 7.

14 In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement
 15 in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands
 16 desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may
 17 decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the
 18 potential improvements in habitat capacity outweighed the potential stranding problems that may
 19 exist in some years.

20 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not
 21 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result
 22 of egg mortality. The effects of Alternative 7 on splittail spawning habitat are largely beneficial due
 23 to increased inundation in the Yolo Bypass. There would be negligible effects on channel margin and
 24 side-channel habitats in the Sacramento River at Wilkins Slough and the Feather River, and
 25 negligible effects on water temperatures in the Feather River, relative to NAA.

26 **CEQA Conclusion:** In general, Alternative 7 would have beneficial effects on splittail spawning
 27 habitat relative to CEQA Existing Conditions by increasing the quantity of spawning habitat in the
 28 Yolo Bypass. There would be negligible effects on channel margin and side-channel habitats in the
 29 Sacramento River at Wilkins Slough and the Feather River. There would be negative effects on water
 30 temperatures in the Feather River relative to CEQA Existing Conditions, but the benefits due to
 31 increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water
 32 temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to
 33 splittail than channel margin habitat in the Feather River as evidenced by the large amount of
 34 spawning activity when inundated.

35 **Floodplain Habitat**

36 Comparisons of splittail weighted habitat area for Alternative 7 and Existing Conditions show
 37 relatively little difference between the two scenarios, with no change or relatively small increases or
 38 decreases in longer-duration inundation events for Alternative 7 compared to Existing Conditions,
 39 except for wet year types (Figure 11-7-4, Table 11-7-63). During wet years there were four fewer
 40 inundation events of 30-49 days under Alternative 7, and five fewer inundation events of 50-69
 41 days, but eight (50%) more events of >70 days, compared to Existing Conditions. Alternative 7
 42 would result in increased acreage of suitable spawning habitat compared to Existing Conditions
 43 (Table 11-7-64), with increases of between 5 and 971 acres of suitable spawning habitat depending
 44 on water year type. Increased areas for wet, above normal, and below normal water years are

1 predicted to be 63%, 57%, and 183%, respectively for Alternative 7. Comparisons for dry and
2 critical water years indicate project-related increases of 7 and 5 acres of suitable spawning habitat,
3 respectively, compared to 0 acres for Existing Conditions. These results indicate that Alternative 7
4 would have beneficial effects on splittail habitat through increasing spawning habitats by up to
5 183%.

6 **Table 11-7-63. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**
7 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**
8 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
30-49 Days		
Wet	-4	-2
Above Normal	-2	-2
Below Normal	3	3
Dry	1	1
Critical	1	1
50-69 Days		
Wet	-5	-5
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0
≥70 Days		
Wet	8	7
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0

9

10 ***Channel Margin and Side-Channel Habitat***

11 Modeled flows were evaluated in the Sacramento River at Wilkins Slough for the February through
12 June splittail spawning and early life stage rearing period (Appendix 11C, *CALSIM II Model Results*
13 *utilized in the Fish Analysis*). Results indicate that Alternative 7 would have negligible effects (<5%)
14 on channel margin and side-channel habitats through increased flows in February and March,
15 negligible effects or small decreases (to -8%) in April, increases (to 13%) or decreases (to -16%) in
16 May depending on water year type, and an increase for all water year types in June (9% to 24%).
17 Therefore, the impact on spawning habitat for Sacramento splittail on the upper Sacramento River
18 would be less than significant.

19 Flows in the Feather River at the confluence with the Sacramento River were evaluated during
20 February through June. Flows during this period would generally be similar between Existing
21 Conditions and A7_LLT during February, March and April with some exceptions and with substantial
22 decreases in May and June but with higher flows in critical water years during both months

(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would generally be no biologically meaningful difference (>5% absolute scale) between Existing Conditions and Alternative 7 in the frequency of water temperatures in the Sacramento River being within the suitable 45°F to 75°F while the Feather River would exceed that value in all except wet water years (5% to 16% greater) for the 75°F threshold.

There would be no difference between Existing Conditions and A7_LL1T in the number of years with water temperatures below 45°F (Table 11-7-62) because there are never any months with temperatures below 45°F under any scenario. Exceedances above 75°F under A7_LL1T would occur more often than under Existing Conditions in dry and critical water years but not in other water years. These results indicate that Alternative 7 would have small negative temperature effects on splittail spawning in the Feather River

Stranding Potential

Because there would be little difference in flow conditions between Alternative 7 and Existing Conditions in Yolo Bypass, the project will not affect stranding potential.

Collectively, these results indicate that the impact would be less than significant and no mitigation would be necessary. The effects of Alternative 7 on splittail spawning habitat would be largely beneficial. Benefits due to increased inundation in the Yolo Bypass would outweigh increases in water temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to splittail than channel margin habitat in the Feather River, as evidenced by the large amount of spawning activity when inundated.

Table 11-7-64. Increase in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass from Existing Biological Conditions to Alternative 7 by Water Year Type from 15 2-D and Daily CALSIM II Modeling Runs

Water Year Type	EXISTING CONDITIONS vs. A7_LL1T	NAA vs. A7_LL1T
Wet	971 (63%)	832 (49%)
Above Normal	652 (57%)	644 (56%)
Below Normal	240 (183%)	244 (193%)
Dry	7 (NA)	7 (NA)
Critical	5 (NA)	5 (NA)

NA = could not be calculated because the denominator was 0.

^a NA percent differences could not be computed because no splittail weighted habitat occurred in the bypass for NAA and EXISTING CONDITIONS in those years (dividing by 0).

Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail

As described above for spawning habitat, increased inundation of floodplains during wet years is expected to supplement splittail rearing habitat compared to baseline conditions (Table 11-7-64, Figure 11-7-4). Upstream channel flows under Alternative 7 are expected to be similar to baseline conditions.

NEPA Effects: Overall, rearing habitat would be increased under Alternative 7. The effect is not adverse because it would not substantially reduce suitable rearing habitat or substantially reduce the number of fish as a result of juvenile mortality.

1 **CEQA Conclusion:** As described above, upstream splittail rearing habitat under Alternative 7 is
2 expected to be similar to Existing Conditions. Increased flows in the Yolo Bypass in wetter years are
3 expected to increase floodplain habitat for rearing splittail. Overall, the impact on splittail rearing
4 habitat would be less than significant because it would not substantially reduce suitable rearing
5 habitat or substantially reduce the number of fish as a result of juvenile mortality. No mitigation
6 would be required.

7 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento**
8 **Splittail**

9 ***Upstream of the Delta***

10 Effects of Alternative 7 on migration conditions for Sacramento splittail would be the same as
11 described above for channel margin and side-channel environments (Impact AQUA-112). Effects of
12 Alternative 7 on flow in the Sacramento River would consist primarily of negligible effects (<5%) or
13 small increases in flow (to 15%) that would have beneficial effects. Effects of Alternative 7 on flows
14 in the Feather River would consist primarily of negligible effects (<5%) or small increases or
15 decreases in flow that would not have biologically meaningful effects on migration conditions.

16 ***Through-Delta***

17 Alternative 7 would reduce OMR reverse flows during the period of juvenile splittail migration
18 through the Delta, compared to NAA. OMR flows would be greater than NAA averaged across all
19 water years and months under Alternative 7; therefore the effect on splittail migration survival
20 would be beneficial.

21 **NEPA Effects:** In general, effects of Alternative 7 would be beneficial to splittail through-Delta
22 migration survival, due to reduced OMR reverse flows during the migration period. However,
23 negligible upstream effects would occur, relative to NAA, including in the Sacramento River which is
24 the migration corridor to the most productive splittail spawning area, the Yolo Bypass. Therefore,
25 the effect is not adverse.

26 **CEQA Conclusion:**

27 ***Upstream of the Delta***

28 Project effects on splittail rearing habitat are the same as described for spawning habitat in the
29 previous impact discussion, Impact AQUA-286. As concluded above, the impact would be less than
30 significant relative to CEQA Existing Conditions and no mitigation would be necessary. The impacts
31 of Alternative 7 on splittail migration conditions consist of negligible effects or small increases or
32 decreases in mean monthly flow in the Sacramento and Feather Rivers. There would be adverse
33 effects due to increased water temperatures in the Feather River but the impacts of this effect on
34 splittail migration would be offset by substantial benefits to the population using the Sacramento
35 River and the Yolo Bypass because the Yolo Bypass is a more important spawning habitat to splittail
36 than channel margin habitat in the Feather River, as evidenced by the large amount of spawning
37 activity when inundated.

1 **Through-Delta**

2 As described above, average OMR flows would be greater under Alternative 7 than Existing
3 Conditions during the juvenile splittail migration through the Delta. Therefore the impact on splittail
4 migration survival would be beneficial under Alternative 7.

5 **Summary of CEQA Conclusion**

6 As described above, average OMR flows would be greater under Alternative 7 than Existing
7 Conditions during the juvenile splittail migration through the Delta, providing beneficial effects.
8 However, the impact would be less than significant in upstream areas, with negligible increases or
9 decreases in mean monthly flows in the Sacramento and Feather rivers. Therefore, no mitigation is
10 required.

11 **Restoration Measures (CM2, CM4–CM7, and CM10)**

12 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

13 The potential effects of restoration construction activities under Alternative 7 would be greater than
14 that described for Alternative 1A due to the increased floodplain and channel margin habitat
15 enhancement (see Impact AQUA-115). This would include potential effects of turbidity, mercury
16 methylation, accidental spills, disturbance of contaminated sediments, underwater noise, fish
17 stranding, and predation elements.

18 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-115, restoration construction activities
19 under Alternative 115 are not expected to adversely affect Sacramento splittail.

20 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-115 for Sacramento splittail, the
21 potential impact of restoration construction activities is considered less than significant, and no
22 mitigation would be required.

23 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**
24 **Sacramento Splittail**

25 The potential effects of contaminants associated with restoration measures under Alternative 7
26 would be the same as those described for Alternative 1A (see Impact AQUA-116). This would
27 include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate
28 pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000
29 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the
30 effects would be the same as described under Alternative 1A.

31 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-116, contaminants associated with
32 restoration measures are not expected to adversely affect Sacramento splittail with respect to
33 selenium, copper, ammonia and pesticides. The effects of methylmercury on Sacramento splittail are
34 uncertain.

35 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-116 for Sacramento splittail, the
36 potential impact of contaminants associated with restoration measures is considered less than
37 significant, and no mitigation would be required. The same conclusion applies to the additional
38 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 22
39 additional miles of channel margin habitat).

1 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

2 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
3 described for Alternative 1A (see Impact AQUA-117). These would include CM2 Yolo Bypass
4 Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated
5 Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community
6 Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000
7 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat
8 under Alternative 7.

9 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-117, restored habitat conditions are
10 expected to be beneficial for Sacramento splittail and the additional restoration included in
11 Alternative 7 provides proportionally more benefit.

12 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-117 for Sacramento splittail, the
13 potential impact of restored habitat conditions on Sacramento splittail is considered to be beneficial.
14 The additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated
15 floodplain and 20 additional miles of channel margin habitat) provides proportionally more benefit,
16 and no mitigation would be required.

17 **Other Conservation Measures (CM12–CM19 and CM21)**

18 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

19 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**
20 **Splittail (CM13)**

21 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**
22 **(CM14)**

23 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**
24 **(CM15)**

25 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

26 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

27 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

28 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

29 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**
30 **Splittail (CM21)**

31 **NEPA Effects:** As described in Alternative 1A (Impact AQUA-118 through AQUA-125), the effects of
32 these nine impact mechanisms would range from no effect, to not adverse, to beneficial for
33 Sacramento splittail.

34 **CEQA Conclusion:** The nine impact mechanisms listed above would range from no impact, to less
35 than significant to beneficial, and no mitigation is required.

1 **Green Sturgeon**

2 **Construction and Maintenance of CM1**

3 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

4 The potential effects of construction of the water conveyance facilities on green sturgeon would be
5 similar to those described for Alternative 1A (Impact AQUA-127) except that Alternative 7 would
6 include three intakes compared to five intakes under Alternative 1A, so the effects would be
7 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
8 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
9 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
10 would require 27.3 acres of dredging.

11 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and
12 mitigation measures would be available to avoid and minimize potential effects, and the effect would
13 not be adverse for green sturgeon.

14 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-127, the impact of the construction
15 of water conveyance facilities on green sturgeon would be less than significant except for
16 construction noise associated with pile driving. Potential pile driving impacts would be less than
17 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
18 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
19 less than significant.

20 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
21 **of Pile Driving and Other Construction-Related Underwater Noise**

22 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

23 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
24 **and Other Construction-Related Underwater Noise**

25 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

26 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

27 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
28 the same as those described for Alternative 1A (see Impact AQUA-128) except that only three
29 intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

30 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-128, the effect would not be adverse for
31 green sturgeon.

32 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-128, the impact of the maintenance
33 of water conveyance facilities on green sturgeon would be less than significant and no mitigation
34 would be required.

Water Operations of CM1

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Water Exports

Alternative 7 would substantially reduce overall entrainment of juvenile green sturgeon at the south Delta export facilities, estimated as salvage density, by about 72–75% (~100 fish) as compared to NAA (Table 11-7-65). Unlike Alternative 1A (Impact AQUA-3 for green sturgeon), entrainment reductions would be greater in below normal, dry and critical years (99% decrease, ~50 fish) than in wet and above normal years (62–65% decrease, ~60–70 fish) compared to NAA. Alternative 7 would not have adverse effects on juvenile green sturgeon because of the substantial reductions in entrainment loss.

Predation Associated with Entrainment

Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation loss, would change minimally between Alternative 7 and NAA (120 fish). The number of juvenile green sturgeon lost to predation at the south Delta facilities would change negligibly between Alternative 7 and NAA. The effects and conclusion for predation risk associated with NPB structures and the north Delta intakes would be the same as described for Alternative 1A (Impact AQUA-129).

NEPA Effects: The effect on entrainment and entrainment-related predation under Alternative 7 would not be adverse.

CEQA Conclusion: As described above, annual entrainment losses of juvenile green sturgeon across all years would decrease 76% under Alternative 7 (A7_LL) (41 fish) relative to Existing Conditions (166 fish) (Table 11-7-65). Overall, impacts of water operations on entrainment of green sturgeon would be beneficial due to the anticipated reduction in entrainment and no mitigation would be required.

Table 11-7-65. Juvenile Green Sturgeon Annual Entrainment Index^a at the SWP and CVP Salvage Facilities for Alternative 7

Water Year ^b	Entrainment Index			Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS	NAA	A7_LL	EXISTING CONDITIONS vs. A7_LL	NAA vs. A7_LL
Wet and Above Normal	116	104	40	-77 (-66%)	-64 (-62%)
Below Normal, Dry, and Critical	50	42	1	-49 (-99%)	-41 (-99%)
All Years	166	146	41	-126 (-76%)	-120 (-75%)

^a Estimated annual number of fish lost.

^b Sacramento Valley water year-types.

Since few juvenile green sturgeon are entrained at the south Delta, reductions in entrainment (76% reduction compared to Existing Conditions, representing 126 fish) under Alternative 7 would have

1 little effect on entrainment related predation loss. Overall, the impact would be less than significant,
2 because there would be little change in predation loss under Alternative 7.

3 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
4 **Green Sturgeon**

5 In general, Alternative 7 would not affect spawning and egg incubation habitat for green sturgeon
6 relative to NAA.

7 ***Sacramento River***

8 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
9 Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows
10 can reduce the instream area available for spawning and egg incubation. Flows under A7_LL1T would
11 always be similar to or greater than flows under NAA upstream of Red Bluff and similar to or greater
12 than flows under NAA at Keswick, except in below normal and critical years during April (7% and
13 6% lower, respectively) although flows can be lower or higher in individual months of individual
14 years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate
15 that there would be very few reductions in flows in the Sacramento River under Alternative 7.

16 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
17 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,
18 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
19 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
20 NAA and Alternative 7 in any month or water year type throughout the period.

21 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was
22 determined for each month (May through September) and year of the 82-year modeling period
23 (Table 11-7-10). The combination of number of days and degrees above the 63°F threshold were
24 further assigned a “level of concern”, as defined in Table 11-7-11. Differences between baselines and
25 Alternative 7 in the highest level of concern across all months and all 82 modeled years are
26 presented in Table 11-7-66. There would be no difference in levels of concern between NAA and
27 Alternative 7.

28 **Table 11-7-66. Differences between Baseline and Alternative 7 Scenarios in the Number of Years**
29 **in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern,**
30 **Sacramento River at Bend Bridge, May through September**

Level of Concern	EXISTING CONDITIONS vs. A7_LL1T	NAA vs. A7_LL1T
Red	12 (300%)	3 (19%)
Orange	-1 (-100%)	-1 (NA)
Yellow	5 (250%)	2 (29%)
None	-16 (-21%)	-4 (-7%)

31

32 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type
33 during May through September (Table 11-7-67). Total degree-days under Alternative 7 would be
34 4% and 39% lower than under NAA during May and June, respectively, and 14% to 17% higher
35 during July through September.

1 **Table 11-7-67. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days**
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the**
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
May	Wet	9 (NA)	6 (200%)
	Above Normal	6 (NA)	1 (20%)
	Below Normal	0 (NA)	0 (NA)
	Dry	14 (NA)	13 (1,300%)
	Critical	0 (NA)	0 (NA)
	All	60 (462%)	-3 (-4%)
June	Wet	539 (6,738%)	89 (19%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	59 (NA)	52 (743%)
	Critical	48 (NA)	41 (586%)
	All	11 (NA)	-7 (-39%)
July	Wet	4 (NA)	4 (NA)
	Above Normal	1,600 (1,019%)	225 (15%)
	Below Normal	1,629 (524%)	-5 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	10 (NA)	-1 (-9.1%)
	All	718 (8,975%)	88 (14%)
August	Wet	0 (NA)	0 (NA)
	Above Normal	63 (NA)	25 (66%)
	Below Normal	445 (1,435%)	175 (58%)
	Dry	40 (308%)	-3 (-5%)
	Critical	322 (NA)	70 (28%)
	All	1,947 (969%)	318 (17%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	3 (NA)	1 (50%)
	Critical	0 (NA)	0 (NA)
	All	2,055 (690%)	296 (14%)

NA = could not be calculated because the denominator was 0.

4

5 ***Feather River***

6 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
 7 the Sacramento River during the February through June green sturgeon spawning and egg
 8 incubation period. Flows under A7_LLT would be similar to or greater than flows under NAA with
 9 few exceptions of flows up to 26% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 10 *Analysis*). These results indicate that there would be a low level of reductions in flows in the Feather
 11 River under Alternative 7 independent of climate change.

1 Mean monthly water temperatures in the Feather River at Gridley were examined during the
2 February through June green sturgeon spawning and egg incubation period (Appendix 11D,
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
5 NAA and Alternative 7 in any month or water year type throughout the period.

6 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
7 was evaluated during May through September (Table 11-7-68). For this impact, only the months of
8 May and June were examined because spawning and egg incubation does not generally extend
9 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In
10 both May and June, the percent of months exceeding the threshold under Alternative 7 would be
11 similar to or lower (up to 15% lower on an absolute scale) than the percent under NAA.

12 **Table 11-7-68. Differences between Baseline and Alternative 7 Scenarios in Percent of Months**
13 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
14 **River at Gridley Exceed the 64°F Threshold, May through September**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A7_LLT					
May	33 (104%)	23 (127%)	14 (138%)	10 (267%)	10 (400%)
June	6 (7%)	6 (7%)	11 (14%)	20 (31%)	25 (51%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	23 (34%)
August	0 (0%)	0 (0%)	6 (7%)	15 (18%)	28 (46%)
September	11 (16%)	14 (25%)	27 (96%)	35 (467%)	22 (900%)
NAA vs. A7_LLT					
May	-6 (-9%)	-15 (-26%)	-9 (-27%)	-5 (-27%)	0 (0%)
June	0 (0%)	-2 (-3%)	-5 (-5%)	-9 (-9%)	-15 (-17%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-5 (-5%)
August	0 (0%)	0 (0%)	-2 (-2%)	-5 (-5%)	-6 (-6%)
September	12 (18%)	9 (15%)	6 (13%)	-1 (-3%)	-4 (-13%)

15
16 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
17 May through September (Table 11-7-69). Only May and June were examined for spawning and egg
18 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-
19 months exceeding the threshold under Alternative 7 would be 1% to 6% lower than those under
20 NAA during May and June.

1 **Table 11-7-69. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 64°F in**
 3 **the Feather River at Gridley, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LL1	NAA vs. A7_LL1
May	Wet	23 (383%)	-1 (-3%)
	Above Normal	12 (109%)	-2 (-8%)
	Below Normal	24 (300%)	0 (0%)
	Dry	32 (229%)	3 (7%)
	Critical	19 (112%)	-1 (-3%)
	All	110 (196%)	-1 (-1%)
June	Wet	53 (71%)	-14 (-10%)
	Above Normal	16 (31%)	-13 (-16%)
	Below Normal	30 (46%)	-2 (-2%)
	Dry	61 (65%)	8 (5%)
	Critical	23 (41%)	-16 (-17%)
	All	184 (54%)	-36 (-6%)
July	Wet	29 (17%)	13 (7%)
	Above Normal	19 (36%)	2 (3%)
	Below Normal	34 (50%)	2 (2%)
	Dry	81 (94%)	37 (28%)
	Critical	71 (90%)	17 (13%)
	All	234 (51%)	71 (11%)
August	Wet	36 (20%)	19 (10%)
	Above Normal	32 (71%)	10 (15%)
	Below Normal	32 (46%)	0 (0%)
	Dry	105 (154%)	27 (18%)
	Critical	38 (45%)	-12 (-9%)
	All	243 (54%)	44 (7%)
September	Wet	-5 (-13%)	22 (183%)
	Above Normal	10 (63%)	19 (271%)
	Below Normal	40 (143%)	0 (0%)
	Dry	39 (139%)	-13 (-16%)
	Critical	59 (295%)	5 (7%)
	All	143 (109%)	33 (14%)

4

5 ***San Joaquin River***

6 Flows in the San Joaquin River under Alternative 7 would be the same as those under NAA
 7 throughout the March through June period (Appendix 11C, *CALSIM II Model Results utilized in the*
 8 *Fish Analysis*). No water temperatures modeling was conducted in the San Joaquin River.

9 ***NEPA Effects:*** Collectively, these results indicate that the effect is not adverse because it does not
 10 have the potential to substantially reduce the amount of suitable green sturgeon spawning and egg
 11 incubation habitat. Flows and water temperatures under Alternative 7 in all rivers examined would
 12 be similar to those under the NEPA point of comparison.

1 **CEQA Conclusion:** In general, Alternative 7 would not affect spawning and egg incubation habitat for
2 green sturgeon relative to CEQA Existing Conditions.

3 **Sacramento River**

4 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
5 Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under
6 A7_LLT would generally be similar to or greater than those under Existing Conditions, except in
7 April at Keswick, during which flows under A7_LLT would be mostly lower (up to 14%) than under
8 Existing Conditions and at Keswick and upstream of Red Bluff during July in critical years (8% and
9 7% lower, respectively) although flows can be lower or higher in individual months of individual
10 years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results indicate
11 that there would be few reductions in flows in the Sacramento River under Alternative 7 relative to
12 Existing Conditions.

13 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
14 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,
15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
16 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
17 Existing Conditions and Alternative 7 in any month or water year type throughout the period.

18 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was
19 determined for each month (May through September) and year of the 82-year modeling period
20 (Table 11-7-12). The combination of number of days and degrees above the 63°F threshold were
21 further assigned a “level of concern”, as defined in Table 11-7-11. Differences between baselines and
22 Alternative 7 in the highest level of concern across all months and all 82 modeled years are
23 presented in Table 11-7-66. The number of “red” years would be 300% higher under Alternative 7
24 relative to Existing Conditions.

25 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type
26 during May through September (Table 11-7-67). Water temperatures under Alternative 7 would
27 exceed the threshold 60 degree-days (462%) and 11 degree-days (no relative change calculation
28 possible due to division by 0) more than those under Existing Conditions during May and June,
29 respectively.

30 **Feather River**

31 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
32 the Sacramento River during the February through June green sturgeon spawning and egg
33 incubation period. At Thermalito, flows under A7_LLT would generally be similar to or greater than
34 those under Existing Conditions, except during February in below normal and dry years (46% and
35 13% lower, respectively) and during March, in which flows under A7_LLT would be up to 24% lower
36 than under Existing Conditions. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
37 At the confluence with the Sacramento River, flows under A7_LLT would generally be similar to or
38 greater than flows under Existing Conditions, except during May, in which flows under A7_LLT
39 would be up to 27% lower than under Existing Conditions. These results indicate that there would
40 be reductions in flows in the Feather River under Alternative 7 relative to Existing Conditions.

41 Mean monthly water temperatures in the Feather River at Gridley were examined during the
42 February through June green sturgeon spawning and egg incubation period (Appendix 11D,

1 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
2 *Fish Analysis*). There would generally be no differences (<5%) in mean monthly water temperature
3 between Existing Conditions and Alternative 7 in any month or water year type throughout the
4 period, except during February, in which mean monthly temperatures under Alternative 7 would be
5 6% higher than those under Existing Conditions.

6 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
7 was evaluated during May through September (Table 11-7-68). For this impact, only the months of
8 May and June were examined because spawning and egg incubation does not generally extend
9 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131.
10 During the period, the percent of months exceeding the threshold under Alternative 7 would be
11 similar to or higher (up to 33% higher on an absolute scale) than the percent under Existing
12 Conditions.

13 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
14 May through September (Table 11-7-69). Only May and June were examined for spawning and egg
15 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-
16 months exceeding the threshold under Alternative 7 would be 196% and 54% higher than those
17 under Existing Conditions during May and June, respectively.

18 ***San Joaquin River***

19 Flows in the San Joaquin River under Alternative 7 similar to those under Existing Conditions
20 throughout the March through June spawning and egg incubation period for green sturgeon, except
21 during June, in which there would be a 30% flow reduction under Alternative 7 (Appendix 11C,
22 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under Alternative 7 in drier water years
23 during March through May would be up to 16% lower than those under Existing Conditions,
24 however.

25 No water temperatures modeling was conducted in the San Joaquin River.

26 ***Summary of CEQA Conclusion***

27 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between
28 the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA
29 baseline, the alternative could substantially reduce spawning and egg incubation habitat conditions,
30 contrary to the NEPA conclusion set forth above, which is directly related to the inclusion of climate
31 change effects in Alternative 7. Although there are high similarities in flows between Existing
32 Conditions and Alternative 7, water temperature conditions would be substantially degraded in the
33 Sacramento and Feather Rivers.

34 These results are primarily caused by four factors: differences in sea level rise, differences in climate
35 change, future water demands, and implementation of the alternative. The analysis described above
36 comparing Existing Conditions to the alternative does not partition the effect of implementation of
37 the alternative from those of sea level rise, climate change and future water demands using the
38 model simulation results presented in this chapter. However, the increment of change attributable
39 to the alternative is well informed by the results from the NEPA analysis, which found this effect to
40 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
41 implementation period, which does include future sea level rise, climate change, and water
42 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
4 Conditions in the late long-term implementation period and the alternative indicates that flows and
5 reservoir storage in the locations and during the months analyzed above would generally be similar
6 between Existing Conditions and the alternative. This indicates that the differences between
7 Existing Conditions and the alternative found above would generally be due to climate change, sea
8 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
9 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
10 conclusion, and therefore would not in itself result in a significant impact on spawning and egg
11 incubation habitat conditions for green sturgeon. This impact is found to be less than significant and
12 no mitigation is required.

13 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

14 In general, Alternative 7 would not affect the quantity and quality of green sturgeon larval and
15 juvenile rearing habitat relative to NAA.

16 ***Sacramento River***

17 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
18 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*
19 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There
20 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 7
21 in any month or water year type throughout the period.

22 ***Feather River***

23 Mean monthly water temperatures in the Feather River at Gridley were examined during the April
24 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
25 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
26 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 7 in any
27 month or water year type throughout the period.

28 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
29 was evaluated during May through September (Table 11-7-68). The percent of months exceeding
30 the threshold under Alternative 7 would be similar to or lower (up to 15% lower on an absolute
31 scale) than the percent under NAA in all months except September, in which the percent of months
32 under Alternative 7 would be 6% to 12% (absolute scale) lower in the lower three degree categories
33 than the percent under NAA.

34 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
35 May through September (Table 11-7-69). Total degree-months exceeding the threshold under
36 Alternative 7 would be 1% to 6% lower than those under NAA during May and June and 7% to 14%
37 greater than those under NAA during July through September.

38 ***San Joaquin River***

39 Water temperature modeling was not conducted in the San Joaquin River.

1 **NEPA Effects:** Collectively, these results indicate that the effect of Alternative 7 would not be
2 adverse because it does not substantially affect green sturgeon rearing conditions in upstream
3 rivers.

4 **CEQA Conclusion:** In general, Alternative 7 would not affect the quantity and quality of green
5 sturgeon larval and juvenile rearing habitat relative to CEQA Existing Conditions.

6 **Sacramento River**

7 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
8 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*
9 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean
10 monthly water temperature under Alternative 7 would be similar to those under Existing Conditions
11 during May, June and July, but 5% to 7% lower than those under Existing Conditions during August
12 through October and in critical years during July.

13 **Feather River**

14 Mean monthly water temperatures in the Feather River at Gridley were examined during the April
15 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
16 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
17 be no differences (<5%) in mean monthly water temperature between Existing Conditions and
18 Alternative 7 in any month although dry and critical years during July and dry years during August
19 would be 7% to 9% greater under Alternative 7 than those under Existing Conditions.

20 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
21 was evaluated during May through September (Table 11-7-68). The percent of months exceeding
22 the threshold under Alternative 7 would be similar to or greater (up to 35% higher on an absolute
23 scale) than the percent under Existing Conditions in all months during the period.

24 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
25 May through September (Table 11-7-69). Total degree-months exceeding the threshold under
26 Alternative 7 would be 51% to 196% greater than those under Existing Conditions depending on
27 month.

28 **San Joaquin River**

29 Water temperature modeling was not conducted in the San Joaquin River.

30 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between
31 the CEQA baseline and Alternative 7 could be significant because, when compared to the CEQA
32 baseline, the alternative could substantially reduce rearing habitat conditions, contrary to the NEPA
33 conclusion set forth above, which is directly related to the inclusion of climate change effects in
34 Alternative 7. Results indicate that water temperature conditions would be substantially degraded
35 in the Sacramento and Feather Rivers.

36 These results are primarily caused by four factors: differences in sea level rise, differences in climate
37 change, future water demands, and implementation of the alternative. The analysis described above
38 comparing Existing Conditions to the alternative does not partition the effect of implementation of
39 the alternative from those of sea level rise, climate change and future water demands using the
40 model simulation results presented in this chapter. However, the increment of change attributable
41 to the alternative is well informed by the results from the NEPA analysis, which found this effect to

1 be not adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
2 implementation period, which does include future sea level rise, climate change, and water
3 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
4 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
5 effect of the alternative from those of sea level rise, climate change, and water demands.

6 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
7 Conditions in the late long-term implementation period and the alternative indicates that flows and
8 reservoir storage in the locations and during the months analyzed above would generally be similar
9 between Existing Conditions and the alternative. This indicates that the differences between
10 Existing Conditions and the alternative found above would generally be due to climate change, sea
11 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
12 Alternative 7, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
13 conclusion, and therefore would not in itself result in a significant impact on rearing habitat
14 conditions for green sturgeon. This impact is found to be less than significant and no mitigation is
15 required.

16 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

17 In general, Alternative 7 would reduce green sturgeon migration conditions relative to NAA.

18 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
19 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
20 the Sacramento River during the April through October larval migration period, the August through
21 March juvenile migration period, and the November through June adult migration period (Appendix
22 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
23 entire year, flows during all months were compared. Reduced flows could slow or inhibit
24 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
25 cues and pass impediments by adults.

26 Sacramento River flows under A7_LLTT would generally be similar to or greater than flows under
27 NAA in all months except for November and December (at Keswick only) during which flows would
28 be up to 17% lower depending on location, month, and water year type.

29 Feather River flows under A7_LLTT would generally be lower by up to 38% than those under NAA
30 during July through September and December. Flows during other months under A7_LLTT would
31 generally be similar to or greater than flows under NAA with some exceptions.

32 Larval transport flows were also examined by utilizing the positive correlation between white
33 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the
34 assumption that the mechanism responsible for the relationship is that Delta outflow provides
35 improved green sturgeon larval transport that results in improved year class strength. Results for
36 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation
37 between Delta outflow and year class strength, green sturgeon year class strength would be lower
38 under Alternative 7 than those under NAA (up to 33% lower).

39 **NEPA Effects:** Collectively, these results indicate that the effect is adverse because it has the
40 potential to substantially interfere with the movement of green sturgeon. Reductions in flows under
41 Alternative 7 relative to NAA in the Sacramento River would affect the migratory abilities of
42 juveniles and adults by slowing or inhibiting downstream migration of larvae and juveniles and

1 reducing the ability to sense upstream migration cues and pass impediments by adults and flow
2 reduction in the Feather River would affect the migratory abilities of all three green sturgeon life
3 stages. This effect is a result of the specific reservoir operations and resulting flows associated with
4 this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows)
5 to the extent necessary to reduce this effect to a level that is not adverse would fundamentally
6 change the alternative, thereby making it a different alternative than that which has been modeled
7 and analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
8 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-132a through AQUA-
9 132c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
10 level.

11 **CEQA Conclusion:** In general, Alternative 7 would reduce green sturgeon migration conditions
12 relative to CEQA Existing Conditions.

13 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
14 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
15 the Sacramento River during the April through October larval migration period, the August through
16 March juvenile migration period, and the November through June adult migration period (Appendix
17 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
18 entire year, flows during all months were compared. Reduced flows could slow or inhibit
19 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
20 cues and pass impediments by adults.

21 Sacramento River flows at Keswick under A7_LLT would generally be lower than flows under
22 Existing Conditions during April, September, and December by up to 23% depending on location,
23 month, and water year type. Flows during other months would generally be similar to or greater
24 than flows under Existing Conditions with some exceptions.

25 For Delta outflow, the percent of months exceeding flow thresholds under A7_LLT would generally
26 be lower than those under Existing Conditions (up to 50% lower) with few exceptions (see Table
27 11-7-75 below).

28 Flows in the Feather River at Thermalito under A7_LLT would generally be up to 53% lower than
29 flows under Existing Conditions during January, March, May, July, November, and December. Flows
30 during other months under A7_LLT would generally be similar to or greater than flows under
31 Existing Conditions with some exceptions.

32 **Summary of CEQA Conclusion**

33 Collectively, these results indicate that the impact would be significant because it has the potential
34 to substantially interfere with the movement of fish. The reduction in flows in the Sacramento and
35 Feather rivers would reduce the migration periods of larval, juvenile, and adult migration, which
36 would substantially slow or inhibit their downstream migration.

37 This impact is a result of the specific reservoir operations and resulting flows associated with this
38 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
39 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
40 change the alternative, thereby making it a different alternative than that which has been modeled
41 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
42 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
43 severity of impact though not necessarily to a less-than-significant level.

1 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**
2 **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**
3 **Mitigation to Reduce Impacts to Migration Conditions**

4 Although analysis conducted as part of the EIR/EIS determined that Alternative 7 would have
5 significant and unavoidable adverse effects on migration, this conclusion was based on the best
6 available scientific information at the time and may prove to have been overstated. Upon the
7 commencement of operations of CM1 and continuing through the life of the permit, the BDCP
8 proponents will monitor effects on migration in order to determine whether such effects would
9 be as extensive as concluded at the time of preparation of this document and to determine any
10 potentially feasible means of reducing the severity of such effects. This mitigation measure
11 requires a series of actions to accomplish these purposes, consistent with the operational
12 framework for Alternative 7.

13 The development and implementation of any mitigation actions shall be focused on those
14 incremental effects attributable to implementation of Alternative 7 operations only.
15 Development of mitigation actions for the incremental impact on migration attributable to
16 climate change/sea level rise are not required because these changed conditions would occur
17 with or without implementation of Alternative 7.

18 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**
19 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

20 Following commencement of initial operations of CM1 and continuing through the life of the
21 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
22 modified operations could reduce impacts to migration under Alternative 7. The analysis
23 required under this measure may be conducted as a part of the Adaptive Management and
24 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

25 **Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and**
26 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**
27 **Conditions Consistent with CM1**

28 In order to determine the feasibility of reducing the effects of CM1 operations on green sturgeon
29 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
30 Wildlife to identify and implement any feasible operational means to minimize effects on
31 migration. Any such action will be developed in conjunction with the ongoing monitoring and
32 evaluation of habitat conditions required by Mitigation Measure AQUA-132a.

33 If feasible means are identified to reduce impacts on migration consistent with the overall
34 operational framework of Alternative 7 without causing new significant adverse impacts on
35 other covered species, such means shall be implemented. If sufficient operational flexibility to
36 reduce effects on green sturgeon habitat is not feasible under Alternative 7 operations,
37 achieving further impact reduction pursuant to this mitigation measure would not be feasible
38 under this Alternative, and the impact on green sturgeon would remain significant and
39 unavoidable.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

3 The potential effects of restoration construction activities under Alternative 7 would be greater than
4 that described for Alternative 1A due to the increased floodplain and channel margin habitat
5 enhancement (see Impact AQUA-133). This would include potential effects of turbidity, exposure to
6 methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish
7 stranding, and predation.

8 **NEPA Effects:** However, as concluded in Alternative 1A, Impact AQUA-133, environmental
9 commitments and mitigation measures would be available to avoid and minimize potential effects,
10 and restoration construction activities are not expected to adversely affect green sturgeon.

11 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-133 for green sturgeon, the
12 potential impact of restoration construction activities is considered less than significant, and no
13 mitigation would be required.

14 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green**
15 **Sturgeon**

16 The potential effects of contaminants associated with restoration measures under Alternative 7
17 would be the same as those described for Alternative 1A (see Impact AQUA-134). This would
18 include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate
19 pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000
20 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the
21 effects would be the same as described under Alternative 1A.

22 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-134, contaminants associated with
23 restoration measures are not expected to adversely affect green sturgeon with respect to copper,
24 ammonia and pesticides. The effects of methylmercury and selenium on green sturgeon are
25 uncertain.

26 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-134 for green sturgeon, the
27 potential impact of contaminants associated with restoration measures is considered less than
28 significant, and no mitigation would be required. The same conclusion applies to the additional
29 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20
30 additional miles of channel margin habitat).

31 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

32 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
33 described for Alternative 1A (see Impact AQUA-135). These would include *CM2 Yolo Bypass Fisheries*
34 *Enhancements*, *CM4 Tidal Natural Communities Restoration*, *CM5 Seasonally Inundated Floodplain*
35 *Restoration*, *CM6, Channel Margin Enhancement*, *CM7 Riparian Natural Community Restoration*, and
36 *CM10 Nontidal Marsh Restoration*. It would also include the additional 10,000 acres of seasonally
37 inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

38 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-135, restored habitat conditions are
39 expected to be beneficial for green sturgeon and the additional restoration included in Alternative 7
40 provides proportionally more benefit.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-135 for green sturgeon, the
2 potential impact of restored habitat conditions on green sturgeon is considered to be beneficial. The
3 additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain
4 and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no
5 mitigation would be required.

6 **Other Conservation Measures (CM12–CM19 and CM21)**

7 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

8 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**
9 **(CM13)**

10 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

11 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**
12 **(CM15)**

13 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

14 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

15 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

16 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

17 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**
18 **Sturgeon (CM21)**

19 **NEPA Effects:** Detailed discussions regarding the potential effects of these impact mechanisms on
20 green sturgeon are the same as those described under Alternative 1A (Impact AQUA-136 through
21 144). The effects range from no effect, to not adverse, to beneficial.

22 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
23 less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is
24 required.

25 **White Sturgeon**

26 **Construction and Maintenance of CM1**

27 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

28 The potential effects of construction of the water conveyance facilities on white sturgeon would be
29 similar to those described for Alternative 1A (Impact AQUA-145) except that Alternative 7 would
30 include three intakes compared to five intakes under Alternative 1A, so the effects would be
31 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
32 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
33 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
34 would require 27.3 acres of dredging.

1 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and
2 mitigation measures would be available to avoid and minimize potential effects, and the effect would
3 not be adverse for white sturgeon.

4 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-145, the impact of the construction
5 of water conveyance facilities on white sturgeon would be less than significant except for
6 construction noise associated with pile driving. Potential pile driving impacts would be less than
7 under Alternative 1A because only three intakes would be constructed rather than five.
8 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
9 that noise impact to less than significant.

10 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
11 **of Pile Driving and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

13 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
14 **and Other Construction-Related Underwater Noise**

15 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

16 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

17 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
18 the same as those described for Alternative 1A (see Impact AQUA-146) except that only three
19 intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

20 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse for
21 white sturgeon.

22 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance
23 of water conveyance facilities on white sturgeon would be less than significant and no mitigation
24 would be required.

25 **Water Operations of CM1**

26 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

27 **Water Exports**

28 Alternative 7 would substantially reduce overall entrainment of juvenile white sturgeon at the south
29 Delta export facilities, estimated as salvage density, by about 92% across all years as compared to
30 NAA (Table 11-7-70). As discussed for Alternative 1A (Impact AQUA-3 for white sturgeon),
31 entrainment is highest in wet and above normal water years. Under Alternative 7, entrainment in
32 wet and above normal water years would be reduced 96%, compared to NAA. Therefore, Alternative
33 7 would not have adverse effects on juvenile white sturgeon because of the reductions in
34 entrainment loss.

35 **Predation Associated with Entrainment**

36 Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to
37 entrainment loss. The total reduction of juvenile white sturgeon entrainment, and hence predation

1 loss, would change minimally between Alternative 7 and NAA (254 fish). The impact and conclusion
2 for predation risk associated with NPB structures and the north Delta intakes would be the same as
3 described for Alternative 1A (Impact AQUA-147).

4 **NEPA Effects:** The overall effect on entrainment and entrainment-related predation under
5 Alternative 7 would not be adverse.

6 **CEQA Conclusion:** As described above, operational activities associated with water exports from
7 SWP/CVP south Delta facilities would result in an overall reduction in entrainment for juvenile
8 white sturgeon under Alternative 7, compared to Existing Conditions (Table 11-7-70). Overall,
9 impacts of water operations on entrainment of white sturgeon would be beneficial due to a
10 reduction in entrainment and no mitigation would be required.

11 The impact and conclusion for predation associated with entrainment would be the same as
12 described. Since few juvenile white sturgeon are entrained at the south Delta, reductions in
13 entrainment (92% reduction compared to Existing Conditions, representing 254 fish) under
14 Alternative 7 would have little effect in affecting entrainment related predation loss. Overall, the
15 impact would be less than significant, because there would be little change in predation loss under
16 Alternative 7.

17 **Table 11-7-70. Juvenile White Sturgeon Entrainment Index^a at the SWP and CVP Salvage Facilities**
18 **for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between**
19 **Model Scenarios**

Water Year ^b	Absolute Difference (Percent Difference)	
	NAA vs. A7_LLT	EXISTING CONDITIONS vs. A7_LLT
Wet and Above Normal	-256 (-96%)	-232 (-96%)
Below Normal, Dry, and Critical	-26 (-69%)	-22 (-66%)
All Years	-282 (-93%)	-254 (-92%)

^a Estimated annual number of fish lost.

^b Sacramento Valley water year-types.

20
21 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
22 **White Sturgeon**

23 In general, Alternative 7 would not affect spawning and egg incubation habitat for white sturgeon
24 relative to NAA.

25 **Sacramento River**

26 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
27 May spawning and egg incubation period for white sturgeon. Flows at Wilkins Slough under A7_LLT
28 during March would be lower than flows under NAA in all water year types (5% to 7% lower)
29 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT during
30 February, April, and May would be similar to or greater than those under NAA, except in below
31 normal years during February (6% lower) and in dry years during February and May (6% and 5%
32 lower, respectively). These results indicate that there would be mostly small (<10%) reductions in
33 flows in the Sacramento River under Alternative 7.

1 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
 2 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*
 3 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
 4 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 7 in any
 5 month or water year type throughout the period.

6 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by
 7 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year
 8 of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees
 9 above each threshold were further assigned a “level of concern”, as defined in Table 11-7-11.

10 Differences between baselines and Alternative 7 in the highest level of concern across all months
 11 and all 82 modeled years are presented in Table 11-7-71. For the 61°F threshold, there would be 2
 12 fewer (4% fewer) “red” years under Alternative 7 than under NAA. For the 68°F threshold, there
 13 would be negligible differences in the number of years under each level of concern between NAA
 14 and Alternative 7.

15 **Table 11-7-71. Differences between Baselines and Alternative 7 in the Number of Years in Which**
 16 **Water Temperature Exceedances above the 61°F and 68°F Thresholds Are within Each Level of**
 17 **Concern, Sacramento River at Hamilton City, March through June**

Level of Concern	EXISTING CONDITIONS vs. A7_LL1	NAA vs. A7_LL1
61°F threshold		
Red	47 (588%)	-2 (-4%)
Orange	-3 (-20%)	0 (0%)
Yellow	-20 (-65%)	1 (9%)
None	-24 (-86%)	1 (25%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	2 (NA)	-1 (-50%)
None	-2 (-2%)	1 (1%)

NA = could not be calculated because the denominator was 0.

18
 19 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at
 20 Hamilton City during March through June (Table 11-7-72, Table 11-7-73). Total degree-days
 21 exceeding the 61°F threshold under Alternative 7 would be 31% higher than those under NAA
 22 during March, although this is an increase of only 5 degree-days, which would not cause biologically
 23 meaningful effect to white sturgeon. During April the total degree-days exceeding the 61°F threshold
 24 under Alternative 7 would be 8% higher than those under NAA. During May through June, total
 25 degree days exceeding the threshold would be 2% to 6% lower than those under NAA. Total degree-
 26 days exceeding the 68°F threshold would not differ between NAA and Alternative 7 during March
 27 and April, but would be 100% to 38% lower under Alternative 7 than under NAA during May and
 28 June.

1 **Table 11-7-72. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days**
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the**
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LL1	NAA vs. A7_LL1
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	8 (NA)	4 (100%)
	Dry	12 (NA)	1 (9%)
	Critical	1 (NA)	0 (0%)
	All	21 (NA)	5 (31%)
April	Wet	64 (533%)	-2 (-3%)
	Above Normal	60 (600%)	-8 (-10%)
	Below Normal	80 (1,333%)	18 (26%)
	Dry	168 (329%)	24 (12%)
	Critical	17 (1,700%)	3 (20%)
	All	389 (486%)	35 (8%)
May	Wet	1,035 (311%)	-80 (-6%)
	Above Normal	311 (143%)	-40 (-7%)
	Below Normal	502 (273%)	53 (8%)
	Dry	462 (229%)	29 (5%)
	Critical	320 (158%)	-30 (-5%)
	All	2,630 (231%)	-68 (-2%)
June	Wet	605 (105%)	-353 (-23%)
	Above Normal	322 (106%)	-44 (-7%)
	Below Normal	532 (252%)	30 (4%)
	Dry	780 (233%)	78 (8%)
	Critical	566 (151%)	20 (2%)
	All	2,805 (156%)	-269 (-6%)

NA = could not be calculated because the denominator was 0.

4

1 **Table 11-7-73. Differences between Baseline and Alternative 7 Scenarios in Total Degree-Days**
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the**
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
April	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
May	Wet	33 (471%)	-3 (-7%)
	Above Normal	21 (NA)	1 (5%)
	Below Normal	1 (NA)	1 (NA)
	Dry	2 (NA)	0 (0%)
	Critical	0 (NA)	-1 (-100%)
	All	57 (814%)	-2 (-3%)
June	Wet	6 (NA)	-2 (-25%)
	Above Normal	4 (400%)	0 (0%)
	Below Normal	0 (NA)	-2 (-100%)
	Dry	0 (NA)	0 (NA)
	Critical	15 (NA)	-12 (-44%)
	All	25 (2,500%)	-16 (-38%)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
 7 River were examined during the February to May spawning and egg incubation period for white
 8 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLT
 9 would be similar to or greater than flows under NAA during February to May, except for March of
 10 below normal water years (8%). Flows under A7_LLT at the confluence with the Sacramento River
 11 would generally be similar to or greater than flows under NAA, except in below normal and dry
 12 years during May (7% and 16% lower, respectively). These results indicate that there would
 13 generally be few low magnitude reductions in flows in the Feather River during the white sturgeon
 14 spawning and egg incubation period under Alternative 7.

15 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the
 16 confluence with the Sacramento River were examined during the February through May white
 17 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ
 18 between NAA and Alternative 7 at either location throughout the period.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis under Alternative 7 during February through May would
3 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*).

5 Water temperature modeling was not conducted for the San Joaquin River.

6 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not
7 have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 7
8 are generally similar to flows under NAA. In addition, exceedances above key water temperature
9 thresholds for spawning adults and egg incubation under Alternative 7 would generally be similar to
10 or lower than exceedances under NAA.

11 **CEQA Conclusion:** In general, under Alternative 7 water operations, the quantity and quality of
12 spawning and egg incubation habitat for white sturgeon would be reduced relative to the CEQA
13 baseline. Differences between the anticipated future conditions under this alternative and Existing
14 Conditions (the CEQA baseline) are largely attributable to sea level rise and climate change, and not
15 to the operational scenarios. As a result, the differences between Alternative 7 (which is under LLT
16 conditions that include future sea level rise and climate change) and the CEQA baseline (Existing
17 Conditions) may therefore either overstate the effects of Alternative 7 or suggest significant effects
18 that are largely attributable to sea level rise and climate change, and not to Alternative 7.

19 **Sacramento River**

20 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
21 May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results*
22 *utilized in the Fish Analysis*). At Wilkins Slough, flows under A7_LL7 would generally be similar to or
23 greater than those under Existing Conditions, except in wet years during May (16% lower), below
24 normal years during March, April, and May (5% to 10% lower depending on month), and in dry
25 years during April (6% lower). At Verona, flows under A7_LL7 during February would generally be
26 similar to flows under Existing Conditions. Flows under A7_LL7 during March through May would
27 generally be lower (6% to 11%) than those under Existing Conditions. These results indicate that
28 there would be small reductions in flows in the Sacramento River under Alternative 7 relative to
29 Existing Conditions.

30 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
31 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*
32 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
33 be no differences (<5%) in mean monthly water temperature between Existing Conditions and
34 Alternative 7 in any month or water year type throughout the period except for wet years during
35 May (5% greater).

36 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by
37 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year
38 of the 82-year modeling period (Table 11-7-10). The combination of number of days and degrees
39 above each threshold were further assigned a “level of concern”, as defined in Table 11-7-11.
40 Differences between baselines and Alternative 7 in the highest level of concern across all months
41 and all 82 modeled years are presented in Table 11-7-71. For the 61°F threshold, there would be 47
42 more (588% increase) “red” years under Alternative 7 than under Existing Conditions. For the 68°F

1 threshold, there would be negligible differences in the number of years under each level of concern
2 between Existing Conditions and Alternative 7.

3 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at
4 Hamilton City during March through June (Table 11-7-72, Table 11-7-73). Total degree-days
5 exceeding the 61°F threshold under Alternative 7 compared to Existing Conditions would be 21
6 degree-days (percent change unable to be calculated due to division by 0) to 2,805 degree-days
7 (156%) higher depending on month. Total degree-days exceeding the 68°F threshold would not
8 differ between Existing Conditions and Alternative 7 during March and April. During May and June,
9 total degree-days would be 57 (814%) and 25 (2,500%) degree-days higher under Alternative 7,
10 although these small absolute differences would not cause a biologically meaningful effect on white
11 sturgeon.

12 **Feather River**

13 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
14 River were examined during the February to May spawning and egg incubation period for white
15 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito
16 Afterbay during February, April and May under A7_LLT would generally be similar to or greater
17 than those under Existing Conditions, except in below normal and dry water years during February
18 (46% and 13% lower, respectively), in critical years during April (6% lower), and in wet years
19 during May (35% lower). Flows during March would generally be similar to or up to 24% lower than
20 flows under Existing Conditions. Flows at the confluence with the Sacramento River under A7_LLT
21 would generally be similar to or greater than flows under Existing Conditions, except in below
22 normal years during February and March (12% and 8% lower, respectively) and critical years
23 during March and April (8% and 6% lower, respectively), and in all but critical years during May
24 (11% to 27% lower depending on water year type). These results indicate that there would be
25 mostly small reductions in flows in the Feather River under Alternative 7 relative to Existing
26 Conditions.

27 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the
28 confluence with the Sacramento River were examined during the February through May white
29 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality
30 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water
31 temperatures would not differ between Existing Conditions and Alternative 7 at either location
32 throughout the period, except below Thermalito Afterbay during February and March, in which
33 temperatures under Alternative 7 would be 6% higher than temperatures under Existing
34 Conditions.

35 **San Joaquin River**

36 Flows in the San Joaquin River at Vernalis under Alternative 7 during February through May would
37 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish
38 Analysis*).

39 Water temperature modeling was not conducted for the San Joaquin River.

40 **Summary of CEQA Conclusion**

41 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between
42 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the

1 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA
2 conclusion set forth above. Water temperature exceedances above NMFS thresholds in the Feather
3 River under Alternative 7 would be more frequent than under Existing Conditions. Elevated water
4 temperatures can lead to reduced green sturgeon spawning success and higher egg mortality.

5 These results are primarily caused by four factors: differences in sea level rise, differences in climate
6 change, future water demands, and implementation of the alternative. The analysis described above
7 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
8 alternative from those of sea level rise, climate change and future water demands using the model
9 simulation results presented in this chapter. However, the increment of change attributable to the
10 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
11 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
12 implementation period, which does include future sea level rise, climate change, and water
13 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
14 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
15 effect of the alternative from those of sea level rise, climate change, and water demands.

16 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
17 term implementation period and Alternative 7 indicates that flows in the locations and during the
18 months analyzed above would generally be similar between Existing Conditions during the LLT and
19 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
20 found above would generally be due to climate change, sea level rise, and future demand, and not
21 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
22 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
23 result in a significant impact on spawning and egg incubation habitat for white sturgeon. This
24 impact is found to be less than significant and no mitigation is required.

25 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

26 In general, Alternative 7 would not affect the quantity and quality of white sturgeon larval and
27 juvenile rearing habitat relative to NAA.

28 Water temperature was used to determine the potential effects of Alternative 7 on white sturgeon
29 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
30 their habitat is more likely to be limited by changes in water temperature than flow rates.

31 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
32 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water
33 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
34 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 7 in any
35 month or water year type throughout the period.

36 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the
37 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality
38 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no
39 differences (<5%) in mean monthly water temperature between NAA and Alternative 7 in any
40 month or water year type throughout the period

41 Water temperatures were not modeled in the San Joaquin River.

1 **NEPA Effects:** These results indicate that the effect is not adverse because it does not have the
2 potential to substantially reduce the amount of suitable habitat. There would be no differences in
3 water temperatures in the Sacramento and Feather Rivers.

4 **CEQA Conclusion:** In general, Alternative 7 would not affect the quantity and quality of white
5 sturgeon larval and juvenile rearing habitat relative to CEQA Existing Conditions.

6 Water temperature was used to determine the potential effects of Alternative 7 on white sturgeon
7 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
8 their habitat is more likely to be limited by changes in water temperature than flow rates.

9 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
10 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water
11 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
12 be no differences (<5%) in mean monthly water temperature between Existing Conditions and
13 Alternative 7 in any month or water year type throughout the period, except for a 5% to 6% higher
14 mean monthly temperature during August through October, in critical years during January, in wet
15 years during May, in critical years during July, and in below normal years during November under
16 Alternative 7.

17 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the
18 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality
19 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no
20 differences (<5%) in mean monthly water temperature between Existing Conditions and Alternative
21 7 during April through June, and August and September (except for an individual water year in
22 each). During January through March and October through December mean monthly water
23 temperatures under Alternative 7 would be 5% to 7% greater than under Existing Conditions.

24 Water temperatures were not modeled in the San Joaquin River.

25 **Summary of CEQA Conclusion**

26 Considering the mostly small increase in temperature exceedance under Alternative 7, it is
27 concluded that this impact is less than significant because it does not have the potential to
28 substantially reduce the amount of suitable habitat. No mitigation is necessary.

29 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

30 In general, the effects of Alternative 7 on white sturgeon migration conditions relative to the NAA
31 are uncertain.

32 Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins
33 Slough and Verona). Larval transport flows were represented by the average number of months per
34 year during the February through May larval transport period that exceeded thresholds of 17,700
35 cfs (Wilkins Slough) and 31,000 cfs (Verona) (Table 11-7-74). Exceedances of the 17,700 cfs
36 threshold for Wilkins Slough under A7_LL1T were similar to those under NAA, except in above
37 normal water years (6% higher). The number of months per year above 31,000 cfs at Verona would
38 be similar to or lower than the number under NAA in all water year types. On an absolute scale, all
39 these changes would be negligible (up to 0.3 months).

1 **Table 11-7-74. Difference and Percent Difference in Number of Months in Which Flow Rates**
 2 **Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wilkins Slough, 17,700 cfs^a		
Wet	0 (-2%)	0 (0%)
Above Normal	0.3 (18%)	0.1 (6%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs^b		
Wet	-0.1 (-2%)	0.1 (1%)
Above Normal	-0.4 (-6%)	-0.1 (-1%)
Below Normal	0 (0%)	0.3 (6%)
Dry	0.2 (4%)	-0.1 (-1%)
Critical	0.3 (7%)	0.2 (5%)
Verona, 31,000 cfs^a		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.2 (-10%)	0 (0%)
Below Normal	-0.2 (-42%)	-0.1 (-33%)
Dry	-0.2 (-61%)	-0.1 (-50%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Months analyzed: February through May.

^b Months analyzed: November through May.

3
 4 Larval transport flows were also examined by utilizing the positive correlation between year class
 5 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the
 6 mechanism responsible for the relationship is that Delta outflow provides improved larval transport
 7 that results in improved year class strength. The percent of months exceeding flow thresholds under
 8 A7_LLT would generally be lower than those under NAA (up to 33%) (Table 11-7-75). These results
 9 suggest that, using the positive correlation between Delta outflow and year class strength, year class
 10 strength would be lower under Alternative 7.

1 **Table 11-7-75. Difference and Percent Difference in Percentage of Months in Which Average Delta**
 2 **Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second in April and May**
 3 **of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
April			
15,000 cfs	Wet	0 (0%)	0 (0%)
	Above Normal	0 (0%)	0 (0%)
20,000 cfs	Wet	-8 (-9%)	-8 (-9%)
	Above Normal	-8 (-11%)	0 (0%)
25,000 cfs	Wet	-8 (-10%)	-4 (-5%)
	Above Normal	-17 (-29%)	-8 (-17%)
May			
15,000 cfs	Wet	-4 (-4%)	4 (5%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-31 (-36%)	-8 (-13%)
	Above Normal	-17 (-40%)	-8 (-25%)
25,000 cfs	Wet	-27 (-39%)	-15 (-27%)
	Above Normal	-17 (-50%)	-8 (-33%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-17 (-17%)	-8 (-9%)
20,000 cfs	Wet	-12 (-13%)	-8 (-9%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-8 (-17%)	-8 (-17%)

4
 5 For juveniles, year-round migration flows at Verona would be more than 5% lower under A7_LLТ
 6 relative to NAA throughout much of the year under each water year, although differences would
 7 rarely exceed ~15% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 For adults, the average number of months per year during the November through May adult
 9 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was
 10 determined (Table 11-7-74). The average number of months exceeding 5,300 cfs under A7_LLТ
 11 would generally be similar to the number of months under NAA, except in below normal (6%
 12 higher) and critical (5% higher) water year types (Table 11-7-74). These increases in exceedances
 13 are considered small (<15%) and would not affect white sturgeon adult migration.

14 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 7 and
 15 NAA (Table 11-7-74). However, due to the removal of water at the North Delta intakes, there are
 16 substantial differences in through-Delta flows between Alternative 7 and NAA (Table 11-7-75).
 17 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between
 18 year class strength and Delta outflow during April and May. However, this conclusion was reached in
 19 the absence of north Delta intakes and the exact mechanism that causes this correlation is not
 20 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper
 21 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another

1 hypothesis suggests that the positive correlation is a result of higher flows through the Delta
2 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some
3 combination of these factors are working together to produce the positive correlation between high
4 flows and sturgeon year-class strength.

5 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation
6 between year class strength and river/Delta flow will be addressed through targeted research and
7 monitoring to be conducted in the years leading up to the initiation of north Delta facilities
8 operations. If these targeted investigations determine that the primary mechanisms behind the
9 positive correlation between high flows and sturgeon year-class strength are related to upstream
10 conditions, then Alternative 7 would be deemed Not Adverse due to the similarities in upstream
11 flow conditions between Alternative 7 and NAA. However, if the targeted investigations lead to a
12 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and
13 through-Delta flow conditions, then Alternative 7 would be deemed Adverse due to the magnitude of
14 reductions in through-Delta flow conditions in Alternative 7 as compared to NAA.

15 **CEQA Conclusion:** In general, under Alternative 7 water operations, white sturgeon migration
16 conditions would not be affected relative to the CEQA baseline.

17 The number of months per year with exceedances above the 17,700 cfs threshold at Wilkins Slough
18 under A7_LLTT would generally be similar to or lower than those under Existing Conditions, except in
19 above normal years (18% higher) (Table 11-7-74). The number of months per year above 31,000 cfs
20 at Verona would be similar to or lower than those under Existing Conditions in all water years.

21 For Delta outflow, the percent of months exceeding flow thresholds under A7_LLTT would generally
22 be lower than those under Existing Conditions (up to 50% lower) with few exceptions (Table 11-7-
23 75).

24 For juveniles, average migration flows during were more than 5% lower under A7_LLTT relative to
25 Existing Conditions throughout much of the year under each water year type, although differences
26 would rarely exceed ~15% (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 For adult migration, the average number of months exceeding 5,300 cfs under A7_LLTT would
28 generally be similar to or lower than the number of months under Existing Conditions, except in
29 critical water years (7% increase) (Table 11-7-74).

30 **Summary of CEQA Conclusion**

31 Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between
32 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
33 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA
34 conclusion set forth above. As discussed above, the Delta outflow-white sturgeon year class strength
35 correlation has high uncertainty such that it is not possible to determine whether reduced outflow
36 would result in a significant impact. However, flows at Verona would generally not meet the 31,000
37 cfs threshold under Alternative 7 as frequently as under Existing Conditions.

38 These results are primarily caused by four factors: differences in sea level rise, differences in climate
39 change, future water demands, and implementation of the alternative. The analysis described above
40 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
41 alternative from those of sea level rise, climate change and future water demands using the model
42 simulation results presented in this chapter. However, the increment of change attributable to the

1 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
2 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
3 implementation period, which does include future sea level rise, climate change, and water
4 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
5 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
6 effect of the alternative from those of sea level rise, climate change, and water demands.

7 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
8 term implementation period and Alternative 7 indicates that flows in the locations and during the
9 months analyzed above would generally be similar between Existing Conditions during the LLT and
10 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
11 found above would generally be due to climate change, sea level rise, and future demand, and not
12 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
13 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would
14 not in itself result in a significant impact on migration conditions for white sturgeon. Additionally, as
15 described above in the NEPA Effects statement, further investigation is needed to better understand
16 the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management
17 would be used to make adjustments to meet the biological goals and objectives. This impact is found
18 to be less than significant and no mitigation is required.

19 **Restoration Measures (CM2, CM4–CM7, and CM10)**

20 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

21 The potential effects of restoration construction activities under Alternative 7 would be greater than
22 that described for Alternative 1A due to the increased floodplain and channel margin habitat
23 enhancement (see Impact AQUA-151). This would include potential effects of turbidity, exposure to
24 methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish
25 stranding, and predation.

26 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-151, restoration construction activities
27 are not expected to adversely affect white sturgeon.

28 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-151 for white sturgeon, the
29 potential impact of restoration construction activities is considered less than significant, and no
30 mitigation would be required.

31 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White 32 Sturgeon**

33 The potential effects of contaminants associated with restoration measures under Alternative 7
34 would be the same as those described for Alternative 1A (see Impact AQUA-152). This would
35 include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate
36 pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000
37 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the
38 effects would be the same as described under Alternative 1A.

39 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-152, contaminants associated with
40 restoration measures are not expected to adversely affect white sturgeon with respect to copper,

1 ammonia and pesticides. The effects of methylmercury and selenium on white sturgeon are
2 uncertain.

3 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-152 for white sturgeon, the
4 potential impact of contaminants associated with restoration measures is considered less than
5 significant, and no mitigation would be required. The same conclusion applies to the additional
6 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20
7 additional miles of channel margin habitat).

8 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

9 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
10 described for Alternative 1A (see Impact AQUA-153). These would include CM2 Yolo Bypass
11 Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated
12 Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community
13 Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000
14 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat
15 under Alternative 7. Under Alternative 7 more restored floodplain habitat may occur in the south
16 Delta. If it does, there would be additional benefits expected for white sturgeon since they occupy
17 these areas.

18 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-153, restored habitat conditions are
19 expected to be beneficial for white sturgeon and the additional restoration included in Alternative 7
20 provides proportionally more benefit.

21 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-153 for white sturgeon, the
22 potential impact of restored habitat conditions on white sturgeon is considered to be beneficial. The
23 additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain
24 and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no
25 mitigation would be required.

26 **Other Conservation Measures (CM12–CM19 and CM21)**

27 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

28 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon** 29 **(CM13)**

30 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

31 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon** 32 **(CM15)**

33 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

34 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

35 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

36 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

1 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**
2 **Sturgeon (CM21)**

3 *NEPA Effects:* Detailed discussions regarding the potential effects of these impact mechanisms on
4 white sturgeon are the same as those described under Alternative 1A (Impact AQUA-154 through
5 162). The effects range from no effect, to not adverse, to beneficial.

6 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
7 less than significant, or beneficial, for the reasons identified for Alternative 1A, and no mitigation is
8 required.

9 **Pacific Lamprey**

10 **Construction and Maintenance of CM1**

11 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

12 The potential effects of construction of the water conveyance facilities on Pacific lamprey would be
13 similar to those described for Alternative 1A (Impact AQUA-163) except that Alternative 7 would
14 include three intakes compared to five intakes under Alternative 1A, so the effects would be
15 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
16 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
17 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
18 would require 27.3 acres of dredging.

19 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and
20 mitigation measures would be available to avoid and minimize potential effects, and the effect would
21 not be adverse for Pacific lamprey.

22 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-163, the impact of the construction
23 of water conveyance facilities on Pacific lamprey would be less than significant except for
24 construction noise associated with pile driving. Potential pile driving impacts would be less than
25 under Alternative 1A because only three intakes would be constructed rather than five.
26 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
27 that noise impact to less than significant.

28 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
29 **of Pile Driving and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

31 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
32 **and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

34 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

35 The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be
36 the same as those described for Alternative 1A (see Impact AQUA-164) except that only three
37 intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

1 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-2, the impact would not be adverse for
2 Pacific lamprey.

3 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance
4 of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation
5 would be required.

6 **Water Operations of CM1**

7 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

8 **Water Exports**

9 The potential entrainment impacts of Alternative 7 on Pacific lamprey would be the same as
10 described above for Alternative 1A (Impact AQUA-165). These actions would avoid or reduce
11 potential entrainment and the effect is not adverse.

12 Under Alternative 7, average annual entrainment of lamprey at the south Delta export facilities, as
13 estimated by salvage density, would be substantially reduced by about 82% (~2,800 fish) (Table 11-
14 7-76) across all years compared to NAA. Therefore, Alternative 7 would not have adverse effects on
15 lamprey.

16 **Predation Associated with Entrainment**

17 Lamprey predation loss at the south Delta facilities is assumed to be proportional to entrainment
18 loss. Average pre-screen predation loss for fish entrained at the south Delta is 75% at Clifton Court
19 Forebay and 15% at the CVP. Lamprey entrainment to the south Delta would be reduced by 82%
20 compared to NAA and predation losses would be reduced at a similar proportion. The impact and
21 conclusion for predation risk associated with NPB structures would be the same as described for
22 Alternative 1A.

23 Predation at the north Delta would be increased due to the construction of the proposed water
24 export facilities on the Sacramento River. The effect on lamprey from predation loss at the north
25 Delta is unknown because of the lack of knowledge about their distribution and population
26 abundances in the Delta.

27 **NEPA Effects:** The overall effect of entrainment and entrainment-related predation on lamprey is
28 considered not adverse.

29 **CEQA Conclusion:** As described above, annual entrainment losses of lamprey would be reduced
30 under Alternative 7 relative to Existing Conditions. Impacts of water operations on entrainment of
31 Pacific lamprey are considered less than significant, and no mitigation would be required.

1 **Table 11-7-76. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for**
2 **Alternative 7^a**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
All Years	-2,751 (-82%)	-2,779 (-82%)

^a Number of fish lost, based on non-normalized data, for all months.

3

4 The impact and conclusion for predation associated with entrainment would be the same as
5 described above because the additional predation losses associated with the proposed north Delta
6 intakes would be offset by the reduction in predation loss at the south Delta. The relative impact of
7 predation loss on the lamprey population is unknown since there is little available knowledge on
8 their distribution and abundance in the Delta. The impact is considered to be less than significant.
9 No mitigation would be required.

10 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
11 **Pacific Lamprey**

12 In general, Alternative 7 would not affect the quality and quantity of spawning and egg incubation
13 habitat for Pacific lamprey relative to NAA.

14 Flow-related effects on Pacific lamprey spawning habitat were evaluated by estimating effects of
15 flow alterations on egg exposure, called redd dewatering risk, and effects on water temperature.
16 Rapid reductions in flow can dewater redds leading to mortality. Locations for each river used in the
17 dewatering risk analysis were based on available literature, personal conversations with agency
18 experts, and spatial limitations of the CALSIM II model, and include the Sacramento River at
19 Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at
20 Thermalito Afterbay, American River at Nimbus Dam and at the confluence with the Sacramento
21 River, and the Stanislaus River at the confluence with the Sacramento River. Pacific lamprey spawn
22 in these rivers between January and August so flow reductions during those months have the
23 potential to dewater redds, which could result in incomplete development of the eggs to
24 ammocoetes (the larval stage). Water temperature results from the SRWQM and the Reclamation
25 Temperature Model were used to assess the exceedances of water temperatures under all model
26 scenarios in the upper Sacramento, Trinity, Feather, American, and Stanislaus Rivers.

27 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-
28 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Results were
29 expressed as the number of cohorts exposed to dewatering risk and as a percentage of the total
30 number of cohorts anticipated in the river based on the applicable time-frame, January to August.

31 Results indicate an increase in redd cohorts exposed to month-over-month flow reductions for
32 Alternative 7 indicates effects would only occur in the Feather River, with a relatively small increase
33 in flow reduction exposures (6%) that would not constitute an adverse effect, and a small reduction
34 in flow reduction exposure (-8%) in the Stanislaus River that would be beneficial (Table 11-7-77).

1 **Table 11-7-77. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**
2 **Cohorts^a**

Location	EXISTING CONDITIONS	
	vs. A7_LL1	NAA vs. A7_LL1
Sacramento River at Keswick	20 (36%)	-2 (-3%)
Sacramento River at Red Bluff	20 (37%)	2 (3%)
Trinity River downstream of Lewiston	0 (0%)	0 (0%)
Feather River at Thermalito Afterbay	-36 (-24%)	6 (6%)
American River at Nimbus Dam	32 (38%)	-5 (-4%)
American River at Sacramento River confluence	34 (36%)	-6 (-4%)
Stanislaus River at Sacramento River confluence	-3 (-5%)	-5 (-8%)

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%. Positive values indicate a higher value in Alternative 7 than in the baseline.

3
4 Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C
5 (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the
6 number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least
7 one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis
8 predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C
9 (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual
10 day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River,
11 corresponding to 82 years of eggs being laid every day each year from January 1 through August 31,
12 and 648 cohorts for the other rivers using monthly data over the same period. The incubation
13 periods used in this analysis are conservative and represent the extreme long end of the egg
14 incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited
15 because the extreme temperatures are masked; however, no better analytical tools are currently
16 available for this analysis. Exact spawning locations of Pacific lamprey are not well defined.
17 Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

18 In most locations, egg cohort exposure would not differ between NAA and Alternative 7 (Table 11-7-
19 78). However, the number of cohorts exposed under Alternative 7 would be 100% lower than those
20 under NAA in the Sacramento River at Keswick. Also, the number of cohorts exposed under
21 Alternative 7 would be 53% greater than those under NAA in the Feather River at Thermalito
22 Afterbay. The increases and decreases in egg cohort exposure under NAA would not have a
23 biologically meaningful effect due to their small absolute values relative to total egg cohort sizes.

1 **Table 11-7-78. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg**
 2 **Cohort Temperature Exposure^a**

Location	EXISTING CONDITIONS	
	vs. A7_LL1	NAA vs. A7_LL1
Sacramento River at Keswick	0 (NA)	-51 (-100%)
Sacramento River at Hamilton City	1,106 (NA)	38 (4%)
Trinity River at Lewiston	8 (NA)	3 (60%)
Trinity River at North Fork	14 (NA)	-3 (-18%)
Feather River at Fish Barrier Dam	1 (NA)	0 (0%)
Feather River below Thermalito Afterbay	116 (483%)	48 (52%)
American River at Nimbus	74 (673%)	0 (0%)
American River at Sacramento River Confluence	155 (277%)	-5 (-2%)
Stanislaus River at Knights Ferry	3 (NA)	1 (50%)
Stanislaus River at Riverbank	83 (4,150%)	-4 (-4%)

NA = could not be calculated because the denominator was 0.

^a Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F during January to August on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in the proposed project than in EXISTING CONDITIONS or NAA.

3
 4 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because Alternative 7
 5 would not have substantial effects on spawning and egg incubation habitat for Pacific lamprey.
 6 Flows and temperatures under Alternative 7 would generally be similar to or better than those
 7 under NAA during the periods of Pacific lamprey presence.

8 **CEQA Conclusion:** In general, Alternative 7 would not affect the quality and quantity of spawning
 9 and egg incubation habitat for Pacific lamprey relative to CEQA Existing Conditions. Comparison of
 10 the month-over-month flow reductions for Alternative 7 to Existing Conditions (Table 11-7-77)
 11 indicate there would be increased exposures to flow reduction in the Sacramento River at Keswick
 12 and Red Bluff (36% and 37%, respectively) and in the American River at Nimbus Dam and the
 13 confluence (38% and 36%, respectively). There would be negligible effects (<5%) on flow reduction
 14 exposures in the Trinity River, a substantial decrease for the Feather River (-24%), and a small
 15 decrease for the Stanislaus River (-5%).

16 The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 7 would be greater than that
 17 under Existing Conditions in all rivers (Table 11-7-78).

18 Collectively, the results of Impact AQUA-166 CEQA analysis indicate that the impact would be
 19 significant because it has the potential to substantially reduce rearing habitat. Both redd dewatering
 20 risk and exposure to high temperatures would increase due to Alternative 7 relative to Existing
 21 Conditions.

22 These results are primarily caused by four factors: differences in sea level rise, differences in climate
 23 change, future water demands, and implementation of the alternative. The analysis described above
 24 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
 25 alternative from those of sea level rise, climate change and future water demands using the model
 26 simulation results presented in this chapter. However, the increment of change attributable to the

1 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
2 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
3 implementation period, which does include future sea level rise, climate change, and water
4 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
5 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
6 effect of the alternative from those of sea level rise, climate change, and water demands.

7 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
8 term implementation period and Alternative 7 indicates that flows in the locations and during the
9 months analyzed above would generally be similar between Existing Conditions during the LLT and
10 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
11 found above would generally be due to climate change, sea level rise, and future demand, and not
12 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
13 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
14 result in a significant impact on spawning and egg incubation habitat for Pacific lamprey. This
15 impact is found to be less than significant and no mitigation is required.

16 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

17 In general, the effect of Alternative 7 would not reduce the quantity or quality of Pacific lamprey
18 rearing habitat relative to NAA based on negligible effects on month-over-month flow reductions
19 and negligible effects on critical water temperatures. There would be small to moderate beneficial
20 effects under Alternative 7 relative to NAA based on decreased occurrence of flow reductions in the
21 Feather River and the American River.

22 Flow-related effects on Pacific lamprey rearing habitat were evaluated by estimating effects of flow
23 alterations on ammocoete exposure, called ammocoete stranding risk. Lower flows can reduce the
24 instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to
25 mortality. Comparisons of effects were made for ammocoete cohorts in the Sacramento River at
26 Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus Dam and
27 at the confluence with the Sacramento River, and Stanislaus River. An ammocoete remains relatively
28 immobile in the sediment in the same location for 5 to 7 years, after which it migrates downstream.
29 During the upstream rearing period there is potential for ammocoete stranding from rapid
30 reductions in flow.

31 The analysis of ammocoete stranding was conducted by analyzing a range of month-over-month
32 flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of
33 ammocoetes was assumed to be born every month during their spawning period (January through
34 August) and spend 7 years rearing upstream. Therefore, a cohort was considered stranded if at least
35 one month-over-month flow reduction was greater than the flow reduction at any time during the
36 period.

37 For the Sacramento River at Keswick (Table 11-7-79), Flow reductions under Alternative 7 would be
38 similar to (<5% difference) or less frequent (-12.3%) than under NAA, with a single small increase
39 (6%) for 65% flow reductions. These results indicate that there would be no project-related effects
40 on flow reductions in the Sacramento River at Keswick.

1 **Table 11-7-79. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
 3 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0.2
-65%	0	6
-70%	4	4
-75%	0.7	0.4
-80%	8	-6
-85%	3	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

4

5 Results of comparisons for the Sacramento River at Red Bluff (Table 11-7-80) provide slightly more
 6 variability in results (Table 11-7-80). Alternative 7 compared to NAA indicates similar conditions
 7 (<5% difference) or small decreases (-8% for the 75% flow reduction category) attributable to the
 8 project. These results indicate that there would be no project-related effects on flow reductions in
 9 the Sacramento River at Red Bluff.

10 **Table 11-7-80. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 11 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
 12 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	4	0.2
-60%	6	4
-65%	2	0.4
-70%	9	-2
-75%	0.2	-8
-80%	13	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

13

14 Comparisons for the Trinity River for Alternative 7 indicate no effect (0%) or negligible effect (<5%
 15 difference) attributable to the project (Table 11-7-81). These results indicate are that there will be
 16 no project-related effects on flow reductions in the Trinity River.

1 **Table 11-7-81. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	21	-3
-80%	27	0
-85%	18	0
-90%	41	3

3 ^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

4 In the Feather River, comparisons of Alternative 7 to NAA indicate reductions in project-related
5 month-over-month flow effects ranging from -8% to -48% (Table 11-7-82). These results indicate
6 that there will be no project-related effects on flow reductions in the Feather River.

7 **Table 11-7-82. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
8 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
9 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-9	-8
-85%	-32	-48
-90%	-64	-28

10 ^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

11 Comparisons for the American River at Nimbus Dam (Table 11-7-83) and at the confluence with the
12 Sacramento River (Table 11-7-84) indicate no effect (0%), negligible effects (<5%), or substantial
13 decreases (to -22%) attributable to the project for both locations (Table 11-7-83). These results
14 indicate that there will be no project-related effects on flow reductions in the American River.

1 **Table 11-7-83. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 3 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	-1
-70%	37	-2
-75%	92	0
-80%	227	-14
-85%	296	-22
-90%	200	0

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

4

5 **Table 11-7-84. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 7 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	7	-1
-75%	34	-2
-80%	207	4
-85%	218	-9
-90%	232	-21

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

8

9 Comparisons for the Stanislaus River (Table 11-7-85) indicate negligible project-related effects on
 10 flow reduction in the Stanislaus River. These results indicate that there will be no project-related
 11 effects on flow reductions in the Stanislaus River.

1 **Table 11-7-85. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the**
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-8	0
-70%	2.5	-6
-75%	52	0.5
-80%	0	0
-85%	0	0
-90%	0	0

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

4
 5 To evaluate water temperature-related effects of Alternative 7 on Pacific lamprey ammocoetes, we
 6 examined the predicted number of ammocoete “cohorts” that experience water temperatures
 7 greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature
 8 data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers
 9 over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each
 10 individual day or month starts a new “cohort” such that there are 18,244 cohorts for the Sacramento
 11 River, corresponding to 82 years of ammocoetes being “born” every day each year from January 1
 12 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

13 In general, there would be no differences in the number of ammocoete cohorts exposed to
 14 temperatures greater than 71.6°F in each river (Table 11-7-86). There would be 79 more cohorts
 15 (70% increase) exposed under Alternative 7 in the Trinity River at Lewiston, but there would be 23
 16 fewer cohorts (8% decrease) exposed at North Fork. In addition, there would be 72 more cohorts
 17 (14% increase) exposed under Alternative 7 in the Feather River below Thermalito Afterbay, but
 18 there would be River at Fish Barrier Dam, but there would be 0% fewer cohorts (0% decrease)
 19 exposed at the Feather River Fish Barrier Dam. Overall, the small to moderate increases and
 20 decreases will balance out within rivers such that there would be no overall effect on Pacific
 21 lamprey ammocoetes.

1 **Table 11-7-86. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey**
2 **Ammocoete Cohorts Exposed to Temperatures Greater than 71.6°F in at Least One Day or Month^a**

Location	EXISTING CONDITIONS	
	vs. A7_LL1	NAA vs. A7_LL1
Sacramento River at Keswick ^b	0 (NA)	-1,705 (-100%)
Sacramento River at Hamilton City ^b	10,569 (NA)	-686 (-6%)
Trinity River at Lewiston	192 (NA)	79 (70%)
Trinity River at North Fork	282 (NA)	-23 (-8%)
Feather River at Fish Barrier Dam	56 (NA)	0 (0%)
Feather River below Thermalito Afterbay	211 (55%)	72 (14%)
American River at Nimbus	297 (153%)	-70 (-12%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	57 (NA)	1 (2%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Positive values indicate a higher value in Alternative 7 than in EXISTING CONDITIONS or NAA.

^b Based on daily data; all other locations use monthly data; 1922–2003.

3

4 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not
5 substantially reduce rearing habitat or substantially reduce the number of fish as a result of
6 ammocoete mortality. In each river, there are no project-related effects on flow reductions or high
7 temperatures during the upstream rearing period that would affect Pacific lamprey ammocoetes.

8 **CEQA Conclusion:** In general, under Alternative 7 water operations, the quantity and quality of
9 rearing habitat for Pacific lamprey would be reduced relative to the CEQA baseline. Differences
10 between the anticipated future conditions under this alternative and Existing Conditions (the CEQA
11 baseline) are largely attributable to sea level rise and climate change, and not to the operational
12 scenarios. As a result, the differences between Alternative 7 (which is under LLT conditions that
13 include future sea level rise and climate change) and the CEQA baseline (Existing Conditions) may
14 therefore either overstate the effects of Alternative 7 or suggest significant effects that are largely
15 attributable to sea level rise and climate change, and not to Alternative 7.

16 In the Feather River, no effect (0%) or decreased occurrence (-9% to -64%) of flow reductions that
17 may cause Pacific lamprey ammocoete stranding are predicted from the project (Table 11-7-82).
18 Comparisons for the American River at Nimbus Dam (Table 11-7-83) and at the confluence with the
19 Sacramento River (Table 11-7-84) indicate increased chance of occurrence of flow reductions
20 between 70% and 90% for Alternative 7 compared to Existing Conditions; predicted increases
21 ranged from 37% to 296% for Nimbus Dam and from 7% to 232% for the confluence, which were
22 derived from numeric increases on the order of 112 to 336 and 56 to 168 (Nimbus Dam) and 145 to
23 445 and 112 to 356 (confluence). Comparisons for the Stanislaus River (Table 11-7-85) indicate a
24 small decrease (65% flow reduction), two increases (3% and 52% for the 70% and 75% flow
25 reduction categories) and no change for the other flow reduction categories from 50% to 90%.

26 The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under
27 Alternative 7 would be higher than those under Existing Conditions in at least one location in all
28 rivers (Table 11-1A-80).

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
5 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Flow-related
6 effects on ammocoete stranding risk would increase in the Sacramento River at Red Bluff (increases
7 in higher flow reduction categories from 9% to 100%), Trinity River (increases from 18% to 41%),
8 and in the American River at Nimbus Dam (increases from 37% to 296%) and at the confluence with
9 the Sacramento (7% to 232%). Large flow reductions would increase the risk of ammocoete
10 stranding and desiccation in these rivers. Further, ammocoetes would be exposed to increased
11 water temperatures exposure in all rivers examined under Alternative 7 relative to Existing
12 Conditions. Increased exposure to higher water temperatures would increase stress and mortality of
13 ammocoetes.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate
15 change, future water demands, and implementation of the alternative. The analysis described above
16 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
17 alternative from those of sea level rise, climate change and future water demands using the model
18 simulation results presented in this chapter. However, the increment of change attributable to the
19 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
20 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
21 implementation period, which does include future sea level rise, climate change, and water
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
26 term implementation period and Alternative 7 indicates that flows in the locations and during the
27 months analyzed above would generally be similar between Existing Conditions during the LLT and
28 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
29 found above would generally be due to climate change, sea level rise, and future demand, and not
30 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
31 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
32 result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less
33 than significant and no mitigation is required.

34 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

35 In general, the effect of Alternative 7 would not reduce the quality of migration habitats for Pacific
36 lamprey relative to NAA due to moderate flow reductions during portions of the juvenile and/or
37 adult migration periods in the Sacramento River at Rio Vista, Feather River, and American River,
38 including in drier water year types. There would be beneficial effects during specific months for
39 some locations due to small to moderate increases in flow, including the Feather River at the
40 confluence with the Sacramento River, the American River, and the Stanislaus River; some of these
41 would occur in drier water year types but would not be of sufficient magnitude or duration to offset
42 the negative effects of flow reductions predicted during the remainder of the migration periods.

43 After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macrophthalmia
44 (juveniles) once they reach the Delta. Migration generally is associated with large flow pulses in

1 winter months (December through March) (USFWS unpublished data) meaning alterations in flow
2 have the potential to affect downstream migration conditions. The effects of Alternative 7 water
3 operations on seasonal migration flows for Pacific lamprey macrophthalmia were assessed using
4 CALSIM II flow output. Flow rates along the likely migration pathways of Pacific lamprey during the
5 likely migration period (December through May) were examined for the Sacramento River at Rio
6 Vista and Red Bluff, the Feather River at the confluence with the Sacramento River, and the
7 American River at the confluence with the Sacramento River.

8 ***Sacramento River***

9 *Macrophthalmia*

10 The difference in mean monthly flow rate for the Sacramento River at Rio Vista (Appendix 11C,
11 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May for Alternative 7 compared
12 to NAA indicates reductions in flow for most months during most water year types, with isolated
13 exceptions where Alternative 7 would have negligible effects (<5%). Flow reductions range from -
14 6% to -44% with the highest values occurring in May. There would also be small increases in flow
15 (6%) during January and February in wet years. There would be flow reductions ranging from -6%
16 to -25% with the highest and most consistent (across water year types) reductions occurring in
17 March, April and May. Project-related decreases in flow in the Sacramento River at Rio Vista (to -
18 25%) would affect Pacific lamprey macrophthalmia migration conditions.

19 For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
20 *Analysis*), the difference in mean monthly flow rate for Alternative 7 compared to NAA for December
21 to May indicate primarily negligible project-related effect. There are several isolated occurrences of
22 small decreases attributable to the project, ranging from -5% (December, above normal years) to -
23 11% (January, critical years), and several occurrences of small increases for some water year types
24 in February and May, ranging from 6% to 11%. Overall in the Sacramento River, these results
25 indicate that the effect of Alternative 7 on flows would generally be negligible (<5%) and would not
26 affect migration conditions.

27 *Adults*

28 Analysis For the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in*
29 *the Fish Analysis*) for the time-frame January to June, indicates primarily negligible (<5%) project-
30 related effects or increases in flow depending on the specific month and water year type, with
31 increases ranging from 6% to 11%, with the exception of small decreases in mean monthly flow in
32 January during dry (-7%) and critical water years (-11%). These results indicate that project-related
33 effects are primarily negligible (<5%) with small increases or decreases (to -11%) for a few months
34 that would not cause biologically meaningful effects.

35 ***Feather River***

36 *Juveniles*

37 Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C,
38 *CALSIM II Model Results utilized in the Fish Analysis*) indicate decreases in mean monthly flow for
39 December and May range from -6% to -18%, and most of the remaining months have negligible
40 project-related effects on flow with the exception of a small decrease (-10%) in January during
41 critical water years, and increases ranging from 6% to 12% for some water year types in January,

1 February, and March. Overall in the Feather River, these results indicate that the effect of Alternative
2 7 on flows would generally be negligible with the exception of moderate reductions in flow for
3 December and May (to -18%) that could affect outmigrating macrophthmia during these months.

4 *Adults*

5 For the Feather River at the confluence with the Sacramento River, January to June (Appendix 11C,
6 *CALSIM II Model Results utilized in the Fish Analysis*), mean monthly flows under Alternative 7
7 indicate negligible effects (<5%), and a reversal of some of the water year type effects in June from
8 decreases to small increases. There would be a small increase in mean monthly flow during January
9 in above normal years (9%) and a decrease in critical years (-10%). There would be increases in
10 flow during February in wet, above normal, and critical years ranging from 6% to 12%. There would
11 be negligible effects during March and April for all water year types with the exception of a small
12 increase in flow during March in below normal years (8%). Results for May and June show variable
13 project-related effects depending on the water year type, with decreases in mean monthly flow
14 during May in below normal and dry years (-7%, -16%) and during June in dry years (-19%), and
15 increases in flow during May in critical years (13%) and June in wet (5%), above normal (24%), and
16 critical (50%) water years. These results indicate that project-related effects would include
17 primarily negligible effects or small increases in flow except for mixed effects by water year type in
18 May and June. Decreases in mean monthly flow during dry water years in May (-16%) and June (-
19 19%) would affect migration; however there would be increases in flow during these two months in
20 critical years (13%, 50%) that would have beneficial effects on migration.

21 *American River*

22 *Juveniles*

23 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
24 *CALSIM II Model Results utilized in the Fish Analysis*) indicate that Alternative 7 would have negligible
25 (<5%) project-related effects on flows in December and January for all water year types, negligible
26 effects for February through April during all but dry and/or critical water years with decreases
27 ranging from -6% to -17%, and increases ranging from 8% to 20% for all but wet water years in
28 May. Overall in the American River, these results indicate that the effect of Alternative 7 on flows
29 would generally be negligible, with the exception of moderate reductions during February through
30 April in dry and critical years (to -17%) that could affect outmigrating macrophthmia during this
31 time-frame.

32 *Adults*

33 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
34 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
35 primarily negligible (<5%) project-related effects for January to April, with exceptions consisting of
36 small decreases for some months during drier water year types (February during critical years, -7%;
37 and March and April during dry and critical years, -6% to -17%). In contrast, project-related effects
38 for May and June consist of increases in mean monthly flow for almost all water year types, ranging
39 from 8% to 20%, with negligible effects (<5%) in May during wet years and June during dry years.
40 These results indicate the project-related effects on flow would be negligible except during March
41 and April in dry and critical years, when flows would be reduced up to -17%. Project-related
42 increases in flow during May and June (to 20%) would have a beneficial effect on migration.

1 **Stanislaus River**

2 *Juveniles*

3 Comparisons for the Stanislaus River at the confluence with the Sacramento River (Appendix 11C,
4 *CALSIM II Model Results utilized in the Fish Analysis*) indicate that effects of Alternative 7 on mean
5 monthly flows compared to NAA for the months of December through May are negligible (<5%) for
6 December through May for all water year types. Overall in the Stanislaus River, these results
7 indicate that the effect of Alternative 7 on flows would generally be negligible.

8 *Adults*

9 Comparisons of mean monthly flow for the Stanislaus River at the confluence with the Sacramento
10 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January through June
11 negligible (<5%) project-related effects for January through May, and during June in wet and above
12 normal years; there would be project-related increases in flow for the three drier water year types
13 in June ranging from 7% to 25% that would be beneficial for migration.

14 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not
15 substantially reduce or degrade migration habitat or substantially reduce the number of fish as a
16 result of mortality. Effects of Alternative 7 on mean monthly flow for the macrophthalmia and adult
17 migration periods consist primarily of negligible effects (<5%) in all locations analyzed, with
18 infrequent and small decreases in flow for some months/water years that would not have
19 biologically meaningful effects on migration conditions, with the exception of small to moderate
20 flow reductions for some months and water year types during the migration periods in the
21 Sacramento River at Rio Vista. The negative effect on migration conditions for this location would be
22 offset by beneficial effects from increases in mean monthly flow for some months and water year
23 types during the migration periods for the other locations analyzed, including the Feather,
24 American, and Stanislaus rivers.

25 **CEQA Conclusion:** In general, the effect of Alternative 7 would not reduce the quality of suitable
26 migration habitat relative to CEQA Existing Conditions.

27 **Sacramento River**

28 *Macrophthalmia*

29 Comparing Alternative 7 to Existing Conditions, the difference in mean monthly flow rate for the
30 Sacramento River at Rio Vista (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)
31 for December to May indicates reductions in flow ranging from -6% to -44% that vary by month and
32 water year type, with the most substantial flow reductions in December and April through May, and
33 smaller reductions as well as negligible effects (<5%) for during January and February in some
34 water year types. Conclusions are that Alternative 7 would result in decreases in mean monthly
35 flows (to -44%) during all months for macrophthalmia migration, with less severe effects in January
36 and February.

37 Comparisons for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized*
38 *in the Fish Analysis*) for December to May indicate variable effects of Alternative 7 relative to
39 Existing Conditions by month and water year type, with small decreases (maximum of -6%) for
40 some water year types in December, primarily negligible effects in January except for an increase
41 (11%) during wet years, increases in February during most water year types (5% to 11%), primarily

1 negligible effects in March and April with small increases (5%) or decreases (-6% to -11%) for some
2 water year types, and mixed result in May with increases in flow during above normal and critical
3 years (8%, 14%), and decreases during wet and below normal years (-18%, -11%). Overall, the
4 effects would primarily consist of negligible effects (<5%), and small increases or decreases that
5 would not be biologically meaningful to Pacific lamprey migration.

6 **Adults**

7 Comparisons of mean monthly flow for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II*
8 *Model Results utilized in the Fish Analysis*) for January through June for Alternative 7 relative to
9 Existing Conditions indicate negligible (<5%) effects of Alternative 7 on mean monthly flow or
10 increases ranging from 6% to 14%, depending on the specific month and water year type. Isolated
11 occurrences of decreases in mean monthly flow are predicted during March in below normal years
12 (-11%), April in below normal (-9%) and dry (-6%) years, and May in wet (-18%) and below normal
13 (-11%) years. These results indicate that Alternative 7 would have primarily negligible effects on
14 flow, with relatively small increases or isolated decreases in mean monthly flow that would not have
15 biologically meaningful effects on migration conditions.

16 **Feather River**

17 *Juveniles*

18 Comparisons for the Feather River at the confluence with the Sacramento River (Appendix 11C,
19 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate decreased flow for
20 Alternative 7 compared to Existing Conditions for the three drier water year types during December
21 (-13% to -34%) and January (-5% to -13%), during February in below normal years (-12%), during
22 March in below normal and critical years (-8%, -8%), during April in critical years (-6%), and during
23 May in all but critical water years (-11% to -27%). There would be a small increases in flow that
24 would be beneficial for migration during December in above normal years (9%), January in wet
25 years (16%), February in wet and above normal years (21%, 10%), and May in critical years (9%).
26 Effects would be negligible (<5%) in April during all water year types except critical years. These
27 results indicate that there are substantial flow reductions (to -34%) that would occur during
28 December and January in drier water year types that would affect Pacific lamprey migration.

29 *Adults*

30 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento
31 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
32 indicate variable effects of Alternative 7 relative to Existing Conditions depending on the month and
33 water year type, with meaningful changes in flow (>5%) consisting of increases up to 36% (June,
34 critical years) and decreases to -29% (June, dry years). Effects in January through March vary by
35 water year type with generally increases in mean monthly flow in wetter water year types and
36 decreases or negligible effects during drier water year types. Effects during April are negligible, with
37 the exception of a small decrease (-6%) in critical years. Effects during May consist primarily of
38 reductions in mean monthly flow ranging from -11% to -27%, with the exception of an increase in
39 mean monthly flow in critical years (9%). Effects during June vary by water year type, with
40 decreases in wet (-26%) and dry (-29%) years, and increases in above normal (8%) and critical
41 (36%) years. These results indicate that there would be decreases in flows in drier water year types
42 (to -29%) that would affect migration conditions.

1 **American River**

2 *Juveniles*

3 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
4 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate decreases in flow
5 for Alternative 7 compared to Existing Conditions for most water year types in December (-6% to -
6 24%), April (-9% to -15%), and May (-7% to -33%); as well as in January during below normal, dry,
7 and critical years (-15% to -31%), and in February and March during critical years (-24%, -20%).
8 There would be increases in flow in January, February, and March during wetter water year types,
9 ranging from 7% to 27%. These results indicate that there would be decreases in mean monthly
10 flow for much of the migration period (to -33%), including in drier water years, that would affect
11 Pacific lamprey migration conditions.

12 *Adults*

13 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
14 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
15 indicate variable effects of Alternative 7 depending on the month and water year type. The effect of
16 Alternative 7 on mean monthly flow in January varies by water year type, with increased flow in wet
17 (26%) and above normal years (20%) and decreased flow in the drier water year types (-15% to -
18 31%). Effects of Alternative 7 in February and March consist primarily of increases in mean monthly
19 flow ranging from 7% to 27%, with the exception of decreased flow during critical years for each
20 month (-24%, -20%). In contrast, effects of Alternative 7 in May and June consist primarily of
21 reductions in mean monthly flow ranging from -7% to -44%, with the exception of an increase in
22 June during below normal years (18%) and some water years with negligible effects. These results
23 indicate that there would be decreases in flows in drier water year types (to -44%) that would affect
24 migration conditions.

25 **Stanislaus River**

26 *Juveniles*

27 Comparisons for the Stanislaus River at the confluence with the San Joaquin River (Appendix 11C,
28 *CALSIM II Model Results utilized in the Fish Analysis*) for December to May indicate primarily
29 reductions in flow attributable to Alternative 7 compared to Existing Conditions, ranging from -6%
30 to -36%, with isolated occurrences of negligible effects (<5%) or small increases in flow (in January
31 during above normal years, 14%; and in March during wet years, 7%). These results indicate that
32 there would be decreases in flow predicted for much of the migration period (to -36%), including in
33 drier water years, that would affect Pacific lamprey migration conditions.

34 *Adults*

35 Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin
36 River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) for January to June
37 indicate that flows under Alternative 7 would generally be lower than those under Existing
38 Conditions during February through May (8% to 14% lower) but similar during January and June.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce rearing habitat and substantially interfere with the movement
5 of fish. Alternative 7 would causes decreases in mean monthly flow in all locations analyzed except
6 for the Sacramento River during the macrophthalmia and adult life stages of Pacific lamprey
7 migration. Flow reductions during the macrophthalmia life stage would increase migration delays to
8 the ocean life stage and straying and increase the risk of mortality. Flow reductions during the adult
9 life stage would reduce the ability for adult lamprey to sense olfactory cues from natal spawning
10 grounds if they use these cues for migration.

11 These results are primarily caused by four factors: differences in sea level rise, differences in climate
12 change, future water demands, and implementation of the alternative. The analysis described above
13 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
14 alternative from those of sea level rise, climate change and future water demands using the model
15 simulation results presented in this chapter. However, the increment of change attributable to the
16 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
17 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
18 implementation period, which does include future sea level rise, climate change, and water
19 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
20 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
21 effect of the alternative from those of sea level rise, climate change, and water demands.

22 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
23 term implementation period and Alternative 7 indicates that flows in the locations and during the
24 months analyzed above would generally be similar between Existing Conditions during the LLT and
25 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
26 found above would generally be due to climate change, sea level rise, and future demand, and not
27 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
28 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
29 result in a significant impact on migration habitat for Pacific lamprey. This impact is found to be less
30 than significant and no mitigation is required.

31 **Restoration Measures (CM2, CM4–CM7, and CM10)**

32 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

33 The potential effects of restoration construction activities under Alternative 7 would be greater than
34 that described for Alternative 1A due to the increased floodplain and channel margin habitat
35 enhancement (see Impact AQUA-169). This would include potential effects of turbidity, exposure to
36 methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish
37 stranding, and predation.

38 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-169, restoration construction activities
39 are not expected to adversely affect Pacific lamprey.

40 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-169 for Pacific lamprey, the
41 potential impact of restoration construction activities is considered less than significant, and no
42 mitigation would be required.

1 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**
2 **Lamprey**

3 The potential effects of contaminants associated with restoration measures under Alternative 7
4 would be the same as those described for Alternative 1A (see Impact AQUA-170). This would
5 include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate
6 pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000
7 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the
8 effects would be the same as described under Alternative 1A.

9 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-170, contaminants associated with
10 restoration measures are not expected to adversely affect Pacific lamprey.

11 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-170 for Pacific lamprey, the
12 potential impact of contaminants associated with restoration measures is considered less than
13 significant, and no mitigation would be required. The same conclusion applies to the additional
14 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20
15 additional miles of channel margin habitat).

16 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

17 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
18 described for Alternative 1A (see Impact AQUA-171). These would include *CM2 Yolo Bypass Fisheries*
19 *Enhancements*, *CM4 Tidal Natural Communities Restoration*, *CM5 Seasonally Inundated Floodplain*
20 *Restoration*, *CM6, Channel Margin Enhancement*, *CM7 Riparian Natural Community Restoration*, and
21 *CM10 Nontidal Marsh Restoration*. It would also include the additional 10,000 acres of seasonally
22 inundated floodplain and the additional 20 miles of channel margin habitat under Alternative 7.

23 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-171, restored habitat conditions are
24 expected to be beneficial for Pacific lamprey and the additional restoration included in Alternative 7
25 provides proportionally more benefit.

26 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-171 for Pacific lamprey, the
27 potential impact of restored habitat conditions on Pacific lamprey is considered to be beneficial. The
28 additional restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain
29 and 20 additional miles of channel margin habitat) provides proportionally more benefit, and no
30 mitigation would be required.

31 **Other Conservation Measures (CM12–CM19 and CM21)**

32 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

33 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**
34 **(CM13)**

35 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

36 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**
37 **(CM15)**

38 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

1 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

2 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

3 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

4 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**
5 **Lamprey (CM21)**

6 **NEPA Effects:** Detailed discussions regarding the potential effects of these impact mechanisms on
7 Pacific lamprey are the same as those described under Alternative 1A (Impact AQUA-172 through
8 180). The effects range from no effect, to not adverse, to beneficial.

9 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
10 less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-172
11 through 180), and no mitigation is required.

12 **River Lamprey**

13 **Construction and Maintenance of CM1**

14 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

15 The potential effects of construction of the water conveyance facilities on river lamprey would be
16 similar to those described for Alternative 1A (Impact AQUA-181) except that Alternative 7 would
17 include three intakes compared to five intakes under Alternative 1A, so the effects would be
18 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
19 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
20 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
21 would require 27.3 acres of dredging.

22 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and
23 mitigation measures would be available to avoid and minimize potential effects, and the effect would
24 not be adverse for river lamprey.

25 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-181, the impact of the construction
26 of water conveyance facilities on river lamprey would be less than significant except for
27 construction noise associated with pile driving. Potential pile driving impacts would be less than
28 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
29 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
30 less than significant.

31 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
32 **of Pile Driving and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

34 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
35 **and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey

The potential effects of the maintenance of water conveyance facilities under Alternative 7 would be the same as those described for Alternative 1A (see Impact AQUA-182) except that only three intakes would need to be maintained under Alternative 7 rather than five under Alternative 1A.

NEPA Effects: As concluded in Alternative 1A, Impact AQUA-182, the effect would not be adverse for river lamprey.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-182, the impact of the maintenance of water conveyance facilities on river lamprey would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey

Water Exports

The potential entrainment impacts of Alternative 7 on Pacific lamprey would be the same as described for Impact AQUA-183 for river lamprey under Alternative 1A. These actions would avoid or reduce potential entrainment and the effect is not adverse.

Under Alternative 7, average annual entrainment of lamprey at the south Delta export facilities, as estimated by salvage density, would be substantially reduced by about 82% (~2,800 fish) (Table 11-7-87) across all years compared to NAA.

NEPA Effects: Alternative 7 would not have adverse effects on lamprey.

CEQA Conclusion: As described above, annual entrainment losses of lamprey would be decreased under Alternative 7 relative to Existing Conditions. Impacts of water operations on entrainment of river lamprey are expected to be less than significant, and no mitigation would be required.

Table 11-7-87. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for Alternative 7^a

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
All Years	-2,751 (-82%)	-2,779 (-82%)

^a Number of fish lost, based on non-normalized data, for all months.

Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for River Lamprey

In general, the effect of Alternative 7 would not affect the quantity and quality of spawning habitat for river lamprey relative to NAA.

Flow-related effects on river lamprey spawning habitat were evaluated by estimating effects of flow alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames for river lamprey incorporated into the analysis. The same locations were analyzed as for Pacific lamprey: the Sacramento River at Keswick and Red Bluff, Trinity River downstream of Lewiston,

1 Feather River at Thermalito Afterbay, American River at Nimbus Dam and at the confluence with the
2 Sacramento River, and the Stanislaus River at the confluence with the Sacramento River. River
3 lamprey spawn in these rivers between February and June so flow reductions during those months
4 have the potential to dewater redds, which could result in incomplete development of the eggs to
5 ammocoetes (the larval stage).

6 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-
7 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning
8 location suitability characteristics (e.g., depth, velocity, substrate) of river lamprey are not
9 adequately described to employ a more formal analysis such as a weighted usable area analysis.
10 Therefore, as described for Pacific lamprey, there is uncertainty that these values represent actual
11 redd dewatering events, and results should be treated as rough estimates of flow fluctuations under
12 each model scenario. Results were expressed as the number of cohorts exposed to dewatering risk
13 and as a percentage of the total number of cohorts anticipated in the river based on the applicable
14 time-frame, February to June.

15 Flows in all rivers evaluated for the river lamprey spawning period from February to June indicated
16 small project-related increases would occur in the Sacramento River at Keswick (6%) and in the
17 Feather River (7%) (Table 11-7-88). All other locations would experience negligible effects (<5%)
18 attributable to the project.

19 **Table 11-7-88. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**
20 **Cohorts^a**

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A7_LLT	NAA vs. A7_LLT
Sacramento River at Keswick	Difference	5	2
	Percent Difference	16%	6%
Sacramento River at Red Bluff	Difference	3	1
	Percent Difference	8%	3%
Trinity River downstream of Lewiston	Difference	-3	-1
	Percent Difference	-4%	-1%
Feather River Below Thermalito Afterbay	Difference	-6	4
	Percent Difference	-9%	7%
American River at Nimbus	Difference	8	-1
	Percent Difference	15%	-2%
American River at Sacramento River confluence	Difference	10	-7
	Percent Difference	17%	-9%
Stanislaus River at Sacramento River confluence	Difference	-11	-6
	Percent Difference	-20%	-12%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 7 than in existing biological conditions (EXISTING CONDITIONS or NAA).

1 River lamprey generally spawn between February and June (Beamish 1980; Moyle 2002). Using
2 Pacific lamprey as a surrogate, eggs are assumed to hatch in 18-49 days depending on water
3 temperature (Brumo 2006) and are, therefore, assumed to be present during roughly the same
4 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey “adults need...
5 temperatures [that] do not exceed 25°C,” although there is no mention of thermal requirements for
6 eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs,
7 significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both
8 temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs.
9 The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM
10 period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from
11 USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods
12 during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data
13 from the Bureau’s temperature model. Each individual day or month starts a new “egg cohort” such
14 that there are 12,320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid
15 every day each year from February 1 through June 30, and 405 cohorts for the other rivers using
16 monthly data over the same period. The incubation periods used in this analysis are conservative
17 and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of
18 the monthly average time step is limited because the extreme temperatures are masked; however,
19 no better analytical tools are currently available for this analysis. Spawning locations of river
20 lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is
21 thought to spawn in each river.

22 For both thresholds, there would be few differences in egg cohort exposure between NAA and
23 Alternative 7 among all sites (Table 11-7-89). Differences of 21 to 22 cohorts in the Sacramento
24 River at Hamilton City are negligible to the population considering the total number of cohorts is
25 12,320. In the Feather River below Thermalito Afterbay, there would be 15 more cohorts (39%
26 increase) exposed to the 71.6°F threshold under Alternative 7 relative to NAA, although differences
27 at the 77°F threshold would be negligible. In addition, there would be no differences between NAA
28 and Alternative 7 in egg exposure at the Fish Barrier Dam in the Feather River. Overall, except at one
29 location in the Feather River for the more conservative threshold temperature (71.6°F), these
30 results indicate that there would be no differences in egg exposure to elevated temperatures under
31 Alternative 7.

1 **Table 11-7-89. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg**
2 **Cohort Temperature Exposure^a**

Location	EXISTING CONDITIONS vs. A7_LL1	NAA vs. A7_LL1
71.6°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	344 (NA)	21 (7%)
Trinity River at Lewiston	0 (NA)	-1 (-100%)
Trinity River at North Fork	3 (NA)	-2 (-40%)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	44 (489%)	15 (39%)
American River at Nimbus	26 (520%)	1 (3%)
American River at Sacramento River Confluence	48 (171%)	-6 (-7%)
Stanislaus River at Knights Ferry	1 (NA)	1 (NA)
Stanislaus River at Riverbank	31 (3,100%)	-3 (-9%)
77°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	58 (NA)	22 (61%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	3 (NA)	1 (50%)
American River at Nimbus	4 (NA)	0 (0%)
American River at Sacramento River Confluence	9 (NA)	3 (50%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F and 77°F F during February to June on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in the proposed project than in EXISTING CONDITIONS or NAA.

3
4 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it does not
5 have the potential to substantially reduce suitable spawning habitat and substantially reduce the
6 number of fish as a result of egg mortality. The effect of Alternative 7 on redd dewatering risk would
7 be negligible at all locations. Further, the effect of Alternative 7 on egg exposure to elevated
8 temperatures would be negligible all locations except the Feather River at Thermalito Afterbay at
9 the more conservative temperature threshold, although there is no effect at the higher threshold, or
10 at Fish Barrier Dam for either temperature threshold.

11 **CEQA Conclusion:** In general, the effect of Alternative 7 would not affect the quantity and quality of
12 suitable spawning habitat for river lamprey relative to CEQA Existing Conditions.

13 Comparisons of Alternative 7 to Existing Conditions indicate increased flow reductions would occur
14 at all locations analyzed in the Sacramento River and the American River; the maximum increase

1 would occur in the American River at the confluence, 17% (Table 11-7-88). Results for the Trinity
 2 River, Feather River and Stanislaus River indicate reduced occurrence of flow reductions for
 3 Alternative 7 relative to Existing Conditions. These results indicate that there would be negligible
 4 effects on flow from Alternative 7 in the Trinity River, Feather River, and Stanislaus River.
 5 Decreased occurrence of flow reductions in the Feather (-9%) and Stanislaus Rivers (-20%) would
 6 have beneficial effects on redd dewatering. There would be increased risk of redd dewatering from
 7 month-over-month flow reductions from Alternative 7 in the Sacramento River (up to 16%) and the
 8 American River (up to 17%).

9 In the Sacramento River at Hamilton City, there would be 344 more cohorts (could not calculate
 10 relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 7 relative
 11 to Existing Conditions, although this represents a very small proportion of the total number of
 12 cohorts evaluated (12,320 cohorts)(Table 11-7-89). Therefore, would not be biologically
 13 meaningful. There would be no differences between Existing Conditions and Alternative 7 at either
 14 location in the Trinity River. In the Feather River below Thermalito Afterbay, there would be 44
 15 more cohorts (489% higher) exposed to the 71.6°F threshold under Alternative 7 relative to Existing
 16 Conditions, although there would be no difference at the Fish Barrier Dam. At both locations in the
 17 American River, there would be 26 to 48 more cohorts (520% to 171% higher) exposed to the
 18 71.6°F threshold under Alternative 7 relative to Existing Conditions. In the Stanislaus River at
 19 Riverbank, there would be 31 more cohorts (3,100% higher) exposed to the 71.6°F threshold under
 20 Alternative 7 relative to Existing Conditions, although there would be no difference at the Knights
 21 Ferry. There would be no or minimal differences between Existing Conditions and Alternative 7 at
 22 any location examined in exposure of egg cohorts to the 77°F threshold except for the Sacramento
 23 River at Hamilton City (58 additional cohorts).

24 **Summary of CEQA Conclusion**

25 The results of the Impact AQUA-184 CEQA analysis indicate that that the difference between the
 26 CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
 27 alternative could substantially reduce the quality and quantity of spawning and egg incubation
 28 habitat and substantially reduce the number of fish as a result of egg mortality, contrary to the NEPA
 29 conclusion set forth above. Both redd dewatering risk and exposure to high temperatures would
 30 increase due to Alternative 7 relative to Existing Conditions.

31 These results are primarily caused by four factors: differences in sea level rise, differences in climate
 32 change, future water demands, and implementation of the alternative. The analysis described above
 33 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
 34 alternative from those of sea level rise, climate change and future water demands using the model
 35 simulation results presented in this chapter. However, the increment of change attributable to the
 36 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
 37 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
 38 implementation period, which does include future sea level rise, climate change, and water
 39 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
 40 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
 41 effect of the alternative from those of sea level rise, climate change, and water demands.

42 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
 43 term implementation period and Alternative 7 indicates that flows in the locations and during the
 44 months analyzed above would generally be similar between Existing Conditions during the LLT and

1 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
2 found above would generally be due to climate change, sea level rise, and future demand, and not
3 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
4 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
5 result in a significant impact on spawning and egg incubation habitat for river lamprey. This impact
6 is found to be less than significant and no mitigation is required.

7 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

8 In general, the effect of Alternative 7 would be negligible relative to NAA.

9 Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow
10 alterations on ammocoete stranding risk. Lower flows can reduce the instream area available for
11 rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparisons of
12 effects were made for ammocoete cohorts, as described for Pacific lamprey, in the Sacramento River
13 at Keswick and Red Bluff, the Trinity River, Feather River, the American River at Nimbus Dam and at
14 the confluence with the Sacramento River, and the Stanislaus River at the confluence with the
15 Sacramento River.

16 As for Pacific lamprey, the analysis of river lamprey ammocoete stranding was conducted by
17 analyzing a range of month-over-month flow reductions from CALSIM II outputs, using the range of
18 50%–90% in 5% increments. A cohort of ammocoetes was assumed to be born every month during
19 their spawning period (February through June) and spend 5 years rearing upstream. Therefore, a
20 cohort was considered stranded if at least one month-over-month flow reduction was greater than
21 the flow reduction at any time during the period.

22 Comparisons of Alternative 7 to NAA for the Sacramento River at Keswick (Table 11-7-90) indicate
23 either no effect (0%), negligible effects (<5%), or a small increase (9%) in one category (65% flow
24 reductions) attributable solely to the project (Table 11-7-90).

25 **Table 11-7-90. Percent Difference between Model Scenarios in the Number of River Lamprey**
26 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
27 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	2	0
-60%	6	3
-65%	10	9
-70%	3	4
-75%	-2	4
-80%	13	1
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

28

1 Results of comparisons for the Sacramento River at Red Bluff (Table 11-7-91) indicate indicates no
2 change (0%), negligible effects (<5%), or very small effects ($\pm 5\%$) attributable to the project

3 **Table 11-7-91. Percent Difference between Model Scenarios in the Number of River Lamprey**
4 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
5 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	6	3
-60%	12	5
-65%	4	3
-70%	10	1
-75%	16	-5
-80%	10	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

6
7 Comparisons for the Trinity River indicate no effect (0%) or negligible effects (<5%) attributable to
8 the project for all flow reduction categories (Table 11-7-92).

9 **Table 11-7-92. Percent Difference between Model Scenarios in the Number of River Lamprey**
10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	26	-4.7
-80%	39	0
-85%	31	0
-90%	62	6

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

11
12 In the Feather River, all comparisons show no difference (0%) or reductions in the occurrence of
13 flow reductions between 50–90% (Table 11-7-93).

1 **Table 11-7-93. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
 3 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0.0
-75%	-2	-2
-80%	-21	-16
-85%	-41	-56
-90%	-62	-32

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

4
 5 Comparisons for the American River at Nimbus Dam (Table 11-7-94) and at the confluence with the
 6 Sacramento River (Table 11-7-95) indicated no effect (0%), negligible effects (<5%), or substantial
 7 decreases (maximum of -29%) attributable to the project.

8 **Table 11-7-94. Percent Difference between Model Scenarios in the Number of River Lamprey**
 9 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 10 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	4	-3
-70%	52	-4
-75%	126	0
-80%	296	-17
-85%	300 [25 to 100]	-29
-90%	200 [25 to 75]	0

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

11

1 **Table 11-7-95. Relative Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLTT	NAA vs. A7_LLTT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	4	-3
-75%	2	-2
-80%	27	4
-85%	10	-11
-90%	248	-27

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

4
 5 Comparisons for the Stanislaus River at the confluence with the Sacramento River (Table 11-7-96)
 6 indicate that under Alternative 7 there would be no effect (0%) or negligible effect (<5%) for all flow
 7 reduction categories.

8 **Table 11-7-96. Relative Difference between Model Scenarios in the Number of River Lamprey**
 9 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the**
 10 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A7_LLTT	NAA vs. A7_LLTT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	-2
-70%	-6	0
-75%	-4	0
-80%	-120	0
-85%	-31	0
-90%	0	0

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 7.

11
 12 Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of
 13 Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et
 14 al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be
 15 conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day
 16 or month starts a new “cohort” such that there are 18,730 cohorts for the Sacramento River,

1 corresponding to 82 years of ammocoetes being “born” every day each year from January 1 through
2 August 31, and 380 cohorts for the other rivers using monthly data over the same period.

3 In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative 7
4 would be similar to or lower than those under NAA (Table 11-7-97). Biologically meaningful
5 exceptions includes the Trinity River at Lewiston and Feather River below Thermalito Afterbay for
6 the 71.6°F threshold and the Sacramento River at Hamilton City and the Feather River below
7 Thermalito Afterbay confluence for the 77°F threshold. In all cases, there would be another location
8 within the river that would have similar or lower exceedances under Alternative 7.

9 **Table 11-7-97. Differences (Percent Differences) between Model Scenarios in River Lamprey**
10 **Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F and 77°F**
11 **in at Least One Month^a**

Location	EXISTING CONDITIONS	
	vs. A7_LL1	NAA vs. A7_LL1
71.6°F Threshold		
Sacramento River at Keswick ^b	0 (NA)	-1,218 (-100%)
Sacramento River at Hamilton City ^b	8,781 (NA)	-714 (-8%)
Trinity River at Lewiston	90 (NA)	40 (80%)
Trinity River at North Fork	135 (NA)	-25 (-16%)
Feather River at Fish Barrier Dam	25 (NA)	0 (0%)
Feather River below Thermalito Afterbay	185 (97%)	55 (17%)
American River at Nimbus	210 (233%)	-35 (-10%)
American River at Sacramento River Confluence	135 (55%)	0 (0%)
Stanislaus River at Knights Ferry	25 (NA)	0 (0%)
Stanislaus River at Riverbank	335 (1,340%)	0 (0%)
77°F Threshold		
Sacramento River at Keswick ^b	0 (NA)	0 (NA)
Sacramento River at Hamilton City ^b	1,502 (NA)	1,352 (90%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	25 (NA)	25 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	65 (NA)	25 (63%)
American River at Nimbus	190 (NA)	-30 (-14%)
American River at Sacramento River Confluence	240 (NA)	10 (4%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Positive values indicate a higher value in the preliminary proposal than in EXISTING CONDITIONS or NAA.

^b Based on daily data; all other locations use monthly data; 1922–2003.

12
13 **NEPA Effects:** These results indicate the effect would not be adverse because it would not
14 substantially reduce rearing habitat or substantially reduce the number of fish through ammocoete
15 mortality. Project-related effects on flow reductions and effects on water temperatures in all

1 locations analyzed would be negligible and would not affect river lamprey ammocoete stranding
2 risk and rearing success.

3 **CEQA Conclusion:** In general, under Alternative 7 water operations, the quantity and quality of
4 rearing habitat for river lamprey would not be affected relative to the CEQA baseline.

5 Comparisons of Alternative 7 to Existing Conditions for the Sacramento River at Keswick indicate no
6 effect (0%) and negligible effect (<5%) in occurrence of flow reductions for the lower flow reduction
7 categories as well as 90% (all values are 0), small increases (6% to 13%) in the occurrence of flow
8 reductions for 60%, 65%, and 80%, and a larger increase (44%) in flow reductions of 85% (Table
9 11-7-90). Comparisons for the Sacramento River at Red Bluff indicate slightly more variable results
10 with small increases in the occurrence of flow reductions in the 55%, 60% and 70% through 80%
11 flow reduction categories ranging from 6% to 16%, and a 100% increase (from 25 to 50
12 occurrences) in the 85% flow reduction category (Table 11-7-91). Based on the prevalence of
13 negligible effects (<5%), or relatively small increased occurrence of flow reductions for most of the
14 flow reduction categories, the effects of a more substantial increase in flow reductions in a single
15 flow reduction category would not be considered biologically meaningful to river lamprey in the
16 Sacramento River.

17 Comparisons for the Trinity River indicated no effect (0%) for the lower flow reduction categories,
18 up to 70%, and increases in occurrence ranging from 26% to 62% for the 75% through 90% flow
19 reduction categories (Table 11-7-92). The prevalence of increased occurrence of higher-magnitude
20 flow reductions would affect river lamprey ammocoete stranding in the Trinity River.

21 Comparisons for the Feather River indicated no effect (0%) or negligible effect (<5%) for all flow
22 reduction categories through 75% flow reductions; for the higher flow reduction categories, there
23 would be a decrease in the occurrence of flow reduction events, ranging from -21% to -62% (Table
24 11-7-93). Decreased occurrences of flow reductions would have a beneficial effect.

25 Comparisons for the American River at Nimbus Dam (Table 11-7-94) and at the confluence with the
26 Sacramento River (Table 11-7-95) for Alternative 7 compared to Existing Conditions indicated no
27 effect (0%) or negligible effect (<5%) for the lower flow reduction categories, and increased
28 occurrence of flow reductions between 70% and 90% ranging from 52% to 300% (actual increase
29 from 25 to 100) for Nimbus Dam and from 10% to 248% (actual increase from 25 to 85) for the
30 confluence. The prevalence of increased occurrence of higher-magnitude flow reductions would
31 constitute a biologically meaningful effect on river lamprey ammocoete stranding in the American
32 River.

33 Comparisons for the Stanislaus River at the confluence with the Sacramento River (Table 11-7-96)
34 indicate no effect (0%), negligible effects (<5%), and flow reductions ranging from -31% to -120%.
35 Decreased occurrences of flow reductions would have a beneficial effect.

36 The number of ammocoete cohorts exposed to 71.6°F under Alternative 7 would be higher than
37 those under Existing Conditions in most locations examined (Table 11-7-97). The number of
38 ammocoete cohorts exposed to 77°F under Alternative 7 would be higher at the Sacramento River at
39 Hamilton City, the Trinity river at North Fork, the Feather River below Thermalito Afterbay, and
40 both locations on the American River. The other locations would have 0 additional cohorts affected.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
5 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. There would be
6 increases in occurrence of flow reduction events for Alternative 7 with respect to Existing
7 Conditions for the Trinity River and the American River at Nimbus Dam and at the confluence with
8 the Sacramento that would be considered a significant impact on river lamprey ammocoete
9 stranding risk for these locations. Alternative 7 would not affect flow reductions in the Sacramento
10 River, Feather River and Stanislaus River. There would also be increases under Alternative 7 on
11 ammocoete cohort exposure to critical water temperatures in the Feather River below Thermalito
12 Afterbay, based on an increase from 0 to 190 cohorts exposed to 71.6°F, and an increase from 0 to
13 65 cohorts exposed to 77°F, that would have a significant impact on rearing success through
14 ammocoete mortality.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate
16 change, future water demands, and implementation of the alternative. The analysis described above
17 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
18 alternative from those of sea level rise, climate change and future water demands using the model
19 simulation results presented in this chapter. However, the increment of change attributable to the
20 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
21 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
22 implementation period, which does include future sea level rise, climate change, and water
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
27 term implementation period and Alternative 7 indicates that flows in the locations and during the
28 months analyzed above would generally be similar between Existing Conditions during the LLT and
29 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
30 found above would generally be due to climate change, sea level rise, and future demand, and not
31 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
32 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
33 result in a significant impact on rearing habitat for river lamprey. This impact is found to be less
34 than significant and no mitigation is required.

35 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

36 In general, the effect of Alternative 7 would have negligible effects on river lamprey migration
37 conditions relative to NAA based on negligible effects on flow. There would be beneficial effects from
38 project-related increases in flow in the Feather River and the American River including in drier
39 water year types.

40 ***Macrophthalmia***

41 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once
42 they reach the Delta. River lamprey migration generally occurs September through November
43 (USFWS unpublished data). The effects of water operations on seasonal migration flows for river

1 lamprey macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely
2 migration pathways of river lamprey during the likely migration period (September through
3 November) were examined to predict how Alternative 7 may affect migration flows for outmigrating
4 macrophthalmia. Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the
5 confluence with the Sacramento River, American River at the confluence with the Sacramento River,
6 and Stanislaus River at the confluence with the Sacramento River.

7 *Sacramento River*

8 Mean monthly flow rates for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model*
9 *Results utilized in the Fish Analysis*) for the river lamprey outmigrating period, September to
10 November, indicate variable project-related effects in September and October ranging from
11 negligible effects (<5%), increases to 7%, and decreases to -18% for above normal and below
12 normal water years. Drier water years would experience negligible effects or small increases in flow.
13 Project-related effects in November would be limited to negligible effects (<5%) and decreases in
14 flow during wetter water year types, ranging from -9% to -14%.

15 *Feather River*

16 Comparisons for the Feather River at the confluence with the Sacramento River indicate (Appendix
17 11C, *CALSIM II Model Results utilized in the Fish Analysis*) predominantly decreases in mean monthly
18 flow in September and November with a substantial portion of the September flow reductions (-
19 13% to -25% for wetter water year types) directly attributable to the project; however, project-
20 related effects in September during critical years would increase mean monthly flow by 15%.
21 Project-related effects in October consist of increases in mean monthly flow for the drier water year
22 types ranging from 10% to 29%. Project-related effects would be negligible (<5%) in November for
23 all water year types with the exception of a small decrease in mean monthly flow (-8%) during
24 above normal years. Conclusions are that project-related effects would decrease mean monthly
25 flows in September (to -25%) except in critical years; effects in October and November would be
26 negligible (<5%), small decreases, or increases (October) that would have a beneficial effect. There
27 would be a decrease in flows during September.

28 *American River*

29 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
30 *CALSIM II Model Results utilized in the Fish Analysis*) indicate variable results, with decreases in mean
31 monthly flow in September during wetter water years (-9% to -15%) and increases during dry
32 (15%) and critical (27%) years; negligible effects (<5%) in October during wet and critical years,
33 decreases in mean monthly flow during above normal (-13%) and below normal (-12%) years, and a
34 small increase (8%) during below normal years. Project-related effects in November would be
35 negligible (<5%) or consist of a small increase (6%) or decrease (-6%) in mean monthly flow
36 depending on water year type. These results indicate that project-related effects during drier water
37 year types in September would be beneficial for migration, with negligible (<5%) or small increases
38 or decreases in October and November depending on water year type.

39 *Stanislaus River*

40 Comparisons for the Stanislaus River at the confluence with the Sacramento River (Appendix 11C,
41 *CALSIM II Model Results utilized in the Fish Analysis*) negligible project-related effects for all three

1 months during all water year types. These results indicate that Alternative 7 would not affect flows
2 in the Stanislaus River.

3 **Adults**

4 Consideration of effects of flow on adult migration from September through November would be the
5 same as described for the macrophthalmia migration period, September through November, above
6 for all rivers evaluated. Alternative 7 would primarily have negligible effects (<5%), small increases
7 or decreases in flow, or decreases in wetter water year types (Appendix 11C, *CALSIM II Model*
8 *Results utilized in the Fish Analysis*). Project-related increases in flow in the Feather River during
9 October and in the American River during September in drier water years would have a beneficial
10 effect on adult river lamprey migration.

11 **NEPA Effects:** Collectively, these results indicate that the effect is not adverse because it would not
12 substantially reduce the amount of suitable habitat or substantially interfere with the movement of
13 fish. Alternative 7 would primarily have negligible effects (<5%), small increases or decreases in
14 flow, or decreases in wetter water year types. Project-related increases in flow in the Feather River
15 during October and in the American River during September in drier water years would have a
16 beneficial effect on river lamprey macrophthalmia migration.

17 **CEQA Conclusion:** In general, under Alternative 7 water operations, the quantity and quality of river
18 lamprey migration habitat would be reduced relative to the CEQA baseline. Differences between the
19 anticipated future conditions under this alternative and Existing Conditions (the CEQA baseline) are
20 largely attributable to sea level rise and climate change, and not to the operational scenarios. As a
21 result, the differences between Alternative 7 (which is under LLT conditions that include future sea
22 level rise and climate change) and the CEQA baseline (Existing Conditions) may therefore either
23 overstate the effects of Alternative 7 or suggest effects that are largely attributable to sea level rise
24 and climate change, and not to Alternative 7.

25 **Macrophthalmia**

26 For the Sacramento River at Red Bluff, comparisons of mean monthly flow rate for Alternative 7 to
27 Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate
28 increases in mean monthly flow in September during wetter water years (39%, 52%), and decreases
29 during drier water years ranging from -16% to -19%. Effects of Alternative 7 in October and
30 November consist primarily of negligible (<5%) effects with the exception of an increase in mean
31 monthly flow in October during dry years (11%) and a decrease in November during dry years (-
32 7%). These results indicate that Alternative 7 has the potential for significant effects on river
33 lamprey macrophthalmia migration due to flow reductions during a portion of the migration period
34 (decreases during September to -19%).

35 Comparisons for the Feather River at the confluence with the Sacramento River indicate (Appendix
36 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate variable effects of Alternative 7
37 relative to Existing Conditions based on month and water year type. There would be increases in
38 mean monthly flow in September during wetter water year types (106%, 57%) and critical years
39 (10%) and decreases during below normal (-7%) and dry (-33%) years. There would be negligible
40 effects (<5%) or increases (10% to 17%) in mean monthly flow in October during all water year
41 types except for a small decrease in mean monthly flow during wet years (-6%). There would be
42 negligible effects (<5%) or decreases (-18% and -9% for wet and below normal years, respectively)
43 in November. Decreases during wetter water year types would not affect migration. However,

1 decreases in flow during September in drier water years (to -33%) would affect migration during
2 this portion of the migration period.

3 Comparisons for the American River at the confluence with the Sacramento River (Appendix 11C,
4 *CALSIM II Model Results utilized in the Fish Analysis*) indicate primarily decreases in mean monthly
5 flow rate for September through November, ranging from -5% to -46% depending on the specific
6 month and water year type. Exceptions include negligible effects (<5%) in October during wet and
7 below normal years and an increase in October during critical years (8%). These results indicate
8 that overall effects of Alternative 7 on flows consist of decreases (to -46%) that would affect river
9 lamprey macrophthalmia migration.

10 Comparisons for the Stanislaus River at the confluence with the Sacramento River (Appendix 11C,
11 *CALSIM II Model Results utilized in the Fish Analysis*) indicate primarily negligible effects (<5%) and
12 reductions in flow ranging from -5% to -17% depending on the specific month and water year type.
13 Decreases during drier water year types would be small (negligible to -11%) and would have less-
14 than-significant impacts on migration. These results indicate that Alternative 7 effects on flows in
15 the Stanislaus River would affect macrophthalmia migration.

16 **Adults**

17 Consideration of effects of flow on adult migration from September through November would be the
18 same as described for the macrophthalmia migration period, September through November, above.

19 **Summary of CEQA Conclusion**

20 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between
21 the CEQA baseline and Alternative 7 could be significant because, under the CEQA baseline, the
22 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
23 the movement of fish, contrary to the NEPA conclusion set forth above. There would be reductions
24 in flows in the Sacramento River during September (to -19%), in the Feather River during
25 September of drier years (to -33%), and in the American River for the entire migration period
26 (decreases to -46%). These flow reductions would affect juvenile migration success, increase
27 straying, and delay access to the ocean. These flow reductions would also affect adult migration
28 success, including a reduction in the ability for adults to sense olfactory cues if they use these cues to
29 find natal spawning grounds.

30 These results are primarily caused by four factors: differences in sea level rise, differences in climate
31 change, future water demands, and implementation of the alternative. The analysis described above
32 comparing Existing Conditions to Alternative 7 does not partition the effect of implementation of the
33 alternative from those of sea level rise, climate change and future water demands using the model
34 simulation results presented in this chapter. However, the increment of change attributable to the
35 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
36 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
37 implementation period, which does include future sea level rise, climate change, and water
38 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
39 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
40 effect of the alternative from those of sea level rise, climate change, and water demands.

41 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
42 term implementation period and Alternative 7 indicates that flows in the locations and during the

1 months analyzed above would generally be similar between Existing Conditions during the LLT and
2 Alternative 7. This indicates that the differences between Existing Conditions and Alternative 7
3 found above would generally be due to climate change, sea level rise, and future demand, and not
4 the alternative. As a result, the CEQA conclusion regarding Alternative 7, if adjusted to exclude sea
5 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
6 result in a significant impact on migration habitat for river lamprey. This impact is found to be less
7 than significant and no mitigation is required.

8 **Restoration Measures (CM2, CM4–CM7, and CM10)**

9 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

10 The potential effects of restoration construction activities under Alternative 7 would be greater than
11 that described for Alternative 1A due to the increased floodplain and channel margin habitat
12 enhancement (see Impact AQUA-187). This would include potential effects of turbidity, exposure to
13 methyl mercury, accidental spills, disturbance of contaminated sediments, underwater noise, fish
14 stranding, and predation.

15 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-187, restoration construction activities
16 are not expected to adversely affect river lamprey.

17 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-187 for river lamprey, the potential
18 impact of restoration construction activities is considered less than significant, and no mitigation
19 would be required.

20 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River 21 Lamprey**

22 The potential effects of contaminants associated with restoration measures under Alternative 7
23 would be the same as those described for Alternative 1A (see Impact AQUA-188). This would
24 include potential effects of mercury, selenium, copper, ammonia, pyrethroids, organophosphate
25 pesticides and organochlorine pesticides. Under Alternative 7 there would be an additional 10,000
26 acres of seasonally inundated floodplain and additional 20 miles of channel margin habitat but the
27 effects would be the same as described under Alternative 1A.

28 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-188, contaminants associated with
29 restoration measures are not expected to adversely affect river lamprey.

30 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-188 for river lamprey, the potential
31 impact of contaminants associated with restoration measures is considered less than significant, and
32 no mitigation would be required. The same conclusion applies to the additional restoration in
33 Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20 additional miles of
34 channel margin habitat).

35 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

36 The potential effects of restored habitat conditions under Alternative 7 would be the same as those
37 described for Alternative 1A (see Impact AQUA-189). These would include CM2 Yolo Bypass
38 Fisheries Enhancements, CM4 Tidal Natural Communities Restoration, CM5 Seasonally Inundated
39 Floodplain Restoration, CM6, Channel Margin Enhancement, CM7 Riparian Natural Community
40 Restoration, and CM10 Nontidal Marsh Restoration. It would also include the additional 10,000

1 acres of seasonally inundated floodplain and the additional 20 miles of channel margin habitat
2 under Alternative 7.

3 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-189, restored habitat conditions are
4 expected to be beneficial for river lamprey and the additional restoration included in Alternative 7
5 provides proportionally more benefit.

6 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-189 for river lamprey, the potential
7 impact of restored habitat conditions on river lamprey is considered to be beneficial. The additional
8 restoration in Alternative 7 (10,000 additional acres of seasonally inundated floodplain and 20
9 additional miles of channel margin habitat) provides proportionally more benefit, and no mitigation
10 would be required.

11 **Other Conservation Measures (CM12–CM19 and CM21)**

12 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

13 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey**
14 **(CM13)**

15 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

16 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

17 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

18 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

19 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

20 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

21 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**
22 **(CM21)**

23 **NEPA Effects:** Detailed discussions regarding the potential effects of these impact mechanisms on
24 river lamprey are the same as those described under Alternative 1A (Impact AQUA-190 through
25 198). The effects range from no effect, to not adverse, to beneficial.

26 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
27 less than significant, or beneficial, for the reasons identified for Alternative 1A (Impact AQUA-190
28 through 198), and no mitigation is required.

29 **Non-Covered Aquatic Species of Primary Management Concern**

30 **Construction and Maintenance of CM1**

31 The effects of construction and maintenance of CM1 under Alternative 7 would be similar for all non-
32 covered species; therefore, the analysis below is combined for all non-covered species instead of
33 analyzed by individual species.

1 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**
2 **Aquatic Species of Primary Management Concern**

3 Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water
4 conveyance facilities on non-covered species of primary management concern. That discussion
5 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
6 to the aquatic environment and aquatic species. The potential effects of the construction of water
7 conveyance facilities under Alternative 7 would be similar to those described for Alternative 1A (see
8 Alternative 1A, Impact AQUA-1) except that Alternative 7 would include three intakes compared to
9 five intakes under Alternative 1A, so the effects would be proportionally less under this alternative.
10 This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures
11 and would require about 17.1 acres of dredge and channel reshaping. In contrast, Alternative 1A
12 would convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. Additionally,
13 California bay shrimp would not be affected because they do not occur in the vicinity and
14 Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary
15 distributions are upstream.

16 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-199, environmental commitments and
17 mitigation measures would be available to avoid and minimize potential effects, and the effect would
18 not be adverse for non-covered aquatic species of primary management concern.

19 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact
20 of the construction of water conveyance facilities on non-covered species of primary management
21 concern would not be significant except potentially for construction noise associated with pile
22 driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
23 reduce that noise impact to less than significant.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

30 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**
31 **Aquatic Species of Primary Management Concern**

32 Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water
33 conveyance facilities on non-covered species of primary management concern. That discussion
34 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
35 to the aquatic environment and aquatic species. The potential effects of the construction of water
36 conveyance facilities under Alternative 7 would be similar to those described for Alternative 1A (see
37 Alternative 1A, Impact AQUA-200). Also, California bay shrimp would not be affected because they
38 do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are unlikely to be
39 affected because their primary distributions are upstream.

40 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-2, the effects would not be adverse.

1 **CEQA Conclusion:** As described above, these impacts would be less than significant.

2 **Water Operations of CM1**

3 The effects of water operations of CM1 under Alternative 7 include a detailed analysis of the
4 following species:

- 5 ● Striped Bass
- 6 ● American Shad
- 7 ● Threadfin Shad
- 8 ● Largemouth Bass
- 9 ● Sacramento tule perch
- 10 ● Sacramento-San Joaquin roach – California species of special concern
- 11 ● Hardhead – California species of special concern
- 12 ● California bay shrimp

13 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**
14 **Species of Primary Management Concern**

15 Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-
16 covered species of primary management concern.

17 ***Striped Bass***

18 Striped bass spawn mostly upstream of the Delta in the Sacramento River, between Colusa and the
19 Feather River confluence; however spawning can take place as far downstream as Isleton (Moyle
20 2002). Limited spawning occurs in the south Delta and lower San Joaquin River. Striped bass eggs
21 could be transported downstream from spawning grounds towards the proposed north Delta
22 intakes. Although these intakes would be screened to exclude fish larger than 15mm, striped bass
23 eggs or larvae in the vicinity of the screens would have the potential to be entrained. The screens of
24 the alternate NBA intake would be similarly screened.

25 At the south Delta facilities, entrainment peaks during the summer months, based on historical
26 salvage. Entrainment losses under Alternative 7 would be expected to decrease compared to
27 baseline conditions since exports from the south Delta facilities would be substantially reduced in
28 the summer, especially in June. This result is based on the assumption that striped bass entrainment
29 is proportional to south Delta exports.

30 Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile
31 striped bass (Nobriga et al. 2004). These diversions are typically small and located on-shore, which
32 may reduce the vulnerability of striped bass to entrainment to these diversions due to their pelagic
33 nature. Reduction or consolidation of diversions from the ROAs (approximately 4–12% of
34 diversions) would not increase entrainment risk and may provide a minor benefit. Also, restoration
35 activities as part of the conservation measures should increase the amount of habitat for young
36 striped bass (e.g. inshore rearing habitat), and increase their food supply. The expectation is that
37 these habitat changes would result in at least a minor improvement in production of juvenile striped
38 bass.

1 **NEPA Effects:** In summation, potential entrainment would increase in the Sacramento River for eggs
2 and larvae exposed to the north Delta intakes and the NBA alternative intake compared to baseline
3 (no intake facilities), while entrainment of striped bass older than young of year (YOY) at the south
4 Delta facilities would potentially decrease. Although egg and larval survival is correlated with
5 striped bass YOY production, the variability in egg and larval survival is dampened by a population
6 bottleneck between YOY abundance and recruitment at three years of age (Kimmerer et al. 2000).
7 Hence variations in striped bass survival rates during the first few months of life are moderated by
8 this bottleneck (Kimmerer et al. 2000). Therefore it would be expected that reductions in
9 entrainment of juveniles and adults at the south Delta intakes would have a greater population
10 impact than increases in entrainment at the proposed SWP/CVP north Delta intakes and the NBA
11 intake. Furthermore, reductions/consolidations in agricultural diversions may also reduce
12 entrainment of striped bass.

13 Overall, the effect on striped bass entrainment would not be adverse.

14 **CEQA Conclusion:** The impact of water operations on entrainment of striped bass would be the
15 same as described immediately above. The changes in entrainment under Alternative 7 would not
16 substantially reduce the striped bass population when other conservation measures are taken into
17 consideration. The impact would be less than significant and no mitigation would be required.

18 **American Shad**

19 The majority of American shad spawning occurs upstream of the Delta but some spawning is
20 believed to occur in the Delta along the Sacramento River (Stevens 1966). American shad eggs stay
21 suspended in the water column and may gradually drift downstream towards the proposed north
22 Delta intakes. The north Delta is also used as nursery habitat for American shad. The intakes of the
23 proposed north Delta diversions and the NBA intake would be screened, but small life stages (eggs
24 and larvae) would have the potential to be entrained. Some larval American shad would be in the
25 north Delta, but only a small fraction of the total larval population would encounter the proposed
26 North Delta intakes when they are still vulnerable to entrainment.

27 At the SWP/CVP south Delta facilities, historical salvage of American shad was highest in the
28 summer months but continued to be elevated through the fall months. American shad entrainment
29 losses under Alternative 7 would decrease compared to NAA due to reduced south Delta exports for
30 all months. Reduced south Delta entrainment would also be expected to reduce predation loss
31 associated with these facilities, especially within Clifton Court Forebay. Reduction or consolidation
32 of agricultural diversions in ROAs would not increase entrainment.

33 **NEPA Effects:** Overall, the effect on American shad would not be adverse, and would be slightly
34 beneficial.

35 **CEQA Conclusion:** The impact of water operations on entrainment of American shad would be the
36 same as described immediately above. The changes in entrainment under Alternative 7 would not
37 substantially reduce the American shad population. The impact would be less than significant and
38 no mitigation would be required.

39 **Threadfin Shad**

40 Threadfin shad are widely distributed throughout the Delta, however they are most abundant in the
41 southeastern region of the Delta where areas of dense SAV in shallow water serve as important
42 spawning and rearing habitat (Feyrer et al. 2009). The proposed SWP/CVP north Delta intakes and

1 alternate NBA intake would be located well upstream of this region, which would limit potential
2 entrainment of shad eggs and larvae, and the intakes would be screened to avoid entrainment of
3 juveniles and adults.

4 At the SWP/CVP south Delta facilities, historical salvage of threadfin shad peaks sharply in the
5 summer months, with smaller peaks occurring in late fall and early winter. Threadfin shad
6 entrainment losses would decrease due to reduced south Delta exports under Alternative 7.
7 Additionally, reduced south delta entrainment is expected to reduce predation loss associated with
8 these entrainment at these facilities, especially within Clifton Court Forebay.

9 Agricultural diversions may be sources of entrainment for threadfin shad. Reduction or
10 consolidation of these agricultural diversions under the Plan would decrease or have no impact on
11 threadfin shad entrainment.

12 **NEPA Effects:** Overall, entrainment would be reduced, which would benefit threadfin shad. The
13 effect on threadfin shad would not be adverse.

14 **CEQA Conclusion:** The impact of water operations on entrainment of threadfin shad would be the
15 same as described immediately above. The changes in entrainment under Alternative 7 would not
16 substantially reduce and may benefit the threadfin shad population. The impact would be less than
17 significant and no mitigation would be required.

18 **Largemouth Bass**

19 Historically, entrainment of largemouth bass to the south Delta export facilities peaks during the
20 summer months. At the SWP/CVP south Delta facilities, entrainment losses under Alternative 7
21 would be expected to decrease compared to NAA, assuming largemouth bass entrainment is
22 proportional to south Delta exports. Water exports from the south Delta would decrease in all
23 months under Alternative 7 compared to NAA.

24 Largemouth bass are predominantly distributed in the central and south Delta in areas of dense SAV,
25 and thus would have minimal overlap with propose north Delta intake facilities and alternate NBA
26 intake on the Sacramento River. The proposed intakes would be screened to exclude fish larger than
27 15 mm. Largemouth bass lay demersal eggs in a nest guarded by the male and newly hatched
28 largemouth bass hold around their nests until they begin feeding. Parental male bass protect newly
29 hatched young bass for several weeks at which time, they would be effectively screened. These
30 behaviors minimize the potential for larval largemouth bass to encounter and be entrained into the
31 proposed north Delta intakes and NBA intake.

32 Agricultural diversions may be sources of entrainment for largemouth bass. Agricultural diversions
33 are typically located nearshore, which is the habitat mainly used by largemouth bass. Reduction or
34 consolidation of these agricultural diversions under the Plan would not be expected to increase
35 entrainment of largemouth bass and would likely reduce overall entrainment attributable to these
36 diversions.

37 **NEPA Effects:** Overall, entrainment of largemouth bass would decrease compared to baseline
38 conditions. The effect from Alternative 7 would not be adverse and would likely provide minor
39 benefits.

40 **CEQA Conclusion:** The impact of water operation on largemouth bass would be as described
41 immediately above. The changes in entrainment under Alternative 7 would likely benefit the

1 largemouth bass population. The impact would be less than significant and no mitigation would be
2 required.

3 ***Sacramento Tule Perch***

4 At the SWP/CVP south Delta facilities, entrainment losses under Alternative 7 would be expected to
5 decrease compared to baseline conditions, because Sacramento tule perch entrainment is assumed
6 to be proportional to south Delta exports. Because water would be exported from the proposed
7 north Delta facilities under Alternative 7, less water would be exported from the south Delta, leading
8 to presumed reductions in Sacramento tule perch south Delta entrainment. Additionally, reduced
9 south Delta entrainment would be expected to reduce the amount of entrainment-related predation
10 loss associated with these facilities, especially within Clifton Court Forebay.

11 The proposed SWP/CVP north Delta intakes would be screened with state-of-the-art fish screens for
12 fish less than 15 mm in size. Because Sacramento tule perch are viviparous, newly born Sacramento
13 tule perch would be large enough to be effectively screened at the proposed north delta facilities.

14 Agricultural diversions may be sources of entrainment for Sacramento tule perch. Agricultural
15 diversions are typically located nearshore, which is the habitat mainly used by juvenile and adult
16 Sacramento tule perch. Reduction or consolidation of these agricultural diversions under the Plan
17 would decrease entrainment of Sacramento tule perch into these agricultural intakes.

18 ***NEPA Effects:*** In summation, entrainment of Sacramento tule perch would decrease compared to
19 Existing Conditions. Overall, the effect on entrainment from Alternative 7 would not be adverse.

20 ***CEQA Conclusion:*** The impact of water operations on entrainment of Sacramento tule perch would
21 be the same as described immediately above. The changes in entrainment under Alternative 7 would
22 be beneficial to the Sacramento tule perch. The impact would be less than significant and no
23 mitigation would be required.

24 ***Sacramento-San Joaquin Roach***

25 The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 7
26 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201).

27 ***NEPA Effects:*** As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

28 ***CEQA Conclusion:*** The impact of water operations on entrainment of Sacramento-San Joaquin roach
29 would be the same as described immediately above. The impacts would be less than significant.

30 ***Hardhead***

31 The effect of water operations on entrainment of hardhead under Alternative 7 would be similar to
32 that described for Alternative 1A (see Alternative 1A, Impact AQUA-201).

33 ***NEPA Effects:*** As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

34 ***CEQA Conclusion:*** The impact of water operations on entrainment of hardhead would be the same
35 as described immediately above. The impacts would be less than significant.

1 **California Bay Shrimp**

2 **NEPA Effects:** California bay shrimp do not occur in the vicinity of the intakes and there would be
3 effect.

4 **CEQA Conclusion:** The impact of water operations on entrainment of California bay shrimp would
5 be the same as described immediately above. There would be no impact.

6 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
7 **Non-Covered Aquatic Species of Primary Management Concern**

8 Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-
9 covered species of primary management concern.

10 **Striped Bass**

11 In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat
12 conditions for striped bass relative to NAA.

13 **Flows**

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
15 Clear Creek were examined during the April through June striped bass spawning, embryo
16 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
17 habitat available for spawning, egg incubation, and rearing.

18 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
19 greater than flows under NAA during April through June except in below normal years during April
20 (6% lower) and wet and below normal years during May (9% lower) (Appendix 11C, *CALSIM II*
21 *Model Results utilized in the Fish Analysis*).

22 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
23 greater than flows under NAA during April through June except in above normal years during April
24 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than
26 flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the*
27 *Fish Analysis*).

28 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
29 greater than flows under NAA during April through June except in wet years during May and June
30 (35% and 10% lower, respectively), and critical years during April (7% lower), below normal and
31 dry years during May (19% and 26% lower, respectively), and dry years during June (18% lower)
32 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
34 under NAA throughout the period except in dry and critical years during April (13% and 8% lower,
35 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
37 always be similar to or greater than flows under NAA during April through June regardless of water
38 year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
2 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
3 Alternative 1A indicates that there would be no differences in flows relative to the NAA.

4 *Water Temperature*

5 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
6 bass spawning, embryo incubation, and initial rearing during April through June was examined in
7 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
8 range could lead to reduced spawning success and increased egg and larval stress and mortality.
9 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
11 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
12 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related
13 effects in these rivers during the April through June period.

14 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the
15 range would be lower than the percentage under NAA in all water year types except in critical years
16 (8% higher) (Table 11-7-98).

17 **Table 11-7-98. Difference and Percent Difference in the Percentage of Months during April–June in**
18 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F**
19 **to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial**
20 **Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (0%)	-5 (-12%)
Above Normal	-9 (-20%)	-6 (-17%)
Below Normal	-5 (-11%)	-7 (-19%)
Dry	0 (0%)	4 (8%)
Critical	8 (21%)	-6 (-12%)
All	-1 (-2%)	-3.7 (-9%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

21
22 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
23 Alternative 7 would not cause a substantial reduction in striped bass spawning, incubation, or initial
24 rearing habitat. Flows in all rivers examined during the April through June spawning, incubation,
25 and initial rearing period under Alternative 7 would generally be similar to or greater than flows
26 under NAA, with infrequent, small-magnitude flow reductions that would not have biologically
27 meaningful effects. The percentage of months outside the 59°F to 68°F water temperature range
28 would generally be lower under Alternative 7 than under NAA.

29 **CEQA Conclusion:** In general, Alternative 7 would not affect the quality and quantity of upstream
30 habitat conditions for striped bass relative to CEQA Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the April through June striped bass spawning, embryo
4 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
5 habitat available for spawning, egg incubation, and rearing.

6 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
7 greater than flows under Existing Conditions during April through June, except in below normal and
8 dry years during April (9% and 6% lower, respectively) and wet and below normal years during
9 May (18% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
10 *Analysis*).

11 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
12 greater than flows under Existing Conditions during April through June, except in critical years
13 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than
15 flows under Existing Conditions during April through June regardless of water year type (Appendix
16 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
18 greater than flows under Existing Conditions during April through June, except in critical years
19 during April (6% lower), wet years during May (35% lower), and in wet and dry years during June
20 (9% and 14% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
21 *Analysis*).

22 In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or lower
23 than flows under Existing Conditions during April through June (up to 38% lower) except in above
24 and below normal years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
25 *Analysis*). Despite several moderate flow reductions for specific months and water year types,
26 reductions would not be consistent for all three months for any one water year type and therefore
27 would not have biologically meaningful effects.

28 In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
29 generally be similar to or lower than flows under Existing Conditions during April through June (to
30 27% lower) except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results*
31 *utilized in the Fish Analysis*). There would be moderate flow reductions in drier water year types for
32 two of the three months of the period; they would not be substantial enough to have biologically
33 meaningful effects.

34 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
35 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
36 Alternative 1A indicates that there would be small to moderate reductions in flows during the
37 period relative to Existing Conditions.

38 *Water Temperature*

39 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
40 bass spawning, embryo incubation, and initial rearing during April through June was examined in
41 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this

1 range could lead to reduced spawning success and increased egg and larval stress and mortality.
2 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

3 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
4 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
5 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related
6 effects in these rivers during the April through June period.

7 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside of
8 the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation,
9 and initial rearing during April through June would be similar to or lower than the percentage under
10 Existing Conditions in all water years except critical years (21% higher) (Table 11-7-98). This is a
11 small-magnitude increase that would not have biologically meaningful effects.

12 Collectively, these results indicate that the impact would not be significant because Alternative 7
13 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of
14 striped bass relative to Existing Conditions. Flows under Alternative 7 during the April through June
15 spawning, incubation, or initial rearing period would generally be similar to or lower than flows
16 under Existing Conditions, with isolated and small-magnitude occurrence of flow reductions that
17 would not have biologically meaningful effects on the striped bass population. The percentage of
18 months outside the 59°F to 68°F water temperature range would generally be similar to or lower
19 under Alternative 7 compared to Existing Conditions.

20 ***American Shad***

21 In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat
22 conditions for American shad relative to NAA.

23 ***Flows***

24 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
25 Clear Creek were examined during the April through June American shad adult migration and
26 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
27 quality for spawning.

28 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
29 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
30 *utilized in the Fish Analysis*).

31 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
32 greater than flows under NAA during April through June except above normal years during April
33 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than
35 flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results utilized in the*
36 *Fish Analysis*).

37 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
38 greater than flows under NAA during April through June except in below normal and dry years
39 during May (19% and 26% lower, respectively), and dry years during June (18% lower) (Appendix
40 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
2 under NAA throughout the period except in dry and critical years during April (13% and 8% lower,
3 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
5 always be similar to or greater than flows under NAA during April through June regardless of water
6 year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
8 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
9 Alternative 1A indicates that there would be no differences in flows relative to the NAA.

10 *Water Temperature*

11 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
12 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
13 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
14 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
15 were not modeled in the San Joaquin River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
17 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
18 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related
19 effects in these rivers during the April through June period.

20 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the
21 60°F to 70°F water temperature range would generally be similar to or lower than the percentage
22 under NAA, except in below normal years (11% greater) (Table 11-7-99). These are small-
23 magnitude increases that would not have biologically meaningful effects.

24 **Table 11-7-99. Difference and Percent Difference in the Percentage of Months during April–June in**
25 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F**
26 **to 70°F Water Temperature Range for American Shad Adult Migration and Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-5 (-11%)	0 (0%)
Above Normal	-3 (-8%)	-12 (-36%)
Below Normal	12 (38%)	5 (11%)
Dry	6 (14%)	0 (0%)
Critical	-3 (-8%)	-8 (-25%)
All	1 (2%)	-2 (-5%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

27
28 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
29 Alternative 7 would not cause a substantial reduction in American shad spawning or adult
30 migration. Flows in all rivers examined during the April through June adult migration and spawning
31 period under Alternative 7 would generally be similar to or greater than flows under NAA, with
32 infrequent, small-magnitude flow reductions that would not have biologically meaningful effects.

1 The percentage of months outside the 60°F to 70°F water temperature range would generally be
2 similar to or lower under Alternative 7 than under NAA.

3 **CEQA Conclusion:** In general, Alternative 7 would not affect the quality and quantity of upstream
4 habitat conditions for American shad relative to CEQA Existing Conditions.

5 *Flows*

6 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
7 Clear Creek were examined during the April through June American shad adult migration and
8 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
9 quality for spawning.

10 In the Sacramento River upstream of Red Bluff, flows under A7_LLTT would generally be similar to or
11 greater than flows under Existing Conditions during April through June, except in below normal and
12 dry years during April (9% and 6% lower, respectively) and wet and below normal years during
13 May (18% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
14 *Analysis*).

15 In the Trinity River below Lewiston Reservoir, flows under A7_LLTT would generally be similar to or
16 greater than flows under Existing Conditions during April through June, except in critical years
17 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 In Clear Creek at Whiskeytown Dam, flows under A7_LLTT would always be similar to or greater than
19 flows under Existing Conditions during April through June regardless of water year type (Appendix
20 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the Feather River at Thermalito Afterbay, flows under A7_LLTT would generally be similar to or
22 greater than flows under Existing Conditions during April through June, except in critical years
23 during April (6% lower), wet years during May (35% lower), and in wet and dry years during June
24 (9% and 14% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
25 *Analysis*).

26 In the American River at Nimbus Dam, flows under A7_LLTT would generally be similar to or lower
27 than flows under Existing Conditions during April through June (up to 38% lower) except in above
28 and below normal years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*). Despite several moderate flow reductions for specific months and water year types,
30 reductions would not be consistent for all three months for any one water year type and therefore
31 would not have biologically meaningful effects.

32 In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLTT would
33 generally be similar to or lower than flows under Existing Conditions during April through June (to
34 27% lower) except in wet and critical years during June (Appendix 11C, *CALSIM II Model Results*
35 *utilized in the Fish Analysis*). There would be moderate flow reductions in drier water year types for
36 two of the three months of the period; they would not be substantial enough to have biologically
37 meaningful effects.

38 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
39 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
40 Alternative 1A indicates that there would be small to moderate reductions in flows during the
41 period relative to Existing Conditions.

1 **Water Temperature**

2 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
3 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
4 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
5 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
6 were not modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
8 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
9 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature related
10 effects in these rivers during the April through June period.

11 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LL1T outside of
12 the 60°F to 70°F water temperature range would be similar to or lower than the percentage under
13 Existing Conditions in all water years except below normal and dry years (38% and 14% higher,
14 respectively) (Table 11-7-99). These increases correspond to relatively small absolute increases,
15 12% and 6%, respectively, and would not have biologically meaningful effects.

16 Collectively, these results indicate that the impact would not be significant because Alternative 7
17 would not cause a substantial reduction in American shad adult migration and spawning habitat.
18 Flows under Alternative 7 would generally be similar to or lower than flows under Existing
19 Conditions, with isolated and small-magnitude occurrence of flow reductions that would not have
20 biologically meaningful effects. The percentages of months outside the 60°F to 70°F water
21 temperature range would generally be similar to or lower under Alternative 7 than under Existing
22 Conditions.

23 **Threadfin Shad**

24 In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for
25 threadfin shad relative to NAA.

26 **Flows**

27 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
28 Clear Creek were examined during April through August threadfin shad spawning period. Lower
29 flows could reduce the quantity and quality of instream habitat available for spawning.

30 In the Sacramento River upstream of Red Bluff, flows under A7_LL1T during April and May would
31 always be similar to or greater than flows relative to NAA regardless of water year type (Appendix
32 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 In the Trinity River below Lewiston Reservoir, flows under A7_LL1T would generally be similar to or
34 greater than flows under NAA, except in above normal years during April and critical years during
35 August (11% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In Clear Creek at Whiskeytown Dam, flows under A7_LL1T would nearly always be similar to or
37 greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*
38 *utilized in the Fish Analysis*).

39 In the Feather River at Thermalito Afterbay, flows under A7_LL1T would generally be lower than
40 those under NAA during July and August (up to 32% lower), greater during June (up to 53%

1 greater), and similar during the rest of the period, with some exceptions (up to 26% lower)
2 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate flow reductions that
3 occur in drier water years would generally be offset by increases in adjoining months and would not
4 have biologically meaningful negative effects.

5 In the American River at Nimbus Dam, flows under A7_LLTT would generally be similar to or greater
6 than flows under NAA throughout the period, with relatively infrequent and small-magnitude
7 exceptions and a single, substantial flow reduction in critical years during August (41% lower) that
8 would be isolated and not have biologically meaningful effects.

9 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLTT would always
10 be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*).

12 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
13 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
14 Alternative 1A indicates that there would no differences in flows relative to the NAA.

15 *Water Temperature*

16 The percentage of months below 68°F water temperature threshold for the April through August
17 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
18 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
19 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
20 Creek.

21 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
22 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
23 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
24 effects in these rivers throughout the year.

25 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLTT below
26 68°F would similar to or greater than those under NAA in all water years (to 7% greater) except in
27 dry years (18% lower) (Table 11-7-100). The increases are of small magnitude and would not have
28 biologically meaningful effects.

29 **Table 11-7-100. Difference and Percent Difference in the Percentage of Months during April–**
30 **August in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below**
31 **the 68°F Water Temperature Threshold for Threadfin Shad Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLTT	NAA vs. A7_LLTT
Wet	-9 (-15%)	4 (7%)
Above Normal	-25 (-33%)	4 (7%)
Below Normal	-21 (-31%)	3 (6%)
Dry	-37 (-49%)	-7 (-18%)
Critical	-28 (-44%)	0 (0%)
All	-22 (-33%)	1 (2%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

32

1 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
2 Alternative 7 would not cause a substantial reduction in spawning habitat. Flows in all rivers
3 examined during the April through August spawning period under Alternative 7 would generally be
4 similar to or greater than flows under NAA, except during summer months in the Sacramento,
5 Feather, and American rivers. Lower flows during these months in these rivers are not of sufficient
6 magnitude or frequency to have a biologically meaningful effect on threadfin shad. The percentage
7 of months below the spawning temperature threshold would be similar to or slightly higher under
8 Alternative 7 relative to NAA, and is not expected to have a biologically meaningful effect on the
9 threadfin shad population. Additionally, there are no temperature-related effects in any other rivers.

10 **CEQA Conclusion:** In general, Alternative 7 would not affect the quality and quantity of upstream
11 habitat conditions for threadfin shad relative to CEQA Existing Conditions.

12 *Flows*

13 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
14 Clear Creek were examined during April through August spawning period. Lower flows could reduce
15 the quantity and quality of instream habitat available for spawning.

16 In the Sacramento River upstream of Red Bluff, flows under A7_LLTT during April, May, and August
17 would generally be similar to or greater than flows under Existing Conditions, with some exceptions
18 (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during
19 June and July would generally be greater than flows under Existing Conditions by up to 11%.

20 In the Trinity River below Lewiston Reservoir, flows under A7_LLTT would generally be similar to or
21 greater than flows under Existing Conditions throughout the period, except in critical years during
22 May and August (6% and 33% lower, respectively) and wet years during July (14% lower)
23 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 In Clear Creek at Whiskeytown Dam, flows under A7_LLTT would nearly always be similar to or
25 greater than flows under Existing Conditions throughout the period, except in critical years during
26 August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

27 In the Feather River at Thermalito Afterbay, flows under A7_LLTT would generally be greater than
28 flows under Existing Conditions during April through June, and August (up to 63% greater) with
29 some exceptions, and similar to or lower than flows under Existing Conditions during July (to 47%
30 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be
31 persistent, moderate flow reductions in dry water years during June through August that would
32 have a localized effect during that specific water year; other flow reductions would be of small
33 magnitude and would generally be offset by increases in flow in adjoining months.

34 In the American River at Nimbus Dam, flows under A7_LLTT would generally be lower than flows
35 under Existing Conditions during April through August (up to 56% lower) with some exceptions
36 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water
37 years, when effects would be more critical for habitat conditions, would be of relatively small
38 magnitude and/or would be inconsistent month to month and would not have biologically
39 meaningful negative effects.

40 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLTT would
41 generally be lower than Existing Conditions by up to 27% during April, May and July, but similar to

1 or greater than flows under Existing Conditions during the June and August with some exceptions
2 (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
4 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
5 Alternative 1A indicates that there would be small to moderate reductions in flows during the
6 period relative to Existing Conditions.

7 *Water Temperature*

8 The percentage of months below 68°F water temperature threshold for the April through August
9 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
10 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
11 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
12 Creek.

13 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
14 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
15 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
16 effects in these rivers during the April through November period.

17 In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water
18 temperature threshold for threadfin shad spawning under A7_LLT would be 15% to 49% lower than
19 the percentage under Existing Conditions, depending on water year type (Table 11-7-100).

20 Collectively, these results indicate that the impact would not be significant because Alternative 7
21 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers
22 examined during the April through August spawning period under Alternative 7 would generally be
23 similar to or greater than flows under Existing Conditions, except during summer months in the
24 Sacramento, Feather, and American rivers. Lower flows during these months in these rivers would
25 not be of sufficient magnitude or frequency to cause a biologically meaningful effect on threadfin
26 shad. The percentage of months outside all temperature thresholds are lower under Alternative 7
27 than under Existing Conditions, indicating that there would be a net temperature-related benefit of
28 Alternative 7 to threadfin shad.

29 **Largemouth Bass**

30 In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for
31 largemouth bass relative to NAA.

32 *Flows*

33 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
34 Clear Creek were examined during the March through June largemouth bass spawning period.
35 Lower flows could reduce the quantity and quality of instream spawning habitat.

36 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
37 greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*
38 *utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
2 greater than flows under NAA during March through June, except in above normal years during
3 April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would be similar to or greater than flows
5 under NAA during March through June, except in below normal years during March (6% lower)
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
8 greater than flows under NAA during March through June, except in critical years during April (7%
9 lower), below normal and dry years during May (19% and 26% lower, respectively), and dry years
10 during June (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater
12 than flows under NAA during March, April, and June, with some exceptions (up to 31% lower)
13 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May under
14 A7_LLT would generally greater by up to 16% relative to NAA.

15 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always
16 be similar to or greater than flows relative to NAA during March through June (Appendix 11C,
17 *CALSIM II Model Results utilized in the Fish Analysis*).

18 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
19 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
20 Alternative 1A indicates that there would no differences in flows relative to the NAA.

21 *Water Temperature*

22 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
23 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
24 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
25 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
26 Creek.

27 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
28 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
29 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
30 effects in these rivers during the March through June period.

31 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the
32 59°F to 75°F water temperature range would be lower than the percentage under NAA in all water
33 years (Table 11-7-101).

34 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
35 Alternative 7 would not cause a substantial reduction in flows that would affect spawning habitat.
36 Similarly, water temperatures in all rivers would not negatively affect largemouth bass. The effects
37 would not be adverse.

1 **Table 11-7-101. Difference and Percent Difference in the Percentage of Months during March–**
 2 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside**
 3 **the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-9 (-16%)	0 (0%)
Above Normal	-16 (-32%)	-2 (-7%)
Below Normal	-14 (-32%)	-4 (-12%)
Dry	-18 (-38%)	0 (0%)
Critical	-15 (-33%)	-4 (-14%)
All	-14 (-28%)	-2 (-4%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **CEQA Conclusion:** In general, Alternative 7 would reduce the quality and quantity of upstream
 6 habitat conditions for largemouth bass relative to CEQA Existing Conditions.

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 9 Clear Creek were examined during the March through June largemouth bass spawning period.
 10 Lower flows could reduce the quantity and quality of instream spawning habitat.

11 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
 12 greater than flows under Existing Conditions during March through June, except in below normal
 13 years during March through May (9% to 11% lower), dry years during April (6% lower), and wet
 14 years during May (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
 16 greater than flows under Existing Conditions during March through June, except in below normal
 17 years during March (6% lower), critical years during May (6% lower), and wet years during July
 18 (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than
 20 flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results*
 21 *utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A7_LLT would be lower than flows under
 23 Existing Conditions in drier water year types during March (up to 24% lower), and generally similar
 24 to or greater than flows under Existing Conditions during the rest of the period, with some
 25 exceptions (up to 25% lower) but no consistent, substantial flow reductions from month to month in
 26 any specific water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater
 28 than flows under Existing Conditions during March and June, except in critical years during March
 29 and June (16% and 38% lower, respectively) and wet years during June (28% lower). Flows under
 30 A7_LLT during April and May would generally be lower (up to 30% lower) than those under Existing
 31 Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions
 32 would not be consistent month to month in any specific water year type.

1 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLTT would be lower
2 than flows under Existing Conditions by up to 28% during March through May in all water year
3 types except wet years, and similar to or greater than flows under Existing Conditions during June,
4 except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM*
5 *II Model Results utilized in the Fish Analysis*). The flow reductions during March through May would
6 follow flow reductions during December through February as well and would result in a localized
7 effect on spawning conditions.

8 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
9 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
10 Alternative 1A indicates that there would be small to moderate reductions in flows during the
11 period relative to Existing Conditions.

12 *Water Temperature*

13 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
14 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
15 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
16 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
17 Creek.

18 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
19 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
20 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
21 effects in these rivers during the March through June period.

22 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLTT outside of
23 the 59°F to 75°F water temperature range for largemouth bass spawning would be lower than the
24 percentage under Existing Conditions in all water years (16% to 38% lower) (Table 11-7-101).

25 ***Sacramento Tule Perch***

26 The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 7
27 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202).

28 ***NEPA Effects:*** As concluded for Alternative 1A, Impact AQUA-202, the effects would not be adverse.

29 ***CEQA Conclusion:*** The impact of water operations on entrainment of Sacramento tule perch would
30 be the same as described immediately above. The impacts would be less than significant.

31 ***Sacramento-San Joaquin Roach – California Species of Special Concern***

32 In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for
33 Sacramento-San Joaquin Roach relative to NAA.

34 *Flows*

35 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
36 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
37 period. Lower flows could reduce the quantity and quality of instream habitat available for
38 spawning.

1 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
2 greater than flows under NAA during March through June (Appendix 11C, *CALSIM II Model Results*
3 *utilized in the Fish Analysis*).

4 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
5 greater than flows under NAA during March through June, except in above normal years during
6 April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would be similar to or greater than flows
8 under NAA during March through June, except in below normal years during March (6% lower)
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
11 greater than flows under NAA during March through June, except in critical years during April (7%
12 lower), below normal and dry years during May (19% and 26% lower, respectively), and dry years
13 during June (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater
15 than flows under NAA during March, April, and June, with some exceptions (up to 31% lower)
16 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during May under
17 A7_LLT would generally be greater by up to 16%.

18 In the Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
19 always be similar to or greater than flows relative to NAA during March through June (Appendix
20 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
22 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
23 Alternative 1A indicates that there would be no differences in flows relative to the NAA.

24 *Water Temperature*

25 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
26 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
27 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
28 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
29 River or Clear Creek.

30 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
31 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
32 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
33 effects in these rivers during the March through June period.

34 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures
35 would be below the 60.8°F water temperature threshold for roach spawning initiation under
36 A7_LLT would be similar to or lower than the percentage under NAA in all water years (Table 11-7-
37 102).

38 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
39 Alternative 7 would not cause a substantial reduction in flows that would affect spawning habitat.
40 Similarly, water temperatures in all rivers would not negatively affect Sacramento-San Joaquin
41 roach. The effects would not be adverse.

1 **Table 11-7-102. Difference and Percent Difference in the Percentage of Months during March–**
 2 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the**
 3 **60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach**
 4 **Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-13%)	0 (0%)
Below Normal	-5 (-11%)	0 (0%)
Dry	-13 (-23%)	-1 (-3%)
Critical	-17 (-30%)	-2 (-5%)
All	-11 (-19%)	-1 (-1%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

5
 6 **CEQA Conclusion:** In general, Alternative 7 would affect the quality and quantity of upstream habitat
 7 conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

8 *Flows*

9 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 10 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
 11 period. Lower flows could reduce the quantity and quality of instream habitat available for
 12 spawning.

13 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
 14 greater than flows under Existing Conditions during March through June, except in below normal
 15 years during March through May (9% to 11% lower), dry years during April (6% lower), and wet
 16 years during May (18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
 18 greater than flows under Existing Conditions during March through June, except in below normal
 19 years during March (6% lower), critical years during May (6% lower), and wet years during July
 20 (14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than
 22 flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results*
 23 *utilized in the Fish Analysis*).

24 In the Feather River at Thermalito Afterbay, flows under A7_LLT would be lower than flows under
 25 Existing Conditions in drier water year types during March (up to 24% lower), and generally similar
 26 to or greater than flows under Existing Conditions during the rest of the period, with some
 27 exceptions (up to 25% lower), but with no consistent, substantial flow reductions from month to
 28 month in any specific water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 29 *Analysis*).

30 In the American River at Nimbus Dam, flows under A7_LLT would generally be similar to or greater
 31 than flows under Existing Conditions during March and June, except in critical years during March
 32 and June (16% and 38% lower, respectively) and wet years during June (28% lower). Flows under
 33 A7_LLT during April and May would generally be lower (up to 30% lower) than those under Existing

1 Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions
2 would not be consistent month to month in any specific water year type.

3 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would be lower
4 than flows under Existing Conditions by up to 28% during March through May in all water year
5 types except wet years, and similar to or greater than flows under Existing Conditions during June,
6 except in above and below normal years (14% and 8% lower, respectively) (Appendix 11C, *CALSIM*
7 *II Model Results utilized in the Fish Analysis*). The flow reductions during March through May would
8 follow flow reductions during December through February as well and would result in a localized
9 effect on spawning conditions.

10 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
11 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
12 Alternative 1A indicates that there would be small to moderate reductions in flows during the
13 period relative to Existing Conditions.

14 *Water Temperature*

15 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
16 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
17 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
18 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
19 River or Clear Creek.

20 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
21 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
22 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
23 effects in these rivers during the March through June period.

24 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures
25 would be below the 60.8°F water temperature threshold for roach spawning initiation under
26 A7_LLT would be lower than the percentage under Existing Conditions in all water years (from 11%
27 to 30% lower) (Table 11-7-102).

28 ***Hardhead – California Species of Special Concern***

29 In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat
30 conditions for hardhead relative to NAA.

31 *Flows*

32 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
33 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
34 could reduce the quantity and quality of instream habitat available for spawning.

35 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
36 greater than flows under NAA during April and May (Appendix 11C, *CALSIM II Model Results utilized*
37 *in the Fish Analysis*).

38 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
39 greater than flows under NAA during April and May, except in above normal years during April
40 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always to be similar to flows under
2 NAA during April and May regardless of water year type (Appendix 11C, *CALSIM II Model Results*
3 *utilized in the Fish Analysis*).

4 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
5 greater than flows under NAA during April and May, except in critical years during April (7% lower),
6 and below normal and dry years during May (19% and 26% lower, respectively) (Appendix 11C,
7 *CALSIM II Model Results utilized in the Fish Analysis*).

8 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
9 under NAA throughout the period except in dry and critical years during April (13% and 8% lower,
10 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always
12 be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
14 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
15 Alternative 1A indicates that there would be no differences in flows relative to the NAA.

16 *Water Temperature*

17 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
18 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
19 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
20 spawning success and increased egg and larval stress and mortality. Water temperatures were not
21 modeled in the San Joaquin River or Clear Creek.

22 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
23 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
24 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
25 effects in these rivers throughout the year.

26 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the
27 range would be similar to or lower than the percentage under NAA in all water years (Table 11-7-
28 103).

29 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
30 Alternative 7 would not cause a substantial reduction in flows that would affect spawning habitat.
31 Similarly, water temperatures in all rivers would not negatively affect hardhead. The effects would
32 not be adverse.

1 **Table 11-7-103. Difference and Percent Difference in the Percentage of Months during April–May**
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**
 3 **59°F to 64°F Water Temperature Range for Hardhead Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	2 (3%)	0 (0%)
Above Normal	-18 (-29%)	-9 (-20%)
Below Normal	14 (33%)	-7 (-13%)
Dry	-6 (-10%)	0 (0%)
Critical	-4 (-8%)	-4 (-8%)
All	-1 (-2%)	-3 (-6%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative

4

5 **CEQA Conclusion:** In general, Alternative 7 would reduce the quality and quantity of upstream
 6 spawning habitat conditions for hardhead relative to CEQA Existing Conditions.

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 9 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
 10 could reduce the quantity and quality of instream habitat available for spawning.

11 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
 12 greater than flows under Existing Conditions during April and May, except in below normal and dry
 13 years during April (9% and 6% lower, respectively) and wet and below normal years during May
 14 (18% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 15 *Analysis*).

16 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
 17 greater than flows under Existing Conditions throughout the period, except in critical years during
 18 May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

19 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would always be similar to or greater than
 20 flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*
 21 *utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
 23 greater than flows under Existing Conditions during April and May, except in critical years during
 24 April (6% lower) and wet years during May (35% lower) (Appendix 11C, *CALSIM II Model Results*
 25 *utilized in the Fish Analysis*).

26 In the American River at Nimbus Dam, flows under A7_LLT would be lower than flows under
 27 Existing Conditions throughout the period (up to 30% lower) (Appendix 11C, *CALSIM II Model*
 28 *Results utilized in the Fish Analysis*). Flow reductions would not be consistent from April to May for
 29 any specific water year type except above and below water years, with small reductions during April
 30 (7% and 9% lower, respectively) followed by moderate reductions during May (30% and 28%,
 31 respectively). These would have a small, localized effect on conditions for those specific water years
 32 but would not have biologically meaningful negative effects on spawning success.

1 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLTT would
2 generally be lower relative to Existing Conditions by up to 27% during April through May (Appendix
3 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be small to moderate flow
4 reductions in drier water year types for both months that would have a localized effect on spawning
5 conditions but would not have biologically meaningful effects for the region.

6 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
7 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
8 Alternative 1A indicates that there would be small to moderate reductions in flows during the
9 period relative to Existing Conditions.

10 *Water Temperature*

11 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
12 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
13 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
14 spawning success and increased egg and larval stress and mortality. Water temperatures were not
15 modeled in the San Joaquin River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
17 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
18 Alternative 1A.

19 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLTT outside of
20 the 59°F to 64°F water temperature range for hardhead spawning would be similar to or lower than
21 the percentage under Existing Conditions in all water years (<5% difference to 29% lower) except in
22 below normal years (33% greater) (Table 11-7-103). This moderate increase for a single water year
23 type would not have biologically meaningful effects.

24 *California Bay Shrimp*

25 **NEPA Effects:** The effect of water operations on spawning habitat of California bay shrimp under
26 Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
27 AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects
28 would not be adverse.

29 **CEQA Conclusion:** The impact of water operations on spawning habitat of California bay shrimp
30 would be the same as described immediately above. The impacts would be less than significant.

31 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic 32 Species of Primary Management Concern**

33 Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-
34 covered species of primary management concern.

35 *Striped Bass*

36 The discussion under Alternative 7, Impact AQUA-202 for striped bass also addresses the embryo
37 incubation and initial rearing period. That analysis indicates that there is no adverse effect on
38 striped bass rearing during that period.

1 **NEPA Effects:** Other effects of water operations on rearing habitat for striped bass under Alternative
2 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a
3 detailed discussion, please see Alternative 1A, Impact AQUA-203. The effects would not be adverse.

4 **CEQA Conclusion:** As described above the impacts on striped bass rearing habitat would be less
5 than significant.

6 **American Shad**

7 The effects of water operations on rearing habitat for American shad under Alternative 7 would be
8 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

9 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

10 **CEQA Conclusion:** As described above the impacts on American shad rearing habitat would be less
11 than significant.

12 **Threadfin Shad**

13 The effects of water operations on rearing habitat for threadfin shad under Alternative 7 would be
14 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

15 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

16 **CEQA Conclusion:** As described above the impacts on threadfin shad rearing habitat would be less
17 than significant.

18 **Largemouth Bass**

19 *Juveniles*

20 *Flows*

21 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
22 Clear Creek were examined during the April through November juvenile largemouth bass rearing
23 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
24 rearing.

25 In the Sacramento River upstream of Red Bluff, flows under A7_LLTT would generally be similar to or
26 greater than flows under NAA during April through November except in above normal and below
27 normal years during September (7% and 18% lower, respectively), below normal years during
28 October (6% lower), and wetter water years during November (to 14% lower) (Appendix 11C,
29 *CALSIM II Model Results utilized in the Fish Analysis*).

30 In the Trinity River below Lewiston Reservoir, flows under A7_LLTT would generally be similar to or
31 greater than flows under NAA during April through November except for infrequent, small-
32 magnitude reductions in flow (to 14% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
33 *Fish Analysis*).

34 In Clear Creek at Whiskeytown Dam, flows under A7_LLTT generally be similar to or greater than
35 NAA throughout the year, except in critical years during September (13% lower) (Appendix 11C,
36 *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be similar to or
2 greater than flows under NAA during April, June, October, and November, with isolated exceptions,
3 and would be similar to or lower than flows under NAA during May, July, August, and September,
4 (up to 32% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow
5 reductions in drier water years, when effects would be most critical for habitat conditions, would
6 persist from May through August in dry years (to 32% lower) but would be inconsistent and/or of
7 small magnitude in the other drier water year types.

8 In the American River at Nimbus Dam, flows under A7_LLT would generally be lower than flows
9 under NAA during September (up to 14% lower), greater during May and June (up to 18% greater),
10 and similar during the rest of the period, with some exceptions (up to 13% lower) (Appendix 11C,
11 *CALSIM II Model Results utilized in the Fish Analysis*).

12 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always
13 be similar to or greater than flows relative to NAA during April through November (Appendix 11C,
14 *CALSIM II Model Results utilized in the Fish Analysis*).

15 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
16 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
17 Alternative 1A indicates that there would be no differences in flows relative to the NAA.

18 *Water Temperature*

19 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
20 rearing during April through November was examined in the Sacramento, Trinity, Feather,
21 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
22 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
23 temperatures were not modeled in the San Joaquin River or Clear Creek.

24 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
25 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
26 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
27 effects in these rivers during the April through November period.

28 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under
29 NAA or A7_LLT (Table 11-7-104). As a result, there would be no difference in the percentage of
30 months in which the 88°F water temperature threshold is exceeded between Alternative 7 and NAA.

1 **Table 11-7-104. Difference and Percent Difference in the Percentage of Months during April–**
 2 **November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed**
 3 **the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 *Adult Rearing*

6 *Flows*

7 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 8 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows
 9 could reduce the quantity and quality of instream habitat available for adult rearing.

10 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would during November would
 11 be lower than flows under NAA (up to 14% lower) and similar to or greater than flows under NAA
 12 during the rest of the year, with some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model*
 13 *Results utilized in the Fish Analysis*).

14 In the Trinity River below Lewiston Reservoir, flows under A7_LLT generally be similar to or greater
 15 than flows under NAA throughout the year, with some exceptions (up to 14% lower) (Appendix 11C,
 16 *CALSIM II Model Results utilized in the Fish Analysis*).

17 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater
 18 than NAA throughout the year, except in below normal years during March (6% lower) and critical
 19 years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 20 *Analysis*).

21 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than
 22 flows under NAA during February, March, June, and October (up to 35% greater), similar during
 23 May and November, with some exceptions (up to 26% lower), and lower during July through
 24 September and December (up to 32% lower). Flow reductions in drier water years, when effects
 25 would be most critical for habitat conditions, would persist from May through August in dry years
 26 (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year
 27 types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
 29 under NAA during May and June, lower during September (up to 14% lower), and similar during the
 30 remaining months, with some exceptions (up to 16% lower, with an isolated occurrence of flow
 31 being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model Results utilized in*
 32 *the Fish Analysis*).

1 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always
2 be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II*
3 *Model Results utilized in the Fish Analysis*).

4 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
5 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
6 Alternative 1A indicates that there would be no differences in flows relative to the NAA.

7 *Water Temperature*

8 The percentage of months above the 86°F water temperature threshold for year-round adult
9 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and
10 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
11 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
12 modeled in the San Joaquin River or Clear Creek.

13 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
14 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
15 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
16 effects in these rivers during the year-round period.

17 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under
18 NAA and A7_LLT (Table 11-7-105). As a result, there would be no difference in the percentage of
19 months in which the 86°F water temperature threshold is exceeded between Alternative 7 and NAA.

20 **Table 11-7-105. Difference and Percent Difference in the Percentage of Months Year-Round in**
21 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**
22 **Water Temperature Threshold for Adult Largemouth Bass Survival^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative

23

24 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
25 Alternative 7 would not cause a substantial reduction in juvenile and adult rearing or spawning
26 habitat. Flows in all rivers examined during the year under Alternative 7 are generally similar to or
27 greater than flows under NAA in most months. In the Feather River there would be persistent,
28 moderate flow reductions in drier water years from May through August, and inconsistent and/or
29 small-magnitude flow reductions from month to month in the other drier water year types; these
30 flow reductions would not have biologically meaningful effects. The percentage of months outside all
31 temperature thresholds examined in the Feather River under Alternative 7 are similar to or lower
32 than under NAA. Also, there are no temperature-related effects in any other rivers examined.

1 **CEQA Conclusion:** In general, Alternative 7 would reduce the quality and quantity of upstream
2 habitat conditions for largemouth bass relative to CEQA Existing Conditions.

3 *Juveniles*

4 *Flows*

5 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
6 Clear Creek were examined during the April through November juvenile largemouth bass rearing
7 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
8 rearing.

9 In the Sacramento River upstream of Red Bluff, flows under A7_LLTP would generally be similar to or
10 greater than flows under Existing Conditions in all months but September (up to 19% lower) with
11 some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM II Model Results*
12 *utilized in the Fish Analysis*).

13 In the Trinity River below Lewiston Reservoir, flows under A7_LLTP during April through July would
14 generally be similar to or greater than flows under Existing Conditions, with isolated exceptions (up
15 to 16% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under
16 A7_LLTP would be similar to flows under Existing Conditions during August and September except in
17 critical years (33% and 49% lower, respectively), and would generally be lower than flows under
18 Existing Conditions during October and November (to 25% lower) in most water year types.
19 Moderate to substantial flow reductions in critical years during August through November would
20 have a localized effect on rearing conditions for that specific water year type.

21 In Clear Creek at Whiskeytown Dam, flows under A7_LLTP would generally be similar to or greater
22 than flows under Existing Conditions throughout the April through November period, except in
23 critical years during August and September (17% to 38% lower) and below normal years during
24 October (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 In the Feather River at Thermalito Afterbay, flows under A7_LLTP would generally be similar to or
26 greater than flows under Existing Conditions during April through June and August through October,
27 with some exceptions, and similar to or lower than flows under Existing Conditions (up to 47%
28 lower) during July and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more
30 critical, include moderate to substantial reductions in dry years during June through September (to
31 50% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This is a relatively
32 isolated occurrence for a specific water year type and would not have biologically meaningful
33 negative effects on rearing conditions.

34 In the American River at Nimbus Dam, flows under A7_LLTP would generally be similar to or greater
35 than flows under Existing Conditions during June and October with some exceptions (up to 38%
36 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A7_LLTP
37 during April, May, July through September, and November would be lower by up to 56% and flows
38 during October would be similar between Existing Conditions and A7_LLTP. Flow reductions in drier
39 water years, when effects on habitat conditions would be more critical, would be most persistent
40 from August through September (to 41% lower in below normal years, to 36% lower in dry years,
41 and to 56% lower in critical years); in other months, flow reductions in any specific water year type
42 would be less persistent, of smaller magnitude, and/or would be offset by increases in adjoining
43 months.

1 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
2 generally be lower than Existing Conditions during April, May, July, and October (to 27% lower,
3 including small to moderate reductions in drier water year types), and would be similar to or
4 greater than flows under Existing Conditions during the rest of the period with some exceptions (up
5 to 23% lower, primarily in wetter water years) (Appendix 11C, *CALSIM II Model Results utilized in*
6 *the Fish Analysis*).

7 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
8 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
9 Alternative 1A indicates that there would be small to moderate reductions in flows during the
10 period relative to Existing Conditions.

11 *Water Temperature*

12 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
13 rearing during April through November was examined in the Sacramento, Trinity, Feather,
14 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
15 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
16 temperatures were not modeled in the San Joaquin River or Clear Creek.

17 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
18 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
19 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
20 effects in these rivers during the April through November period.

21 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F
22 water temperature threshold for year-round juvenile largemouth bass occurrence under Existing
23 Conditions or A7_LLT (Table 11-7-104). As a result, there would be no difference in the percentage
24 of months in which the 88°F water temperature threshold is exceeded between Alternative 7 and
25 Existing Conditions.

26 *Adult Rearing*

27 *Flows*

28 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
29 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower
30 flows could reduce the quantity and quality of instream habitat available for adult rearing.

31 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
32 greater than flows under Existing Conditions during all months but September and December (up to
33 19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM*
34 *II Model Results utilized in the Fish Analysis*).

35 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
36 greater than flows under Existing Conditions throughout the year with some exceptions (up to 49%
37 lower), except during October and November when it would generally be lower (up to 25% lower)
38 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

39 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or
40 greater than flows under Existing Conditions throughout the year, except in critical years during

1 August and September (17% and 38% lower, respectively) and below normal years during October
2 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than
4 those under Existing Conditions during March through June and August, through October (up to
5 205% greater), lower during January, March, November, and December (up to 43% lower), and
6 similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish
7 Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more
8 critical, include moderate to substantial reductions in below normal years during December through
9 March (to 46% lower), moderate to substantial reductions in dry years during June through
10 September (to 50% lower), and reductions in dry and critical years during December through
11 January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
13 under Existing Conditions during February and March (up to 28% greater), lower during April, May,
14 July through September, and November through January (up to 56% lower), and similar during the
15 rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions
16 in drier water years, when effects would be more critical for habitat conditions, would occur in
17 below normal years during July through September (6% to 41% lower), dry years during July
18 through January (6% to 31% lower), and critical years during August through March (16% to 56%
19 lower) except during October (6% greater). These are fairly persistent flow reductions that would
20 affect rearing conditions for a good part of the year in each of these specific water year types, and
21 would have a localized effect on rearing conditions.

22 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
23 generally be lower than Existing Conditions by up to 36% during December through May and July,
24 but similar to or greater than flows under Existing Conditions during the rest of the period with
25 some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
26 Analysis*).

27 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
28 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
29 Alternative 1A indicates that there would be small to moderate reductions in flows during the
30 period relative to Existing Conditions.

31 *Water Temperature*

32 The percentage of months above the 86°F water temperature threshold for year-round adult
33 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and
34 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
35 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
36 modeled in the San Joaquin River or Clear Creek.

37 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
38 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
39 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
40 effects in these rivers during the April through November period.

41 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F
42 water temperature range for year-round adult largemouth bass occurrence under Existing
43 Conditions or A7_LLT (Table 11-7-105). As a result, there would be no difference in the percentage

1 of months in which the 86°F water temperature threshold is exceeded between Alternative 7 and
2 Existing Conditions.

3 **Summary of CEQA Conclusion**

4 Collectively, these results indicate that the impact would be significant because Alternative 7 would
5 cause a substantial reduction in largemouth bass habitat. Flows would be substantially lower during
6 portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers,
7 which would have biologically meaningful negative effects on the largemouth bass population.
8 Reduced flows in other rivers would not have biologically meaningful effects on largemouth bass.
9 The percentages of years outside all temperature thresholds are generally be similar under
10 Alternative 7 and under Existing Conditions. This impact is a result of the specific reservoir
11 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
12 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
13 less-than-significant level would fundamentally change the alternative, thereby making it a different
14 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
15 unavoidable because there is no feasible mitigation available.

16 The NEPA and CEQA conclusions differ for this impact statement because they were determined
17 using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLТ with NAA
18 and the CEQA conclusion was based on the comparison of A7_LLТ with Existing Conditions. These
19 baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
20 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
21 NEPA point of comparison is assumed to occur during the late long-term implementation period
22 whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore,
23 differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to
24 both the alternative and future climate change.

25 ***Sacramento Tule Perch***

26 In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for
27 Sacramento tule perch relative to NAA.

28 ***Flows***

29 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
30 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
31 reduce the quantity and quality of instream habitat available for rearing.

32 In the Sacramento River upstream of Red Bluff, flows under A7_LLТ would during November would
33 be lower than flows under NAA (up to 14% lower) and similar to or greater than flows under NAA
34 during the rest of the year, with some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model*
35 *Results utilized in the Fish Analysis*).

36 In the Trinity River below Lewiston Reservoir, flows under A7_LLТ would generally be similar to or
37 greater than flows under NAA throughout the year, with some exceptions (up to 14% lower)
38 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

39 In Clear Creek at Whiskeytown Dam, flows under A7_LLТ would generally be similar to or greater
40 than NAA throughout the year, except in below normal years during March (6% lower) and critical

1 years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
2 *Analysis*).

3 In the Feather River at Thermalito Afterbay, flows under A7_LLTT would generally be greater than
4 those under NAA during February, March, June, and October (up to 35% greater), similar during
5 May and November, with some exceptions (up to 26% lower), and lower during July through
6 September and December (up to 32% lower). Flow reductions in drier water years, when effects
7 would be most critical for habitat conditions, would persist from May through August in dry years
8 (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year
9 types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the American River at Nimbus Dam, flows under A7_LLTT would generally be greater than flows
11 under NAA during May, and June (up to 18% greater), lower during September (up to 14% lower),
12 and similar during the remaining months, with some exceptions (up to 16% lower, with an isolated
13 occurrence of flow being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model*
14 *Results utilized in the Fish Analysis*).

15 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLTT would always
16 be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II*
17 *Model Results utilized in the Fish Analysis*).

18 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
19 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
20 Alternative 1A indicates that there would be no differences in flows relative to the NAA.

21 *Water Temperature*

22 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-
23 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,
24 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds
25 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water
26 temperatures were not modeled in the San Joaquin River or Clear Creek.

27 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
28 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
29 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
30 effects in these rivers throughout the year.

31 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLTT exceeding
32 the 72°F threshold would be higher than the percentage under NAA by 19% to 75% depending on
33 water year type. Although relative differences in all years are large due to small values, the absolute
34 differences in percent exceedance are only 2% to 7% relative to NAA, and do not represent
35 biologically meaningful effects to Sacramento tule perch (Table 11-7-106).

36 The percentage of months under A7_LLTT exceeding the 75°F threshold would be similar to or
37 greater than the percentage under NAA (9% to 100% higher). The large relative differences are
38 large due to small values, the absolute differences in percent exceedance are only from 0.3% to 1%,
39 and would not have biologically meaningful effects on Sacramento tule perch (Table 11-7-106).

1 **Table 11-7-106. Difference and Percent Difference in the Percentage of Months Year-Round in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F**
 3 **Water Temperature Thresholds for Sacramento Tule Perch Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
72°F Threshold		
Wet	4 (157%)	4 (67%)
Above Normal	3 (NA)	2 (75%)
Below Normal	5 (NA)	2 (38%)
Dry	12 (NA)	7 (58%)
Critical	14 (333%)	3 (19%)
All	7 (531%)	4 (46%)
75°F Threshold		
Wet	0 (NA)	0.32 (100%)
Above Normal	0 (NA)	0 (NA)
Below Normal	1 (NA)	1 (100%)
Dry	2 (NA)	1 (60%)
Critical	7 (1,000%)	1 (9%)
All	2 (1,700%)	1 (33%)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4
 5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 Alternative 7 would not cause a substantial reduction in rearing habitat. Flows in all rivers examined
 7 during the year under Alternative 7 are generally similar to or greater than flows under NAA in most
 8 months. In the Feather River there would be persistent, moderate flow reductions in drier water
 9 years from May through August, and inconsistent and/or small-magnitude flow reductions from
 10 month to month in the other drier water year types; these flow reductions would not have
 11 biologically meaningful effects on Sacramento tule perch. The percentages of years outside all
 12 temperature thresholds under Alternative 7 are generally similar to or slightly greater than the
 13 percentages under NAA.

14 **CEQA Conclusion:** In general, Alternative 7 would reduce the quality and quantity of upstream
 15 habitat conditions for Sacramento tule perch relative to CEQA Existing Conditions.

16 **Flows**

17 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 18 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
 19 reduce the quantity and quality of instream habitat available for rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
 21 greater than flows under Existing Conditions during all months but September and December (up to
 22 19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM*
 23 *II Model Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
2 greater than flows under Existing Conditions throughout the year with some exceptions (up to 49%
3 lower), except during October and November when it would generally be lower (up to 25% lower)
4 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or
6 greater than flows under Existing Conditions throughout the year, except in critical years during
7 August and September (17% and 38% lower, respectively) and below normal years during October
8 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than
10 those under Existing Conditions during March through June and August, through October (up to
11 205% greater), lower during January, March, November, and December (up to 43% lower), and
12 similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish
13 Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more
14 critical, include moderate to substantial reductions in below normal years during December through
15 March (to 46% lower), moderate to substantial reductions in dry years during June through
16 September (to 50% lower), and reductions in dry and critical years during December through
17 January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
19 under Existing Conditions during February and March (up to 28% greater), lower during April, May,
20 July through September, and November through January (up to 56% lower), and similar during the
21 rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions
22 in drier water years, when effects would be more critical for habitat conditions, would occur in
23 below normal years during July through September (6% to 41% lower), dry years during July
24 through January (6% to 31% lower), and critical years during August through March (16% to 56%
25 lower) except during October (6% greater). These are fairly persistent flow reductions that would
26 affect rearing conditions for a good part of the year in each of these specific water year types, and
27 would have a localized effect on rearing conditions.

28 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
29 generally be lower than Existing Conditions by up to 36% during December through May and July,
30 but similar to or greater than flows under Existing Conditions during the rest of the period with
31 some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
32 Analysis*).

33 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
34 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
35 Alternative 1A indicates that there would be small to moderate reductions in flows during the
36 period relative to Existing Conditions.

37 *Water Temperature*

38 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round
39 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,
40 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead
41 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not
42 modeled in Clear Creek or the San Joaquin River.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
2 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
3 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
4 effects in these rivers during the year.

5 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLTT exceeding
6 72°F would be similar to or higher than the percentage under Existing Conditions, by up to 333%
7 (Table 11-7-106).

8 The percentage of months under A7_LLTT exceeding 75°F would be similar to the percentage under
9 Existing Conditions in all water years except critical years (1,000% higher) (Table 11-7-106). In
10 both cases the high relative percentages are due to low values being compared, with absolute
11 differences corresponding to a maximum of 14% for the lower threshold and 7% for the higher
12 threshold. These effects would not have biologically meaningful negative effects on Sacramento tule
13 perch.

14 **Summary of CEQA Conclusions**

15 Collectively, these results indicate that the impact would be significant because Alternative 7 would
16 cause a substantial reduction in Sacramento tule perch habitat. Flows would be substantially lower
17 during portions of the year-round adult rearing period in the American and Feather rivers, which
18 would have biologically meaningful negative effects on the Sacramento tule perch population.
19 Reduced flows in other rivers would not have biologically meaningful effects on Sacramento tule
20 perch. The percentages of years outside both temperature thresholds are generally lower or slightly
21 greater under Alternative 7 than under Existing Conditions. This impact is a result of the specific
22 reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g.,
23 changing reservoir operations in order to alter the flows) to the extent necessary to reduce this
24 impact to a less-than-significant level would fundamentally change the alternative, thereby making
25 it a different alternative than that which has been modeled and analyzed. As a result, this impact is
26 significant and unavoidable because there is no feasible mitigation available.

27 The NEPA and CEQA conclusions differ for this impact statement because they were determined
28 using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLTT with NAA
29 and the CEQA conclusion was based on the comparison of A7_LLTT with Existing Conditions. These
30 baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
31 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
32 NEPA point of comparison is assumed to occur during the late long-term implementation period
33 whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore,
34 differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to
35 both the alternative and future climate change.

36 ***Sacramento-San Joaquin Roach***

37 In general, Alternative 7 would not affect the quality and quantity of upstream habitat conditions for
38 Sacramento-San Joaquin roach relative to NAA.

1 *Juvenile and Adult Rearing*

2 *Flows*

3 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
4 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
5 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
6 rearing.

7 In the Sacramento River upstream of Red Bluff, flows under A7_LLT be lower than flows under NAA
8 (up to 14% lower) and similar to or greater than flows under NAA during the rest of the year, with
9 some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
10 *Analysis*).

11 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
12 greater than flows under NAA throughout the year, with some exceptions (up to 14% lower)
13 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater
15 than NAA throughout the year, except in below normal years during March (6% lower) and critical
16 years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
17 *Analysis*).

18 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than
19 those under NAA during February, March, June, and October (up to 35% greater), similar during
20 May and November, with some exceptions (up to 26% lower), and lower during July through
21 September and December (up to 32% lower). Flow reductions in drier water years, when effects
22 would be most critical for habitat conditions, would persist from May through August in dry years
23 (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year
24 types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
26 under NAA during May and June, lower during September (up to 14% lower), and similar during the
27 remaining months, with some exceptions (up to 16% lower, with an isolated occurrence of flow
28 being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model Results utilized in*
29 *the Fish Analysis*).

30 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always
31 be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II*
32 *Model Results utilized in the Fish Analysis*).

33 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
34 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
35 Alternative 1A indicates that there would no differences in flows relative to the NAA.

36 *Water Temperature*

37 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
38 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
39 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing
40 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San
41 Joaquin River or Clear Creek.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
2 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
3 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
4 effects in these rivers throughout the year.

5 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under
6 NAA and A7_LLТ (Table 11-7-107). As a result, there would be no difference in the percentage of
7 months in which the 86°F water temperature threshold is exceeded between Alternative 7 and NAA.

8 **Table 11-7-107. Difference and Percent Difference in the Percentage of Months Year-Round in**
9 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**
10 **Water Temperature Range for Sacramento-San Joaquin Roach Survival^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLТ	NAA vs. A7_LLТ
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

11

12 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
13 Alternative 7 would not cause a substantial reduction in spawning and juvenile and adult
14 Sacramento-San Joaquin roach rearing habitat. Flows in all rivers examined during the year under
15 Alternative 7 are generally similar to or greater than flows under NAA in most months. In the
16 Feather River there would be persistent, moderate flow reductions in drier water years from May
17 through August, and inconsistent and/or small-magnitude flow reductions from month to month in
18 the other drier water year types; these flow reductions would not have biologically meaningful
19 effects. The percentages of years outside all temperature thresholds examined in the Feather River
20 are generally similar to or lower under Alternative 7 than under NAA. Also, there are no
21 temperature-related effects in any other rivers examined.

22 **CEQA Conclusion:** In general, Alternative 7 would reduce the quality and quantity of upstream
23 habitat conditions for Sacramento-San Joaquin roach relative to CEQA Existing Conditions.

24 *Juvenile and Adult Rearing*

25 *Flows*

26 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
27 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
28 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
29 rearing.

30 In the Sacramento River upstream of Red Bluff, flows under A7_LLТ would generally be similar to or
31 greater than flows under Existing Conditions during all months but September and December (up to

1 19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM*
2 *II Model Results utilized in the Fish Analysis*).

3 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
4 greater than flows under Existing Conditions throughout the year with some exceptions (up to 49%
5 lower), except during October and November when it would generally be lower (up to 25% lower)
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or
8 greater than flows under Existing Conditions throughout the year, except in critical years during
9 August and September (17% and 38% lower, respectively) and below normal years during October
10 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than
12 those under Existing Conditions during March through June and August, through October (up to
13 205% greater), lower during January, March, November, and December (up to 43% lower), and
14 similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
15 *Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more
16 critical, include moderate to substantial reductions in below normal years during December through
17 March (to 46% lower), moderate to substantial reductions in dry years during June through
18 September (to 50% lower), and reductions in dry and critical years during December through
19 January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
21 under Existing Conditions during February and March (up to 28% greater), lower during April, May,
22 July through September, and November through January (up to 56% lower), and similar during the
23 rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions
24 in drier water years, when effects would be more critical for habitat conditions, would occur in
25 below normal years during July through September (6% to 41% lower), dry years during July
26 through January (6% to 31% lower), and critical years during August through March (16% to 56%
27 lower) except during October (6% greater). These are fairly persistent flow reductions that would
28 affect rearing conditions for a good part of the year in each of these specific water year types, and
29 would have a localized effect on rearing conditions.

30 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
31 generally be lower than Existing Conditions by up to 36% during December through May and July,
32 but similar to or greater than flows under Existing Conditions during the rest of the period with
33 some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
34 *Analysis*).

35 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
36 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
37 Alternative 1A indicates that there would be small to moderate reductions in flows during the
38 period relative to Existing Conditions.

39 *Water Temperature*

40 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
41 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
42 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced

1 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.
2 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

3 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
4 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
5 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
6 effects in these rivers during the April through November period.

7 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water
8 temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or
9 A7_LLT (Table 11-7-107). As a result, there would be no difference in the percentage of months in
10 which the 86°F water temperature threshold is exceeded between Alternative 7 and Existing
11 Conditions.

12 **Summary of CEQA Conclusions**

13 Collectively, these results indicate that the impact would be significant because Alternative 7 would
14 cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be
15 substantially lower during portions of the year-round adult rearing period in the American, Feather,
16 and Stanislaus rivers, which would have biologically meaningful negative effects on the roach
17 population. Reduced flows in other rivers would not have biologically meaningful effects on roach.
18 The percentages of years outside both temperature thresholds are generally lower under
19 Alternative 7 than under Existing Conditions. This impact is a result of the specific reservoir
20 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
21 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
22 less-than-significant level would fundamentally change the alternative, thereby making it a different
23 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
24 unavoidable because there is no feasible mitigation available.

25 The NEPA and CEQA conclusions differ for this impact statement because they were determined
26 using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLT with NAA
27 and the CEQA conclusion was based on the comparison of A7_LLT with Existing Conditions. These
28 baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
29 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
30 NEPA point of comparison is assumed to occur during the late long-term implementation period
31 whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore,
32 differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to
33 both the alternative and future climate change.

34 ***Hardhead***

35 In general, Alternative 7 would slightly improve the quality and quantity of upstream habitat
36 conditions for hardhead relative to NAA.

37 ***Juvenile and Adult Rearing***

38 ***Flows***

39 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
40 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.

1 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
2 adult rearing.

3 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would be lower than flows
4 under NAA (up to 14% lower) and similar to or greater than flows under NAA during the rest of the
5 year, with some exceptions (up to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
6 *Fish Analysis*).

7 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
8 greater than flows under NAA throughout the year, with some exceptions (up to 14% lower)
9 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would generally be similar to or greater
11 than NAA throughout the year, except in below normal years during March (6% lower) and critical
12 years during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
13 *Analysis*).

14 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than
15 those under NAA during February, March, June, and October (up to 35% greater), similar during
16 May and November, with some exceptions (up to 26% lower), and lower during July through
17 September and December (up to 32% lower). Flow reductions in drier water years, when effects
18 would be most critical for habitat conditions, would persist from May through August in dry years
19 (to 32% lower) but would be inconsistent and/or of small magnitude in the other drier water year
20 types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
22 under NAA during May, and June, lower during September (up to 14% lower), and similar during the
23 remaining months, with some exceptions (up to 16% lower, with an isolated occurrence of flow
24 being 41% lower in critical years during August) (Appendix 11C, *CALSIM II Model Results utilized in*
25 *the Fish Analysis*).

26 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would always
27 be similar to or greater than flows relative to NAA throughout the year (Appendix 11C, *CALSIM II*
28 *Model Results utilized in the Fish Analysis*).

29 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
30 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
31 Alternative 1A indicates that there would be small to moderate reductions in flows during the
32 period relative to NAA and no differences in flows relative to the NAA.

33 *Water Temperature*

34 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for
35 juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American,
36 and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat
37 quality and increased stress and mortality. Water temperatures were not modeled in the San
38 Joaquin River or Clear Creek.

39 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
40 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
41 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
42 effects in these rivers throughout the year.

1 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside the
2 range would lower than the percentage under NAA in all water years except below normal years
3 (6% lower) (Table 11-7-108).

4 **Table 11-7-108. Difference and Percent Difference in the Percentage of Months Year-Round in**
5 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F**
6 **to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A7_LLT	NAA vs. A7_LLT
Wet	-4 (-5%)	-1 (-1%)
Above Normal	-8 (-11%)	-4 (-6%)
Below Normal	-7 (-10%)	4 (6%)
Dry	-6 (-9%)	1 (2%)
Critical	-9 (-13%)	-2 (-3%)
All	-6 (-9%)	0 (0%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

7

8 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
9 Alternative 7 would not cause a substantial reduction in spawning and juvenile and adult hardhead
10 rearing. Flows in all rivers examined during the year under Alternative 7 are generally similar to or
11 greater than flows under NAA in most months. In the Feather River there would be persistent,
12 moderate flow reductions in drier water years from May through August, and inconsistent and/or
13 small-magnitude flow reductions from month to month in the other drier water year types; these
14 flow reductions would not have biologically meaningful effects on hardhead. The percentages of
15 years outside all temperature thresholds are generally lower under Alternative 7 than under NAA.

16 **CEQA Conclusion:** In general, Alternative 7 would reduce the quality and quantity of upstream
17 habitat conditions for hardhead relative to CEQA Existing Conditions.

18 *Juvenile and Adult Rearing*

19 *Flows*

20 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
21 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
22 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
23 adult rearing.

24 In the Sacramento River upstream of Red Bluff, flows under A7_LLT would generally be similar to or
25 greater than flows under Existing Conditions during all months but September and December (up to
26 19% lower), with some exceptions during other months (up to 21% lower) (Appendix 11C, *CALSIM*
27 *II Model Results utilized in the Fish Analysis*).

28 In the Trinity River below Lewiston Reservoir, flows under A7_LLT would generally be similar to or
29 greater than flows under Existing Conditions throughout the year with some exceptions (up to 49%
30 lower), except during October and November when it would generally be lower (up to 25% lower)
31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In Clear Creek at Whiskeytown Dam, flows under A7_LLT would almost always be similar to or
2 greater than flows under Existing Conditions throughout the year, except in critical years during
3 August and September (17% and 38% lower, respectively) and below normal years during October
4 (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 In the Feather River at Thermalito Afterbay, flows under A7_LLT would generally be greater than
6 those under Existing Conditions during March through June and August, through October (up to
7 205% greater), lower during January, March, November, and December (up to 43% lower), and
8 similar during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish
9 Analysis*). Flow reductions in drier water years, when effects on habitat conditions would be more
10 critical, include moderate to substantial reductions in below normal years during December through
11 March (to 46% lower), moderate to substantial reductions in dry years during June through
12 September (to 50% lower), and reductions in dry and critical years during December through
13 January (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 In the American River at Nimbus Dam, flows under A7_LLT would generally be greater than flows
15 under Existing Conditions during February and March (up to 28% greater), lower during April, May,
16 July through September, and November through January (up to 56% lower), and similar during the
17 rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions
18 in drier water years, when effects would be more critical for habitat conditions, would occur in
19 below normal years during July through September (6% to 41% lower), dry years during July
20 through January (6% to 31% lower), and critical years during August through March (16% to 56%
21 lower) except during October (6% greater). These are fairly persistent flow reductions that would
22 affect rearing conditions for a good part of the year in each of these specific water year types, and
23 would have a localized effect on rearing conditions.

24 In Stanislaus River at the confluence with the San Joaquin River, flows under A7_LLT would
25 generally be lower than Existing Conditions by up to 36% during December through May and July,
26 but similar to or greater than flows under Existing Conditions during the rest of the period with
27 some exceptions (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
28 Analysis*).

29 Flow rates in the San Joaquin River under Alternative 7 would be the same as those under
30 Alternative 1A. For a discussion of the topic see the analysis for Alternative 1A. The analysis for
31 Alternative 1A indicates that there would be small to moderate reductions in flows during the
32 period relative to Existing Conditions.

33 *Water Temperature*

34 The percentage of months in which year-round in-stream temperatures would be outside of the
35 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was
36 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures
37 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.
38 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

39 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 7
40 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
41 Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related
42 effects in these rivers during the April through November period.

1 In the Feather River below Thermalito Afterbay, the percentage of months under A7_LLT outside of
2 the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be
3 similar to or lower than the percentage under Existing Conditions in all water years (Table 11-7-
4 108).

5 **Summary of CEQA Conclusions**

6 Collectively, these results indicate that the impact would be significant because Alternative 7 would
7 cause a substantial reduction in hardhead habitat. Flows would be substantially lower during
8 portions of the year-round adult rearing period in the American, Feather, and Stanislaus rivers,
9 which would have biologically meaningful negative effects on hardhead. Reduced flows in other
10 rivers would not have biologically meaningful effects on hardhead. The percentages of years outside
11 both temperature thresholds are generally lower under Alternative 7 than under Existing
12 Conditions. This impact is a result of the specific reservoir operations and resulting flows associated
13 with this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the
14 flows) to the extent necessary to reduce this impact to a less-than-significant level would
15 fundamentally change the alternative, thereby making it a different alternative than that which has
16 been modeled and analyzed. As a result, this impact is significant and unavoidable because there is
17 no feasible mitigation available.

18 The NEPA and CEQA conclusions differ for this impact statement because they were determined
19 using two unique baselines. The NEPA conclusion was based on the comparison of A7_LLT with NAA
20 and the CEQA conclusion was based on the comparison of A7_LLT with Existing Conditions. These
21 baselines differ in two ways. First, the NEPA point of comparison (NAA) includes the Fall X2
22 standard in wet above normal water years whereas CEQA Existing Conditions do not. Second, the
23 NEPA point of comparison is assumed to occur during the late long-term implementation period
24 whereas the CEQA baseline is assumed to occur during existing climate conditions. Therefore,
25 differences in model outputs between the CEQA baseline and the Alternative 7 are due primarily to
26 both the alternative and future climate change.

27 **California Bay Shrimp**

28 The effect of water operations on rearing habitat of California bay shrimp under Alternative 7 would
29 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

30 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

31 **CEQA Conclusion:** As described above the impacts on California bay shrimp rearing habitat would
32 be less than significant.

33 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered** 34 **Aquatic Species of Primary Management Concern**

35 Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-
36 covered species of primary management concern.

37 **Striped Bass**

38 Adult striped bass migrate up the Delta via the Sacramento River to reach suitable spawning habitat
39 upstream. It is assumed that this migration period occurs around the same timing as spawning, from
40 April through June.

1 Flows in the Sacramento River below the north Delta diversion facilities would be lower than
2 baseline conditions during the April through June period. Monthly flows on average would be 17-
3 20% lower compared to NAA. Sacramento River flows are highly variable interannually, and striped
4 bass are still able to migrate upstream the Sacramento River during lower flow years.

5 **NEPA Effects:** The effect of reduced Sacramento flows under Alternative 7 would not be adverse.

6 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
7 significant because the changes in flow (22–30% lower compared to Existing Conditions) would not
8 interfere substantially with movement of spawning striped bass through the Delta. No mitigation
9 would be required.

10 **American Shad**

11 Adult American shad migrate up the Delta to reach suitable spawning habitat upstream around
12 March–May. American shad migrate up the Sacramento River while some shad spawn in the San
13 Joaquin River basin. Flows in the Sacramento River below the north Delta diversion facilities would
14 be 18–21% less than NAA. Flows from the San Joaquin River at Vernalis would be unchanged.
15 Sacramento River flows are highly variable interannually, and American shad are still able to
16 migrate upstream the Sacramento River during lower flow years.

17 **NEPA Effects:** Overall, the impact to American shad migration habitat conditions would not be
18 adverse under Alternative 7.

19 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
20 significant because the changes in flow (20–30% lower compared to Existing Conditions) would not
21 interfere substantially with movement of American shad from the Delta to upstream spawning
22 habitat. No mitigation would be required.

23 **Threadfin Shad**

24 **NEPA Effects:** Threadfin shad are semi-anadromous, moving between freshwater and brackish
25 water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn.
26 Therefore there is no effect on migration habitat conditions.

27 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
28 significant because flow changes in the Delta under Alternative 7 would not alter movement
29 patterns for threadfin shad. No mitigation would be required.

30 **Largemouth Bass**

31 **NEPA Effects:** Largemouth bass are non-migratory fish within the Delta. Therefore they do not use
32 the Delta as migration habitat corridor. There would be no effect.

33 **CEQA Conclusion:** As described immediately above, flow changes under Alternative 7 would not
34 affect largemouth movements within the Delta. No mitigation would be required.

35 **Sacramento Tule Perch**

36 **NEPA Effects:** Similar with largemouth bass, Sacramento tule perch are a non-migratory species and
37 do not use the Delta as a migration corridor as they are a resident Delta species. There would be no
38 effect.

1 **CEQA Conclusion:** As described immediately above, flow changes would not affect Sacramento tule
2 perch movements within the Delta. No mitigation would be required.

3 **Sacramento-San Joaquin Roach**

4 **NEPA Effects:** For Sacramento-San Joaquin roach the overall flows and temperature in upstream
5 rivers during migration to their spawning grounds would be similar to those described under
6 Alternative 7, Impact AQUA-202 for spawning. As described there, the flows would slightly improve
7 the upstream conditions relative to NAA. These conditions would not be adverse.

8 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
9 conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

10 **Hardhead**

11 **NEPA Effects:** For hardhead the overall flows and temperature in upstream rivers during migration
12 to their spawning grounds would be similar to those described under Alternative 7, Impact AQUA-
13 202 for spawning. As described there, the flows would slightly improve the upstream conditions
14 relative to NAA. These conditions would not be adverse.

15 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
16 conditions for hardhead would not be significant and no mitigation is required.

17 **California Bay Shrimp**

18 **NEPA Effects:** The effect of water operations on migration conditions of California bay shrimp under
19 Alternative 7 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
20 AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects
21 would not be adverse.

22 **CEQA Conclusion:** As described above the impacts on migration conditions of California bay shrimp
23 would be less than significant.

24 **Restoration Measures (CM2, CM4–CM7, and CM10)**

25 The effects of restoration measures under Alternative 7 would be similar for all non-covered species;
26 therefore, the analysis below is combined for all non-covered species instead of analyzed by
27 individual species.

28 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic
29 Species of Primary Management Concern**

30 Refer to Impact AQUA-7 under delta smelt for a discussion of the effects of construction of
31 restoration measures on non-covered species of primary management concern. That discussion
32 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
33 to the aquatic environment and aquatic species. The potential effects of the construction of
34 restoration measures under Alternative 7 would be similar to those described for Alternative 1A
35 (see Alternative 1A, Impact AQUA-7).

36 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-7, the effects would not be adverse.

37 **CEQA Conclusion:** As described immediately above, the impacts of the construction of restoration
38 measures would be less than significant.

1 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**
2 **Covered Aquatic Species of Primary Management Concern**

3 Refer to Impact AQUA-8 under delta smelt for a discussion of the effects of contaminants associated
4 with restoration measures on non-covered species of primary management concern. That
5 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that
6 are relevant to the aquatic environment and aquatic species. The potential effects of the
7 construction of contaminants associated with restoration measures under Alternative 7 would be
8 similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-8).

9 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-8, the effects would not be adverse.

10 **CEQA Conclusion:** As described immediately above, the impacts of contaminants associated with
11 restoration measures would be less than significant.

12 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**
13 **Primary Management Concern**

14 **NEPA Effects:** Refer to Impact AQUA-9 under delta smelt for a discussion of the effects of restored
15 habitat conditions on non-covered species of primary management concern. That discussion under
16 delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the
17 aquatic environment and aquatic species. Although there are minor differences the effects are
18 similar. The potential effects of restored habitat conditions under Alternative 7 would be similar to
19 those described for Alternative 1A (see Alternative 1A, Impact AQUA-8). For a detailed discussion,
20 please see Alternative 1A, Impact AQUA-8. In addition, see Alternative 1A, Impact AQUA-207 for a
21 discussion of the different effects on non-covered species of primary management concern.
22 Alternative 7 would also include an additional 10,000 acres of seasonally inundated floodplain and
23 an additional 20 miles of channel margin habitat. In general these would provide proportionally
24 more habitat for non-covered species of management concern particularly with respect to food
25 production and export which would be beneficial to downstream species (striped bass, American
26 shad, threadfin shad, largemouth bass and Sacramento tule perch). Sacramento-San Joaquin roach
27 and hardhead would generally occur upstream of these restored areas and would receive minimal
28 benefit from them. Predatory species (striped bass and largemouth bass) and Sacramento tule perch
29 would benefit from the additional cover provided by the additional 20 miles of enhanced channel
30 margin.

31 **CEQA Conclusion:** As described immediately above, the impacts of restored habitat conditions
32 would range from slightly beneficial to beneficial.

33 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**
34 **Primary Management Concern (CM12)**

35 Refer to Impact AQUA-10 under delta smelt for a discussion of the effects of methylmercury
36 management on non-covered species of primary management concern. That discussion under delta
37 smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the
38 aquatic environment and aquatic species. The potential effects of methylmercury management
39 under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A,
40 Impact AQUA-10).

41 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-10, the effects would not be adverse.

1 **CEQA Conclusion:** As described immediately above, the impacts of methylmercury management
2 would be less than significant.

3 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**
4 **Aquatic Species of Primary Management Concern (CM13)**

5 **NEPA Effects:** Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of invasive
6 aquatic vegetation management on non-covered species of primary management concern. That
7 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that
8 are relevant to the aquatic environment and aquatic species. The potential effects of invasive aquatic
9 vegetation management under Alternative 7 would be similar to those described for Alternative 1A
10 (see Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and largemouth
11 bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for predatory
12 fish which improves their hunting success. Sacramento tule perch also use the cover of aquatic
13 plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently, reducing the
14 amount of invasive aquatic habitat will negatively affect these predatory species and Sacramento
15 tule perch. However, this control will not substantially reduce the ability of the predatory species to
16 hunt and there will still be many other habitats in which the predatory species can successfully hunt
17 and in which Sacramento tule perch will thrive. The effect on them will not be adverse. Control of
18 invasive aquatic vegetation would not occur within California bay shrimp habitat and there would
19 be no effect on them.

20 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of
21 invasive aquatic vegetation management on non-covered species of primary management concern.
22 There are minor differences and the effects are similar except for predatory species (striped bass
23 and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding
24 habitat for predatory fish which improves their hunting success. Control of invasive aquatic
25 vegetation would not occur within California bay shrimp habitat and there would be no effect on
26 them. Sacramento tule perch use the cover of aquatic plants in the Sacramento and San Joaquin
27 rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will
28 negatively affect the predatory species and Sacramento tule perch. However, this control will not
29 substantially reduce the ability of the predatory species to hunt and there will still be many other
30 habitats in which the predatory species can successfully hunt and in which Sacramento tule perch
31 will thrive. Therefore the effect on them will not be significant and no mitigation is required.

32 **Other Conservation Measures (CM12–CM19 and CM21)**

33 The effects of other conservation measures under Alternative 7 would be similar for all non-covered
34 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by
35 individual species.

36 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**
37 **Species of Primary Management Concern (CM14)**

38 Refer to Impact AQUA-12 under delta smelt for a discussion of the effects of dissolved oxygen
39 management on non-covered species of primary management concern. That discussion under delta
40 smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the
41 aquatic environment and aquatic species. The potential effects of dissolved oxygen management
42 under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A,
43 Impact AQUA-12).

1 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-12 these effects would be beneficial;
2 however, California bay shrimp do not occur in this habitat and there would be no effect on them.

3 **CEQA Conclusion:** As described immediately above, the impacts of oxygen level management would
4 be beneficial.

5 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**
6 **Species of Primary Management Concern (CM15)**

7 Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the effects of
8 predatory fish (striped bass and largemouth bass) and predator management on non-predatory fish.
9 That discussion under delta smelt addresses the type, magnitude and range of impact mechanisms
10 that are relevant to the aquatic environment and aquatic species. The purpose of predatory fish
11 management is to reduce the numbers of predatory fish and to reduce their hunting success. This
12 management will have negative effects on predatory fish. However, the numbers of predatory fish
13 are high and the extent of the habitats in which they hunt is extensive.

14 **NEPA Effects:** The effects of this management will not be adverse; however, California bay shrimp
15 do not occur in this habitat and there would be no effect on them.

16 **CEQA Conclusion:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the
17 effects of predatory fish and predator management on non-predatory fish. The purpose of predatory
18 fish management is to reduce the numbers of predatory fish and to reduce their hunting success.
19 This management will have negative effects on predatory fish. However, the numbers of predatory
20 fish are high and the extent of the habitats in which they hunt is extensive.

21 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**
22 **Primary Management Concern (CM16)**

23 **NEPA Effects:** Refer to Impact AQUA-14 under delta smelt for a discussion of the effects of
24 nonphysical fish barriers on non-covered species of primary management concern. That discussion
25 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
26 to the aquatic environment and aquatic species. The potential effects of nonphysical fish barriers
27 under Alternative 7 would be similar to those described for Alternative 1A (see Alternative 1A,
28 Impact AQUA-14). For a detailed discussion, please see Alternative 1A, Impact AQUA-14. The effects
29 would be similar except for Sacramento-San Joaquin roach and hardhead which are unlikely to be
30 present in their vicinity. California bay shrimp do not occur in this habitat and there would be no
31 effect on them. The effects would not be adverse.

32 **CEQA Conclusion:** As described immediately above, the impacts of nonphysical fish barriers would
33 be less than significant.

34 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**
35 **Primary Management Concern (CM17)**

36 Refer to Impact AQUA-15 under delta smelt for a discussion of the effects of illegal harvest reduction
37 on non-covered species of primary management concern. That discussion under delta smelt
38 addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic
39 environment and aquatic species. The potential effects of illegal harvest reduction under Alternative
40 7 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-15).

1 **NEPA Effects:** As concluded for 1A, Impact AQUA-15, the effect would not be adverse. California bay
2 shrimp do not occur in this habitat and there would be no effect on them.

3 **CEQA Conclusion:** As described immediately above, the impacts of illegal harvest reduction would
4 be less than significant.

5 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**
6 **Primary Management Concern (CM18)**

7 Refer to Impact AQUA-16 under delta smelt for a discussion of the effects of conservation hatcheries
8 on non-covered species of primary management concern. The potential effects of conservation
9 hatcheries under Alternative 7 would be similar to those described for Alternative 1A (see
10 Alternative 1A, Impact AQUA-16).

11 **NEPA Effects:** For a detailed discussion, please see Alternative 1A, Impact AQUA-16. There would be
12 no effect.

13 **CEQA Conclusion:** As described immediately above, conservation hatcheries would have not impact.

14 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**
15 **of Primary Management Concern (CM19)**

16 Refer to Impact AQUA-17 under delta smelt for a discussion of the effects of stormwater treatment
17 on non-covered species of primary management concern. That discussion under delta smelt
18 addresses the type, magnitude and range of impact mechanisms that are relevant to the aquatic
19 environment and aquatic species. The potential effects of stormwater treatment under Alternative 7
20 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-17).

21 **NEPA Effects:** For a detailed discussion, please see Alternative 1A, Impact AQUA-17. These effects
22 would be beneficial.

23 **CEQA Conclusion:** As described immediately above, the impacts of stormwater management would
24 be beneficial.

25 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**
26 **Aquatic Species of Primary Management Concern (CM21)**

27 Refer to Impact AQUA-18 under delta smelt for a discussion of the effects of removal/relocation of
28 nonproject diversions on non-covered species of primary management concern. That discussion
29 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
30 to the aquatic environment and aquatic species. The potential effects of removal/relocation of
31 nonproject diversions under Alternative 7 would be similar to those described for Alternative 1A
32 (see Alternative 1A, Impact AQUA-18).

33 **NEPA Effects:** For a detailed discussion, please see Alternative 1A, Impact AQUA-18. The effects
34 would be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch which
35 are unlikely to be present near these diversions. California bay shrimp do not occur in this habitat
36 and there would be no effect on them. The effects would not be adverse.

37 **CEQA Conclusion:** As described immediately above, the impacts of removal/relocation of nonproject
38 diversions would be less than significant.

1 **Upstream Reservoirs**

2 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

3 **NEPA Effects:** Similar to the description for Alternative 1A, this effect would not be adverse because
4 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 7 would not be
5 substantially reduced when compared to NAA.

6 **CEQA Conclusion:** Similar to the description for Alternative 1A, Alternative 7 would reduce the
7 quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be
8 a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant
9 impact. These results are primarily caused by four factors: differences in sea level rise, differences in
10 climate change, future water demands, and implementation of the alternative. The analysis
11 described above comparing Existing Conditions to Alternative 7 does not partition the effect of
12 implementation of the alternative from those of sea level rise, climate change and future water
13 demands using the model simulation results presented in this chapter. However, the increment of
14 change attributable to the alternative is well informed by the results from the NEPA analysis, which
15 found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 7, if
16 adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
17 therefore would not in itself result in a significant impact on coldwater habitat in upstream
18 reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.4.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5 and Increased Delta Outflow (9,000 cfs; Operational Scenario F)

Alternative 8 is the same as Alternative 1A except that it involves Intakes 2, 3, and 5 instead of Intakes 1, 2, 3, 4, and 5 and includes a different operational scenario. While Alternative 1A would divert up to 15,000 cfs and uses Operational Scenario A, Alternative 8 would divert up to 9,000 cfs and uses Operational Scenario F. The dimensions of the intakes are in Table 11-5. Alternative 8 has the same six barge facilities as Alternative 1A.

Delta Smelt

Construction and Maintenance of CM1

Small numbers of delta smelt eggs, larvae, and adults could be present in the north Delta in June during construction of intake facilities. Small numbers of delta smelt eggs, larvae could also be present in June or July during construction of the barge landings in the east Delta and south Delta (see Table 11-6). Very low delta smelt abundance would be expected in the south Delta near the southern barge landings during the in-water construction period. These construction areas also occur entirely within designated delta smelt critical habitat.

Construction impacts on delta smelt or critical habitat would be as described for Alternative 1A, Impact AQUA-1, except that Alternative 8 would include only Intakes 2, 3, and 5. No impacts would occur at the locations of Intakes 1 and 4 that are proposed under Alternative 1A.

Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt

NEPA Effects: The potential effects of construction of the water conveyance facilities on delta smelt or critical habitat would be similar to those described for Alternative 1A (Impact AQUA-1) except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the effects would be proportionally less under this alternative. This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-1, environmental commitments and mitigation measures would be available to avoid and minimize potential effects, and the effect would not be adverse for delta smelt or their critical habitat.

CEQA Conclusion: As described for Alternative 1A, Impact AQUA-1, the impact of the construction of water conveyance facilities on delta smelt or their critical habitat would be less than significant except for construction noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A because only three intakes would be constructed rather than five. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than significant.

Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects of Pile Driving and Other Construction-Related Underwater Noise

Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1 in the discussion of Alternative 1A.

1 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
2 **and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1 in the discussion of
4 Alternative 1A.

5 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

6 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
7 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-2, except that
8 only three intakes would need to be maintained under Alternative 8 rather than five under
9 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-2, the effect would not be adverse for
10 delta smelt.

11 **CEQA Conclusion:** As described for Alternative 1A, Impact AQUA-2, the impact of the maintenance of
12 water conveyance facilities on delta smelt would be less than significant and no mitigation would be
13 required.

14 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

15 ***Water Exports from SWP/CVP South Delta Facilities***

16 Overall, operational activities under Alternative 8 would benefit delta smelt by substantially
17 reducing proportional entrainment losses at the south Delta facilities for the combined population
18 by 0.123 (approximately 12% of the population), a 55% relative reduction compared to the NAA.

19 Average larval/juvenile proportional entrainment (March–June) would be 0.06 (i.e., 6% of the
20 juvenile population) under Alternative 8, compared to 0.15 for the NAA (a 58% relative reduction)
21 (Figure 11-8-1). Average adult proportional entrainment (December–March) under Alternative 8
22 (about 0.035, or 3.5% of the adult population) would be 0.04 less (51% relative reduction)
23 compared to the NAA, with little difference attributable to climate change (Figure 11-8-2, Table 11-
24 8-1).

25 This improvement is due to reductions in OMR reverse flows under Alternative 8 operations. South
26 Delta exports would substantially decline compared to the NAA and increase Delta outflow, with no
27 exports in April–May and October–November, thus substantially increasing OMR flows. In all
28 months of the year except during the summer (July, August, September), monthly OMR flows
29 averaged across water year types would be net positive (flowing towards San Francisco Bay).

1 **Table 11-8-1. Proportional Entrainment Index of Delta Smelt at SWP/CVP South Delta Facilities for**
2 **Alternative 8**

Water Year	Proportional Entrainment ^a	
	Difference in Proportions (Relative Change in Proportions)	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Total Population		
Wet	-0.068 (-64%)	-0.094 (-71%)
Above Normal	-0.103 (-64%)	-0.130 (-69%)
Below Normal	-0.123 (-56%)	-0.152 (-61%)
Dry	-0.126 (-48%)	-0.145 (-51%)
Critical	-0.109 (-34%)	-0.109 (-34%)
All Years	-0.101 (-51%)	-0.123 (-55%)
Juvenile Delta Smelt (March–June)		
Wet	-0.028 (-74%)	-0.054 (-85%)
Above Normal	-0.060 (-74%)	-0.089 (-81%)
Below Normal	-0.081 (-59%)	-0.113 (-66%)
Dry	-0.086 (-47%)	-0.106 (-52%)
Critical	-0.076 (-31%)	-0.081 (-32%)
All Years	-0.061 (-50%)	-0.084 (-58%)
Adult Delta Smelt^b (December–March)		
Wet	-0.040 (-58%)	-0.040 (-58%)
Above Normal	-0.043 (-53%)	-0.042 (-53%)
Below Normal	-0.042 (-51%)	-0.040 (-50%)
Dry	-0.041 (-50%)	-0.039 (-49%)
Critical	-0.034 (-44%)	-0.028 (-40%)
All Years	-0.040 (-52%)	-0.038 (-51%)

Note: Negative values indicate lower entrainment loss under Alternative than under existing biological conditions.

^a Proportional entrainment index calculated in accordance with USFWS BiOp (U.S. Fish and Wildlife Service 2008a).

^b Adult proportional entrainment adjusted according to Kimmerer (2011)

3

4 **Water Exports from SWP/CVP North Delta Intake Facilities**

5 The effects would be similar to Impact AQUA-3 in Alternative 1A for north Delta intakes because
6 potential entrainment and impingement risks at the proposed north Delta facilities would be limited
7 because delta smelt rarely occur in the vicinity of the proposed intake site. Alternative 8 would have
8 only three intakes, compared to five intakes for Alternative 1A, and therefore potential entrainment
9 and impingement risk would be relatively reduced compared to Alternative 1A. The effect under
10 Alternative 1A was determined to be not adverse.

Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct

Potential entrainment of larval delta smelt at the NBA, as estimated by particle tracking models, was low, averaging 1.4% under Alternative 8 compared to 2.0% under NAA, a 30% relative reduction (Table 11-8-2).

Table 11-8-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt Entrained by the North Bay Aqueduct under Alternative 8 and Baseline Scenarios

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A8_LLТ	A8_LLТ vs. EXISTING CONDITIONS	A8_LLТ vs. NAA
2.1	2.0	1.4	-0.71 (-34%)	-0.61 (-30%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario

Predation Associated with Entrainment

Pre-screen predation losses of delta smelt at the SWP/CVP facilities are believed to be high. Because proportional entrainment of combined juvenile and adult delta smelt would be substantially reduced under Alternative 8 (55% compared to NAA), there would be less predation loss at the south Delta. Predation loss at the proposed north Delta intakes and the alternate NBA intake would be limited because few delta smelt occur that far upstream. The effect would be beneficial because fewer delta smelt would be lost to predation.

NEPA Effects: In conclusion, under Alternative 8 overall potential entrainment of delta smelt would be reduced at the south Delta SWP/CVP facilities and the NBA. Entrainment and impingement could potentially occur at the proposed north Delta intakes, but the risk would be low due to the location, design, and operation of intakes, and offset by reduced entrainment at the south Delta facilities. The overall effect on delta smelt would be beneficial because of the reduction in entrainment loss and mortality.

CEQA Conclusion: Alternative 8 would result in an overall reduction of entrainment as a whole compared to Existing Conditions. At the south Delta facilities, proportional entrainment of juvenile and adult delta smelt would be substantially reduced (Table 11-8-1, Figures 11-8-1 and 11-8-2) due to substantial reductions in water exports from the south Delta. Proportional entrainment averaged across water year types would be reduced by 0.04 for adults (i.e., 4% of population, a 52% relative reduction) and reduced by 0.061 for juveniles (a 50% relative reduction) compared to Existing Conditions (Table 11-8-1). In addition, pre-screen predation loss would also be substantially reduced at the south Delta facilities under Alternative 8. The risk of entrainment and impingement at the proposed north Delta intake facilities is low due to low abundances of delta smelt in the vicinity, and would be minimized by state-of-the-art screens. At the NBA potential entrainment of larvae is low under Existing Conditions and would be slightly reduced (~1%) under Alternative 8 (Table 11-8-2). Overall, Alternative 8 would benefit delta smelt due to a substantial reduction in entrainment and associated predation losses at the south Delta facilities and minimizing entrainment at the north Delta facilities and NBA intakes. This impact is considered to be beneficial. No mitigation would be required.

1 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
2 **Delta Smelt**

3 **NEPA Effects:** The effects of operations under Alternative 8 on abiotic spawning habitat would be
4 the same as described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta
5 intakes would not reduce available spawning habitat. In-Delta water temperatures, which can affect
6 spawning timing, would not change across Alternatives, because they would be in thermal
7 equilibrium with atmospheric conditions and not strongly influenced by the flow changes. The effect
8 of Alternative 8 operations on spawning would not be adverse, because there would be little change
9 in abiotic spawning conditions for delta smelt.

10 **CEQA Conclusion:** As described above, operations under Alternative 8 would not reduce abiotic
11 spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the
12 impact would be less than significant, and no mitigation would be required.

13 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

14 **NEPA Effects:** As described for other alternatives, Impact AQUA-5, rearing habitat conditions for
15 juvenile delta smelt are considered with respect to the abiotic habitat index (Feyrer et al. 2011) with
16 and without the assumption that BDCP habitat benefits are realized. The abiotic habitat index under
17 Alternative 8 across all water years would be similar (<5% change) to NAA without restoration
18 (Figure 11-8-3, Table 11-8-3). Alternative 8 has the potential to further benefit delta smelt by
19 habitat restoration (CMs 2 and 4), particularly in the Suisun Marsh, West Delta, and Cache Slough
20 ROAs which are closer to delta smelt's main range. Habitat restoration would increase spawning and
21 rearing habitat and supplement food production and export. With habitat restoration, Alternative 8
22 flows may result in a 30% increase in the average abiotic habitat index compared to the NAA. The
23 greatest increase would be in below normal and dry years (34–37% more). These overall effects
24 would be due to the inundation of new areas of the Delta resulting from habitat restoration effects; it
25 is assumed that 100% of the newly restored habitat would be utilized by delta smelt.

26 **CEQA Conclusion:** Without BDCP habitat restoration efforts, the average fall abiotic habitat index
27 would increase by 25% when compared to Existing Conditions, which do not include Fall X2 criteria.
28 The abiotic habitat index would be increased in all water year types under Alternative 8 flows, even
29 without habitat restoration. Habitat restoration under Alternative 8 would further increase the fall
30 abiotic habitat index by 58% when averaged for all water years, with about 85% more in above
31 normal and wet years (Figure 11-8-3, Table 11-8-3). The impact on delta smelt rearing habitat
32 would be beneficial because the abiotic habitat index would be increased under Alternative 8 even
33 without habitat restoration actions.

1 **Table 11-8-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 8 and**
 2 **Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year**
 3 **Type**

Water Year	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
All	992 (25%)	106 (2%)	2,325 (58%)	1,439 (30%)
Wet	2,178 (46%)	-18 (0%)	4,065 (86%)	1,869 (27%)
Above Normal	1,729 (45%)	61 (1%)	3,243 (85%)	1,575 (29%)
Below Normal	60 (1%)	208 (5%)	1,192 (29%)	1,340 (34%)
Dry	195 (5%)	286 (8%)	1,186 (33%)	1,278 (37%)
Critical	28 (1%)	28 (1%)	743 (25%)	743 (25%)

Note: Negative values indicate lower habitat indices under the proposed scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

4

5 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

6 **NEPA Effects:** The effects of operations under Alternative 8 on migration conditions would be the
 7 same as described for Alternative 1A (Impact AQUA-6). Alternative 8 would not affect the first flush
 8 of winter precipitation and the turbidity cues associated with adult delta smelt migration. In-Delta
 9 water temperatures would not change across alternatives, because they would be in thermal
 10 equilibrium with atmospheric conditions and not strongly influenced by the flow changes under
 11 BDCP operations.

12 As described for other alternatives, Alternative 8 may decrease sediment supply to the estuary by 8
 13 to 9 percent, with the potential for decreased habitat suitability for delta smelt in some locations.

14 **CEQA Conclusion:** As described above, operations under Alternative 8 would not substantially alter
 15 the turbidity cues associated with winter flush events that may initiate migration, nor would there
 16 be appreciable changes in water temperatures. Consequently, the impact on adult delta smelt
 17 migration conditions would be less than significant, and no mitigation would be required.

18 **Restoration Measures (CM2, CM4–CM7, and CM10)**

19 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
 20 differences in restoration-related fish effects are anticipated anywhere in the affected environment
 21 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
 22 restoration measures described for delta smelt under Alternative 1A (Impact AQUA-7 through
 23 AQUA-9) also appropriately characterize effects under Alternative 8.

24 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

25 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

26 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**
 27 **Smelt**

28 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms
2 on delta smelt are the same for Alternative 8, as those described under Alternative 1A. The effects
3 would not be adverse, and generally beneficial. Specifically for AQUA-8, the effects of contaminants
4 on delta smelt with respect to selenium, copper, ammonia and pesticides would not be adverse. The
5 effects of methylmercury on delta smelt are uncertain.

6 **CEQA Conclusion:** All three of the impact mechanisms listed above would be beneficial or less than
7 significant, and no mitigation is required.

8 **Other Conservation Measures (CM12–CM19 and CM21)**

9 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
10 differences in other conservation-related fish effects are anticipated anywhere in the affected
11 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
12 effects of other conservation measures described for delta smelt under Alternative 1A (Impact
13 AQUA-10 through Impact AQUA-18) also appropriately characterize effects under Alternative 8.

14 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

15 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

16 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

17 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

18 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

19 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

20 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

21 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

22 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

23 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**
24 **(CM21)**

25 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
26 adverse effect, or beneficial effects on delta smelt for NEPA purposes, for the reasons identified for
27 Alternative 1A.

28 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
29 less than significant, or beneficial on delta smelt, for the reasons identified for Alternative 1A, and no
30 mitigation is required.

1 **Longfin Smelt**

2 **Construction and Maintenance of CM1**

3 **Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt**

4 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on longfin
5 smelt would be similar to those described for Alternative 1A (Impact AQUA-19) except that
6 Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the
7 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
8 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
9 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
10 shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-
11 19, environmental commitments and mitigation measures would be available to avoid and minimize
12 potential effects, and the effect would not be adverse for longfin smelt.

13 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-19, the impact of the construction of
14 water conveyance facilities on longfin smelt would be less than significant except for construction
15 noise associated with pile driving. Potential pile driving impacts would be less than Alternative 1A
16 because only three intakes would be constructed rather than five. Implementation of Mitigation
17 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
18 significant.

19 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
20 **of Pile Driving and Other Construction-Related Underwater Noise**

21 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

22 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
23 **and Other Construction-Related Underwater Noise**

24 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

25 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

26 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
27 Alternative 8 would be the same as those described for Alternative 1A Impact AQUA-20, except that
28 only three intakes would need to be maintained under Alternative 8 rather than five under
29 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-20, the effect would not be adverse for
30 longfin smelt.

31 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-20, the impact of the maintenance
32 of water conveyance facilities on longfin smelt would be less than significant and no mitigation
33 would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

3 ***Water Exports from SWP/CVP South Delta Facilities***

4 Potential entrainment risk for larval longfin smelt, as simulated by mean percent particles entrained
5 at the south Delta diversions, was 0% under Alternative 8, compared to 2.2 for NAA (Table 11-8-4).
6 Entrainment risk of larval longfin smelt to the south Delta facilities is expected to be minimal under
7 Alternative 8.

8 **Table 11-8-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae**
9 **Entrained by the South Delta Facilities under Alternative 8 and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A8_LLT	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wetter	1.9	1.6	0.0	-1.88 (-100%)	-1.70 (-100%)
Drier	2.5	2.2	0.0	-2.51 (-100%)	-2.24 (-100%)

10

11 For juvenile longfin smelt, entrainment at the south Delta facilities (salvage index, averaged across
12 all water year types) would be effectively eliminated (99.9% reduction). For adult longfin smelt,
13 entrainment at the south Delta facilities averaged across all water year types would be substantially
14 reduced by 81% compared to the NAA (Table 11-8-5) because of increases in OMR flows.

15 **Table 11-8-5. Longfin Smelt Entrainment Index at the SWP and CVP Salvage Facilities—Differences**
16 **(Absolute and Percentage) between Model Scenarios for Alternative 8**

Life Stage	Water Year Types	Absolute Difference (Percent Difference)	
		EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Juvenile (March–June)	Wet	-63,749 (-100%)	-69,191 (-100%)
	Above Normal	-4,522 (-100%)	-4,811 (-100%)
	Below Normal	-3,040 (-99%)	-3,249 (-99%)
	Dry	-529,625 (-100%)	-587,932 (-100%)
	Critical	-567,468 (-100%)	-493,597 (-100%)
	All Years	-267,492 (-100%)	-292,504 (-100%)
Adult (December–March)	Wet	-91 (-71%)	-95 (-72%)
	Above Normal	-534 (-82%)	-574 (-83%)
	Below Normal	-1,723 (-89%)	-1,646 (-88%)
	Dry	-1,170 (-97%)	-1,105 (-97%)
	Critical	-24,331 (-100%)	-22,198 (-100%)
	All Years	-2,943 (-82%)	-2,908 (-81%)

Shading indicates >5% increase in entrainment index.

17

Water Exports from SWP/CVP North Delta Intake Facilities

The proposed north Delta intakes could increase entrainment potential and locally attract piscivorous fish predators, but entrainment and predation losses of longfin smelt at the north Delta would be extremely low because this species occur only rarely this far upstream.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Particle tracking modeling of larval entrainment found that under NAA on average less than 1% of particles were entrained at the NBA. Entrainment to the NBA under Alternative 8 would be very similar to NAA (Table 11-8-6). Overall, larval entrainment to the NBA would be minor under this Alternative.

Table 11-8-6. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct under Alternative 8 and Baseline Scenarios

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A8_LLТ	A8_LLТ vs. EXISTING CONDITIONS	A8_LLТ vs. NAA
Wetter	0.20	0.08	0.09	-0.12 (-58.1%)	0.01 (6.2%)
Drier	0.25	0.11	0.11	-0.14 (-57.3%)	0.00 (-0.7%)

In summation, at the SWP/CVP south Delta facilities juvenile and adult longfin smelt entrainment would be reduced substantially under Alternative 8 compared to the NAA. Longfin smelt entrainment to the NBA would be unchanged compared to the NAA. Entrainment loss of longfin smelt at the proposed north Delta intakes would be rare since longfin smelt are not expected to occur in that area of the Sacramento River.

Predation Associated with Entrainment

Pre-screen predation losses of longfin smelt at the SWP/CVP facilities are believed to be high and proportional to entrainment. It is assumed that pre-screen predation losses of longfin smelt would be similar to delta smelt based on their similar size, shape, and pelagic nature. Predation loss of juvenile longfin smelt would be effectively eliminated under Alternative 8, and predation loss of adults would also be substantially reduced (81–82% reduction). Predation loss at the proposed north Delta intakes would be limited because few longfin smelt occur that far upstream. The impact and conclusion for the risk of predation associated with the NPВ structures would be the same as described for Alternative 1A, Impact AQUA-21.

NEPA Effects: In conclusion, the effect on entrainment and entrainment-related predation loss under Alternative 8 would be beneficial because of the substantial reductions in entrainment at the south Delta facilities.

CEQA Conclusion: The results of the PTM model indicate reduced larval entrainment to agricultural diversions relative to Existing Conditions, while larval entrainment would be unchanged at the NBA. Based on PTM analysis and salvage density results, there would be substantial reductions in entrainment of all life stages of longfin smelt at the south Delta facilities under Alternative 8. At the south Delta facilities, juvenile entrainment would be effectively eliminated (99.9% reduction compared to Existing Conditions) and adult entrainment would be substantially reduced by 82%

1 compared to Existing Conditions. Entrainment to the north Delta intakes would be low since longfin
2 smelt would not occur in the vicinity of the intakes.

3 Predation loss of juveniles would be effectively eliminated while predation loss of adult would be
4 reduced by 82% compared to Existing Conditions. Little predation loss would occur at the SWP/CVP
5 north Delta intakes because longfin smelt rarely occur in that vicinity.

6 In conclusion, the impact under Alternative 8 would less than significant because of the substantial
7 reductions in entrainment and predation loss, which would benefit longfin smelt. No mitigation
8 would be required.

9 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**
10 **Habitat for Longfin Smelt**

11 **NEPA Effects:** Predicted average relative longfin smelt abundance would be increased 46% (based
12 on Fall Midwater Trawl index estimates) to 57% (based on Bay Otter Trawl index estimates) under
13 Alternative 8 compared to NAA conditions. Relative abundances would increase particularly in
14 below normal (58–73% more), dry (78–100% more) and critical (70–89% more) water year types
15 (Table 11-8-7).

16 **Table 11-8-7. Estimated Differences Between Scenarios for Longfin Smelt Relative Abundance in**
17 **the Fall Midwater Trawl or Bay Otter Trawl**

Water Year Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
All	204 (4%)	1,680 (46%)	679 (5%)	5,435 (57%)
Wet	-3,779 (-21%)	2,585 (22%)	-15,802 (-24%)	10,347 (27%)
Above Normal	-1,493 (-17%)	1,339 (23%)	-5,395 (-20%)	4,650 (29%)
Below Normal	434 (10%)	1,732 (58%)	1,402 (12%)	5,422 (73%)
Dry	777 (37%)	1,270 (78%)	2,234 (45%)	3,571 (100%)
Critical	442 (46%)	576 (70%)	1,092 (58%)	1,406 (89%)
Shading indicates 10% or greater decrease in relative abundance.				
^a Based on the X2-Relative Abundance Regression of Kimmerer et al. (2009).				

18

19 Rearing conditions for larval and juvenile longfin smelt can also be analyzed by assessing Delta
20 outflows. On average, January–March Delta outflows would be similar to NAA conditions, while
21 outflows would be increased under Alternative 8 from April–June by 10–14%.

22 Delta outflows would be similar or higher than NAA from January to June, providing improved
23 habitat conditions for longfin smelt. Furthermore, longfin smelt may benefit from habitat restoration
24 actions (CM2 and CM4), which are intended to provide additional food production and export to
25 longfin smelt rearing areas. This potential habitat restoration benefit is not reflected in the X2-
26 longfin smelt abundance regression, but may provide benefits to longfin smelt, particularly in Suisun
27 Marsh, West Delta, and Cache Slough ROAs.

28 **CEQA Conclusion:** Under Alternative 8, average flows at Rio Vista would be similar (<10%
29 difference) to Existing Conditions from January through March, and slightly reduced by 11% in

1 December. The impact of Alternative 8 on spawning habitat would be less than significant because
2 flow conditions near longfin smelt spawning habitat would be largely similar to Existing Conditions.
3 No mitigation would be required.

4 Relative longfin smelt abundance averaged across all water years would be similar to Existing
5 Conditions (Table 11-8-7). Longfin smelt abundances by water year type would be greater under
6 Alternative 8 in critical years (46–58%), increased in dry years (37–45%), and reduced in wetter
7 water year types (17–24% less) compared to Existing Conditions.

8 Delta outflows would be similar or improved relative to Existing Conditions from January–June. A
9 number of habitat restoration conservation measures (CM2 and CM4) may improve the quality of
10 rearing habitat for longfin smelt by increasing food production in the Delta. Overall, the impact of
11 Alternative 8 on longfin smelt abundance and Delta outflow during longfin smelt migration would be
12 less than significant and may provide a benefit to the species.

13 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

14 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on rearing habitat
15 for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on Spawning, Egg
16 Incubation, and Rearing Habitat for Longfin Smelt.

17 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

18 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on migration
19 conditions for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on
20 Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.

21 **Restoration Measures (CM2, CM4–CM7, and CM10)**

22 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
23 differences in restoration-related fish effects are anticipated anywhere in the affected environment
24 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
25 restoration measures described for longfin smelt under Alternative 1A (Impact AQUA-25 through
26 Impact AQUA-27) also appropriately characterize effects under Alternative 8.

27 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

28 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

29 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin 30 Smelt**

31 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

32 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms
33 on longfin smelt are the same for Alternative 8, as those described under Alternative 1A. The effects
34 would not be adverse, and generally beneficial. Specifically for AQUA-26, the effects of contaminants
35 on longfin smelt with respect to selenium, copper, ammonia and pesticides would not be adverse.
36 The effects of methylmercury on longfin smelt are uncertain.

1 **CEQA Conclusion:** All three of the impact mechanisms listed above would be at least slightly
2 beneficial, or less than significant, and no mitigation is required for the reasons identified for
3 Alternative 1A.

4 **Other Conservation Measures (CM12–CM19 and CM21)**

5 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
6 differences in other conservation-related fish effects are anticipated anywhere in the affected
7 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
8 effects of other conservation measures described for longfin smelt under Alternative 1A (Impact
9 AQUA-28 through Impact AQUA-36) also appropriately characterize effects under Alternative 8.

10 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

11 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

12 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt** 13 **(CM13)**

14 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

15 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

16 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

17 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

18 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

19 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

20 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt** 21 **(CM21)**

22 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
23 adverse effect, or beneficial effects on longfin smelt for NEPA purposes, for the reasons identified for
24 Alternative 1A.

25 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
26 less than significant, or beneficial on longfin smelt, for the reasons identified for Alternative 1A, and
27 no mitigation is required.

28 **Winter-Run Chinook Salmon**

29 **Construction and Maintenance of CM1**

30 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 31 **(Winter-Run ESU)**

32 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on winter-run
33 Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-37) except

1 that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the
2 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
3 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
4 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
5 shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-
6 37, environmental commitments and mitigation measures would be available to avoid and minimize
7 potential effects, and the effect would not be adverse for winter-run Chinook salmon.

8 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-37, the impact of the construction of
9 water conveyance facilities on Chinook salmon would be less than significant except for
10 construction noise associated with pile driving. Potential pile driving impacts would be less than
11 Alternative 1A, Impact 37, because only three intakes would be constructed rather than five.
12 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
13 that noise impact to less than significant.

14 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
15 **of Pile Driving and Other Construction-Related Underwater Noise**

16 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

17 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
18 **and Other Construction-Related Underwater Noise**

19 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

20 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
21 **(Winter-Run ESU)**

22 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
23 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-38, except that
24 only three intakes would need to be maintained under Alternative 8 rather than five under
25 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for
26 Chinook salmon.

27 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance
28 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
29 would be required.

30 **Water Operations of CM1**

31 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**
32 **Run ESU)**

33 **Water Exports from SWP/CVP South Delta Facilities**

34 Alternative 8 would reduce overall entrainment of juvenile winter-run Chinook salmon at the south
35 Delta export facilities by about 82% (~5,500 fish; Table 11-8-8) across all water year types
36 compared to the NAA. As discussed for Alternative 1A, Impact AQUA-39, entrainment would be
37 highest in wet years and would be reduced during drier water year types. Under Alternative 8,
38 entrainment in wet years would be reduced by 73% compared the NAA (Table 11-8-8). In dry and

1 critical years, entrainment would be virtually eliminated (fewer than 100 fish entrained), with
2 relative reductions in salvage of 98% or greater compared to the NAA.

3 **Table 11-8-8. Juvenile Chinook Salmon Annual Entrainment Index^a at the SWP and CVP Salvage**
4 **Facilities—Differences between Model Scenarios for Alternative 8**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Winter-Run Chinook Salmon		
Wet	-8,199 (-72%)	-8,619 (-73%)
Above Normal	-5,273 (-80%)	-5,397 (-80%)
Below Normal	-6,032 (-84%)	-5,608 (-83%)
Dry	-3,709 (-98%)	-3,401 (-98%)
Critical	-1,261 (-100%)	-1,122 (-100%)
All Years	-5,572 (-82%)	-5,512 (-82%)
Spring-Run Chinook Salmon		
Wet	-77,797 (-88%)	-81,425 (-88%)
Above Normal	-25,409 (-95%)	-28,477 (-96%)
Below Normal	-5,932 (-93%)	-6,727 (-94%)
Dry	-16,419 (-100%)	-17,612 (-100%)
Critical	-11,876 (-100%)	-10,255 (-100%)
All Years	-35,408 (-94%)	-37,018 (-94%)
Fall-Run Chinook Salmon		
Wet	-110,928 (-87%)	-111,105 (-87%)
Above Normal	-29,639 (-90%)	-30,113 (-90%)
Below Normal	-12,096 (-89%)	-12,456 (-89%)
Dry	-19,622 (-100%)	-21,270 (-100%)
Critical	-40,890 (-100%)	-35,712 (-100%)
All Years	-50,643 (-92%)	-50,699 (-92%)
Late Fall-Run Chinook Salmon		
Wet	-4,706 (-79%)	-4,620 (-78%)
Above Normal	-516 (-90%)	-501 (-89%)
Below Normal	-51 (-91%)	-47 (-90%)
Dry	-136 (-99%)	-120 (-99%)
Critical	-164 (-100%)	-151 (-100%)
All Years	-1,716 (-89%)	-1,635 (-88%)

Shading indicates 10% or greater increased entrainment.

^a Estimated annual number of fish lost, based on normalized data.

5
6 The proportion of the annual winter-run Chinook population (assumed to be 500,000 juveniles
7 approaching the Delta) lost at the south Delta facilities averaged 1.4% under the NAA and would be
8 reduced to 0.25% under Alternative 8. Proportional entrainment would be reduced slightly
9 (difference less than 1.25%) under Alternative 8 compared to the NAA. Pre-screen losses, typically
10 attributed to predation, would be expected to decrease commensurate with decreased entrainment
11 at the south Delta facilities.

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
3 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the
4 effects would be minimal because the north Delta intakes would have state-of-the-art screens to
5 exclude juvenile fish.

6 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

7 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
8 entrainment and impingement effects for juvenile salmonids would be minimal because intakes
9 would have state-of-the-art screens installed.

10 In conclusion, Alternative 8 would reduce the total numbers of juvenile Chinook salmon of all races
11 entrained relative to NAA, which would be slightly beneficial. Therefore, this effect would not be
12 adverse and would likely provide some benefit to the species because of the reductions in
13 entrainment loss and mortality. The combined predation loss of juveniles at the south Delta facilities
14 and at the proposed north Delta intakes would be increased. However because the combined
15 predation loss would affect less than 5% of the population for all races of Chinook salmon, the effect
16 under Alternative 8 would not be adverse.

17 **NEPA Effects:** Overall, the effects on entrainment would not be adverse.

18 **CEQA Conclusion:** Entrainment losses of juvenile Chinook salmon at the south Delta export facilities
19 would be substantially reduced by approximately 82% under Alternative 8 for winter-run Chinook
20 salmon across all water year types compared to Existing Conditions (Table 11-8-8). Overall, impacts
21 to juvenile winter-run Chinook salmon would be beneficial because of the reductions in entrainment
22 loss at the south Delta export facilities and at agricultural diversions. No mitigation would be
23 required.

24 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
25 **Chinook Salmon (Winter-Run ESU)**

26 In general, Alternative 8 would reduce the quantity and quality of spawning and egg incubation
27 habitat for winter-run Chinook salmon relative to the NAA.

28 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were
29 examined during the May through September winter-run spawning period (Appendix 11C, *CALSIM II*
30 *Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for
31 spawning and egg incubation. Flows under A8_LLT during May and June would generally be similar
32 to or greater than flows under the NAA, except in dry years during June compared to NAA (9%
33 lower). Flows under A8_LLT during July through September would generally be lower than flows
34 under NAA by up to 29%.

35 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the
36 May through September winter-run spawning and egg incubation period. May Shasta storage
37 volume under A8_LLT would be lower compared to storage under NAA in above and below normal
38 water years by 6% and 10%, respectively, and similar to NAA in wet, dry, and critical water years
39 (Table 11-8-9).

1 **Table 11-8-9. Difference and Percent Difference in May Water Storage Volume (thousand**
2 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
Wet	-165 (-4%)	-131 (-3%)
Above Normal	-352 (-8%)	-266 (-6%)
Below Normal	-606 (-15%)	-408 (-10%)
Dry	-590 (-16%)	-146 (-4%)
Critical	-516 (-21%)	68 (4%)

3
4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
5 examined during the May through September winter-run spawning period (Appendix 11D,
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
8 NAA and Alternative 8 in any month or water year type throughout the period at either location.

9 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
10 determined for each month (May through September) and year of the 82-year modeling period
11 (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were
12 further assigned a “level of concern,” as defined in Table 11-8-11. Differences between baselines and
13 Alternative 8 in the highest level of concern across all months and all 82 modeled years are
14 presented in Table 11-8-12. There would be no difference in levels of concern between NAA and
15 Alternative 8.

16 **Table 11-8-10. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided**
17 **by NMFS and Used in the BDCP Effects Analysis**

Location	Period	Maximum Water Temperature (°F)	Purpose
Upper Sacramento River			
Bend Bridge	May–Sep	56	Winter- and spring-run spawning and egg incubation
		63	Green sturgeon spawning and egg incubation
Red Bluff	Oct–Apr	56	Spring-, fall-, and late fall–run spawning and egg incubation
Hamilton City	Mar–Jun	61 (optimal), 68 (lethal)	White sturgeon spawning and egg incubation
Feather River			
Robinson Riffle (RM 61.6)	Sep–Apr	56	Spring-run and steelhead spawning and incubation
	May–Aug	63	Spring-run and steelhead rearing
Gridley Bridge	Oct–Apr	56	Fall- and late fall–run spawning and steelhead rearing
	May–Sep	64	Green sturgeon spawning, incubation, and rearing
American River			
Watt Avenue Bridge	May–Oct	65	Juvenile steelhead rearing

18

1 **Table 11-8-11. Number of Days per Month Required to Trigger Each Level of Concern for Water**
 2 **Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided**
 3 **by NMFS and Used in the BDCP Effects Analysis**

Exceedance above Water Temperature Threshold (°F)	Level of Concern			
	None	Yellow	Orange	Red
1	0-9 days	10-14 days	15-19 days	≥20 days
2	0-4 days	5-9 days	10-14 days	≥15 days
3	0 days	1-4 days	5-9 days	≥10 days

4

5 **Table 11-8-12. Differences between Baseline and Alternative 8 Scenarios in the Number of Years**
 6 **in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**
 7 **Sacramento River at Bend Bridge, May through September**

Level of Concern ^a	EXISTING CONDITIONS vs. A8_LLTT	NAA vs. A8_LLTT
Red	33 (67%)	0 (0%)
Orange	-14 (-100%)	0 (NA)
Yellow	-16 (-100%)	0 (NA)
None	-3 (-100%)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a For definitions of levels of concern, see Table 11-8-11.

8

9 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type
 10 during May through September (Table 11-8-13). Total degree-days under Alternative 8 would be
 11 12% lower than under NAA during May and up to 34% higher during June through September.

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2
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Table 11-8-13. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River at Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	926 (246%)	-276 (-17%)
	Above Normal	151 (71%)	-204 (-36%)
	Below Normal	364 (166%)	-99 (-15%)
	Dry	560 (301%)	146 (24%)
	Critical	375 (170%)	-35 (-6%)
	All	2,375 (195%)	-469 (-12%)
June	Wet	409 (107%)	-302 (-28%)
	Above Normal	235 (159%)	6 (2%)
	Below Normal	559 (402%)	207 (42%)
	Dry	1,026 (546%)	492 (68%)
	Critical	492 (123%)	-58 (-6%)
	All	2,720 (216%)	344 (9%)
July	Wet	1,278 (247%)	672 (60%)
	Above Normal	731 (902%)	461 (131%)
	Below Normal	1,001 (681%)	545 (90%)
	Dry	1,287 (456%)	359 (30%)
	Critical	1,771 (215%)	-15 (-0.6%)
	All	6,068 (328%)	2,022 (34%)
August	Wet	2,633 (378%)	670 (25%)
	Above Normal	1,262 (309%)	603 (57%)
	Below Normal	1,592 (601%)	557 (43%)
	Dry	1,903 (284%)	293 (13%)
	Critical	2,590 (174%)	-29 (-1%)
	All	9,979 (283%)	2,092 (18%)
September	Wet	857 (116%)	148 (10%)
	Above Normal	616 (86%)	216 (19%)
	Below Normal	1,817 (244%)	671 (35%)
	Dry	2,845 (223%)	249 (6%)
	Critical	1,843 (89%)	-48 (-1%)
	All	7,980 (144%)	1,235 (10%)

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The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be generally greater (up to 131% greater on a relative scale or 2% on an absolute scale) than mortality under NAA, except in critical water years, in which there would be a 7% decrease (5% on an absolute scale) in egg mortality under Alternative 8 (Table 11-8-14). Therefore, the increase in mortality from NAA to A8_LLT, although relatively large in some years, would be negligible at an absolute scale to the winter-run population.

Table 11-8-14. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	1 (353%)	0.3 (20%)
Above Normal	3 (685%)	2 (73%)
Below Normal	3 (331%)	2 (131%)
Dry	8 (509%)	2 (27%)
Critical	39 (146%)	-5 (-7%)
All	9 (192%)	0.4 (3%)

SacEFT predicts that there would be a 9% decrease (3% on an absolute scale) in the percentage of years with good spawning availability, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk under A8_LLT would be identical to the percentage of years under NAA. SacEFT predicts that the percentage of years with good egg incubation conditions under A8_LLT would be 8% lower (6% on an absolute scale) than under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A8_LLT would be 10% lower (3% on an absolute scale) than under NAA. Because the reductions in spawning and egg incubation parameters, other than redd scour risk, are consistent, these results indicate that there would be biologically meaningful negative effects of Alternative 8 on spawning habitat.

Table 11-8-15. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Spawning WUA	-29 (-50%)	-3 (-9%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-29 (-30%)	-6 (-8%)
Redd Dewatering Risk	1 (4%)	-3 (-10%)
Juvenile Rearing WUA	-1 (-2%)	24 (96%)
Juvenile Stranding Risk	-12 (-60%)	-23 (-74%)

WUA = Weighted Usable Area.

NEPA Effects: Considering the range of results presented here for winter-run Chinook salmon spawning and egg incubation, this effect would be adverse because it has the potential to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a result of egg mortality. Shasta reservoir storage volume would be up to 10% lower depending on water year type under Alternative 8 and flows would be reduced in the Sacramento River during the majority of months in which spawning and egg incubation occurs. The exceedance of NMFS water temperature thresholds under Alternative 8 would be 9% to 34% greater than those under the NAA in four of the five months evaluated. However, SacEFT and the Reclamation egg mortality model results do not predict that winter-run Chinook salmon spawning habitat conditions would decline under Alternative 8 relative to the NAA.

1 This effect is a result of the specific reservoir operations and resulting flows associated with this
2 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
3 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change
4 the alternative, thereby making it a different alternative than that which has been modeled and
5 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
6 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-40a through AQUA-
7 40c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
8 level.

9 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of spawning and
10 egg incubation habitat for winter-run Chinook salmon relative to Existing Conditions.

11 CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined
12 during the May through September winter-run spawning and egg incubation period (Appendix 11C,
13 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be similar
14 to or greater than flows under Existing Conditions during May through July, except in wet years
15 during May (up to 10% lower) and below normal and critical years during July (10% to 12% lower).
16 Flows under A8_LLT would generally be lower by up to 33% during August through September.

17 Shasta Reservoir storage volume at the end of May under A8_LLT would be generally lower than
18 Existing Conditions (up to 21% lower) in all water years except wet years, in which storage would
19 be similar between A8_LLT and Existing Conditions (Table 11-8-9).

20 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
21 examined during the May through September winter-run spawning period (Appendix 11D,
22 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
23 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
24 Existing Conditions and Alternative 8 during May and June at either location. Mean monthly water
25 temperature would be up to 7% higher under Alternative 8 in July through September at both
26 locations.

27 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
28 determined for each month (May through September) and year of the 82-year modeling period
29 (Table 11-8-10). The combination of number of days and degrees above the 56°F threshold were
30 further assigned a “level of concern” as defined in Table 11-8-11. The number of years classified as
31 “red” would increase by 67% under Alternative 8 relative to Existing Conditions (Table 11-8-12).

32 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type
33 during May through September (Table 11-8-13). Total degree-days under Alternative 8 would be
34 144% to 328% higher than under Existing Conditions during May through September. The
35 Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the
36 Sacramento River under A8_LLT would be 146% to 685% greater than mortality under Existing
37 Conditions, depending on water year type (Table 11-8-14). These increases in mortality under
38 Alternative 8 would only affect the winter-run population in dry and critical years, in which the
39 absolute percent increase of the winter-run population would be 8 and 39%, respectively.

40 SacEFT predicts that there would be a 50% decrease in the percentage of years with good spawning
41 availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table
42 11-8-15). SacEFT predicts that the percentage of years with good (lower) redd scour risk under
43 A8_LLT would be similar to the percentage of years under Existing Conditions. SacEFT predicts that

1 the percentage of years with good egg incubation conditions under A8_LLT would be 30% lower
2 than under Existing Conditions. SacEFT predicts that the percentage of years with good (lower) redd
3 dewatering risk under A8_LLT would be similar to the percentage of years under Existing
4 Conditions. These results indicate that Alternative 8 would cause small to moderate reductions in
5 spawning WUA and egg incubation conditions.

6 **Summary of CEQA Conclusion**

7 Collectively, these results indicate that the impact would be significant. Egg mortality in dry and
8 critical years, during which winter-run Chinook salmon would already be stressed due to reduced
9 flows and increased temperatures, would be up to 39% greater due to Alternative 8 compared to
10 Existing Conditions (Table 11-8-14). The extent of spawning habitat is predicted by SacEFT to be
11 50% lower due to Alternative 8 compared to Existing Conditions (Table 11-8-15), which represents
12 a substantial reduction in spawning habitat and, therefore, in adult spawner and redd carrying
13 capacity. Egg incubation conditions are predicted by SacEFT to be good in 30% fewer years under
14 Alternative 8 relative to Existing Conditions. This impact is a result of the specific reservoir
15 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
16 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
17 less-than-significant level would fundamentally change the alternative, thereby making it a different
18 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
19 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation
20 that has the potential to reduce the severity of impact though not necessarily to a less-than-
21 significant level.

22 **Mitigation Measure AQUA-40a: Following Initial Operations of CM1, Conduct Additional** 23 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine** 24 **Feasibility of Mitigation to Reduce Impacts to Spawning Habitat**

25 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
26 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on
27 the best available scientific information at the time and may prove to have been overstated.
28 Upon the commencement of operations of CM1 and continuing through the life of the permit, the
29 BDCP proponents will monitor effects on spawning habitat in order to determine whether such
30 effects would be as extensive as concluded at the time of preparation of this document and to
31 determine any potentially feasible means of reducing the severity of such effects. This mitigation
32 measure requires a series of actions to accomplish these purposes, consistent with the
33 operational framework for Alternative 8.

34 The development and implementation of any mitigation actions shall be focused on those
35 incremental effects attributable to implementation of Alternative 8 operations only.
36 Development of mitigation actions for the incremental impact on spawning habitat attributable
37 to climate change/sea level rise are not required because these changed conditions would occur
38 with or without implementation of Alternative 8.

39 **Mitigation Measure AQUA-40b: Conduct Additional Evaluation and Modeling of Impacts** 40 **on Winter-Run Chinook Salmon Spawning Habitat Following Initial Operations of CM1**

41 Following commencement of initial operations of CM1 and continuing through the life of the
42 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
43 modified operations could reduce impacts to spawning habitat under Alternative 8. The analysis

1 required under this measure may be conducted as a part of the Adaptive Management and
2 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

3 **Mitigation Measure AQUA-40c: Consult with NMFS, USFWS, and CDFW to Identify and**
4 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**
5 **Salmon Spawning Habitat Consistent with CM1**

6 In order to determine the feasibility of reducing the effects of CM1 operations on winter-run
7 Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the
8 Department of Fish and Wildlife to identify and implement any feasible operational means to
9 minimize effects on spawning habitat. Any such action will be developed in conjunction with the
10 ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-
11 40a.

12 If feasible means are identified to reduce impacts on spawning habitat consistent with the
13 overall operational framework of Alternative 8 without causing new significant adverse impacts
14 on other covered species, such means shall be implemented. If sufficient operational flexibility
15 to reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 8
16 operations, achieving further impact reduction pursuant to this mitigation measure would not
17 be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain
18 significant and unavoidable.

19 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
20 **(Winter-Run ESU)**

21 In general, Alternative 8 would reduce the quantity and quality of rearing habitat for fry and juvenile
22 winter-run Chinook salmon relative to the NAA.

23 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
24 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
25 *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing
26 habitat. Flows under A8_LLT would generally be lower than flows under the NAA during August
27 through November (up to 27% lower), but similar to flows under the NAA during December, except
28 in above normal years (9% lower).

29 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
30 examined during the August through December winter-run juvenile rearing period (Appendix 11D,
31 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
32 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
33 NAA and Alternative 8 in any month or water year type throughout the period at either location.

34 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
35 measured as weighted usable area, under A8_LLT would be 96% greater than the percentage of
36 years under NAA (Table 11-8-15). However, the percentage of years with good (low) juvenile
37 stranding risk under A8_LLT is predicted to be 74% lower than under NAA. This indicates that the
38 quantity of juvenile rearing habitat in the Sacramento River would be greater under A8_LLT relative
39 to NAA, but the quality of such habitat would be lower.

40 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A8_LLT would
41 be similar to or lower than under NAA (<5% difference in each water year type).

1 **NEPA Effects:** These results indicate that the effect would be adverse. Differences in flows, although
2 small to moderate in magnitude, are consistent among most months and water year types. In
3 addition, effects on juvenile stranding risk are large (74% difference relative to NAA). This effect is a
4 result of the specific reservoir operations and resulting flows associated with this alternative.
5 Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent
6 necessary to reduce this effect to a level that is not adverse would fundamentally change the
7 alternative, thereby making it a different alternative than that which has been modeled and
8 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
9 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-41a through AQUA-
10 41c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
11 level.

12 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of fry and juvenile
13 rearing habitat for winter-run Chinook salmon relative to Existing Conditions.

14 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
15 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
16 *in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under Existing
17 Conditions during August through November (up to 30% lower), and similar to flows under Existing
18 Conditions during December, except in above normal and dry years (8% and 6% lower,
19 respectively).

20 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
21 examined during the August through December winter-run rearing period (Appendix 11D,
22 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
23 *Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 8 in
24 August through October depending on month, water year type, and location, and up to 5% higher
25 during November and December at Bend Bridge.

26 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
27 measured as weighted usable area, under A8_LLT would be similar to that under Existing Conditions
28 (Table 11-8-15). However, the percentage of years with good (low) juvenile stranding risk under
29 A8_LLT is predicted to be 60% lower than under Existing Conditions. This indicates that while the
30 quantity of juvenile rearing habitat in the Sacramento River would be similar under A8_LLT relative
31 to Existing Conditions, its quality would be lower.

32 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A8_LLT would
33 be 7% higher than under Existing Conditions.

34 **Summary of CEQA Conclusion**

35 These results indicate that the impact would be significant. There would be small to moderate
36 reductions in flows under Alternative 8 during the majority of months and water year types.
37 Further, egg mortality would increase by 9% across all water years and a 60% reduction in
38 stranding risk would reduce upstream habitat conditions for winter-run fry and juveniles. This
39 impact is a result of the specific reservoir operations and resulting flows associated with this
40 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
41 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
42 change the alternative, thereby making it a different alternative than that which has been modeled
43 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible

1 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
2 severity of impact though not necessarily to a less-than-significant level.

3 **Mitigation Measure AQUA-41a: Following Initial Operations of CM1, Conduct Additional**
4 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**
5 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

6 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
7 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the
8 best available scientific information at the time and may prove to have been overstated. Upon
9 the commencement of operations of CM1 and continuing through the life of the permit, the
10 BDCP proponents will monitor effects on rearing habitat in order to determine whether such
11 effects would be as extensive as concluded at the time of preparation of this document and to
12 determine any potentially feasible means of reducing the severity of such effects. This mitigation
13 measure requires a series of actions to accomplish these purposes, consistent with the
14 operational framework for Alternative 8.

15 The development and implementation of any mitigation actions shall be focused on those
16 incremental effects attributable to implementation of Alternative 8 operations only.
17 Development of mitigation actions for the incremental impact on rearing habitat attributable to
18 climate change/sea level rise are not required because these changed conditions would occur
19 with or without implementation of Alternative 8.

20 **Mitigation Measure AQUA-41b: Conduct Additional Evaluation and Modeling of Impacts**
21 **on Winter-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

22 Following commencement of initial operations of CM1 and continuing through the life of the
23 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
24 modified operations could reduce impacts to rearing habitat under Alternative 8. The analysis
25 required under this measure may be conducted as a part of the Adaptive Management and
26 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

27 **Mitigation Measure AQUA-41c: Consult with NMFS, USFWS, and CDFW to Identify and**
28 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**
29 **Salmon Rearing Habitat Consistent with CM1**

30 In order to determine the feasibility of reducing the effects of CM1 operations on winter-run
31 Chinook salmon habitat, the BDCP proponents will consult with USFWS and the Department of
32 Fish and Wildlife to identify and implement any feasible operational means to minimize effects
33 on rearing habitat. Any such action will be developed in conjunction with the ongoing
34 monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-41a.

35 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall
36 operational framework of Alternative 8 without causing new significant adverse impacts on
37 other covered species, such means shall be implemented. If sufficient operational flexibility to
38 reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 8
39 operations, achieving further impact reduction pursuant to this mitigation measure would not
40 be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain
41 significant and unavoidable.

1 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon**
2 **(Winter-Run ESU)**

3 In general, Alternative 8 would reduce migration conditions for winter-run Chinook salmon relative
4 to the NAA.

5 **Upstream of the Delta**

6 ***Juveniles***

7 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November
8 juvenile emigration period. A reduction in flow may reduce the ability of juvenile winter-run to
9 migrate effectively down the Sacramento River. Flows under A8_LLT throughout the period would
10 be up to 26% lower than flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the*
11 *Fish Analysis*).

12 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
13 examined during the July through November winter-run juvenile emigration period (Appendix 11D,
14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
16 NAA and Alternative 8 in any month or water year type throughout the period at either location.

17 ***Adults***

18 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run
19 Chinook salmon upstream migration period (December through August). A reduction in flows may
20 reduce the olfactory cues needed by adult winter-run to return to natal spawning grounds in the
21 upper Sacramento River. Flows under A8_LLT would generally be similar to or greater than flows
22 under NAA during December through June and up to 18% lower during July and August. These
23 reductions would not be frequent or large enough to cause biologically meaningful effects to adult
24 migration conditions.

25 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
26 examined during the December through August winter-run upstream migration period (Appendix
27 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
28 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
29 between NAA and Alternative 8 in any month or water year type throughout the period at either
30 location.

31 **Through-Delta**

32 The effects on through-Delta migration were evaluated using the approach described in Alternative
33 1A, Impact AQUA-42.

34 ***Juveniles***

35 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows
36 (up to 15% in November averaged over all water year types) below the north Delta intakes
37 compared to baseline. Predation at the north Delta would be increased at the three new intake
38 structures. The north Delta export facilities would replace aquatic habitat and likely attract
39 piscivorous fish around the intake structures. The predation effects would be the same as those

described for Alternative 4, which also has three proposed intakes. Three NDD intakes would remove or modify habitat along that portion of the migration corridor (22 acres aquatic habitat and 11,900 linear feet of shoreline). Potential predation losses at the north Delta intakes, as estimated by the bioenergetics model, would be less than 2% compared to the annual production estimated for the Sacramento Valley (Table 11-4-11). A conservative assumption of 5% loss per intake would yield a cumulative loss of 11.6% of juvenile winter-run Chinook that reach the north Delta (Appendix 5F, *Biological Stressors*). This assumption is uncertain and represents an upper bound estimate. For further discussion of this topic see Impact AQUA-42 for Alternative 1A.

Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon, as modeled by the DPM under Alternative 8, averaged 33.5% across all years, 27.1% in drier years, and 44% in wetter years (Table 11-8-16). Modeled survival was similar to NAA.

Table 11-8-16. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon under Alternative 8

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A8_LLТ	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
Wetter Years	46.3	46.1	44.0	-2.3 (-5%)	-2.1 (-5%)
Drier Years	28.0	27.1	27.1	-0.9 (-3%)	0.0 (0%)
All Years	34.9	34.2	33.5	-1.4 (-4%)	-0.8 (-2%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

Adults

Attraction flow, as estimated by the percentage of Sacramento River water at Collinsville, decreased under Alternative 8 by no more than 10% during the December through June migration period for winter-run adults compared to NAA when climate change effects are factored in, and similar in other months (Table 11-8-17). Olfactory cues from the Sacramento River would be strong throughout the adult winter-run migration, representing 58–71% of Delta outflows. This topic is discussed in further detail in Impact AQUA-42 for Alternative 1A.

NEPA Effects: Reductions under Alternative 8 in upstream flows in the Sacramento River during the juvenile winter-run Chinook salmon migration period would cause the effect to be adverse.

Near-field effects of Alternative 8 NDD on winter-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating winter-run Chinook salmon, although there is high uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be directly correlated to the number of new intake structures in the river and thus the level of impacts associated with 3 new intakes would be considerably lower than those expected from having 5 new intakes in the river. Estimates within the effects analysis range from very low levels of effects (<2% mortality) to more significant effects (~ 12% mortality above current baseline levels). CM15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD.

1 Additionally, several pre-construction surveys to better understand how to minimize losses
2 associated with the three new intake structures will be implemented as part of the final NDD screen
3 design effort. Alternative 8 also includes an Adaptive Management Program and Real-Time
4 Operational Decision-Making Process to evaluate and make limited adjustments intended to provide
5 adequate migration conditions for winter-run Chinook. However, at this time, due to the absence of
6 comparable facilities anywhere in the lower Sacramento River/Delta, the degree of mortality
7 expected from near-field effects at the NDD remains highly uncertain.

8 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
9 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
10 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8
11 predict improvements in smolt condition and survival associated with increased access to the Yolo
12 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
13 of each of these factors and how they might interact and/or offset each other in affecting salmonid
14 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

15 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
16 all of these elements of BDCP operations and conservation measures to predict smolt migration
17 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
18 migration survival under Alternative 8 would be similar to those estimated for NAA. Further
19 refinement and testing of the DPM, along with several ongoing and planned studies related to
20 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
21 future. These efforts are expected to improve our understanding of the relationships and
22 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
23 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

24 Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 8 on
25 winter-run Chinook salmon migration conditions would be adverse.

26 This effect is a result of the specific reservoir operations and resulting flows associated with this
27 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
28 the extent necessary to reduce this impact to a level that is not adverse would fundamentally change
29 the alternative, thereby making it a different alternative than that which has been modeled and
30 analyzed. As a result, this effect is adverse and unavoidable because there is no feasible mitigation
31 available. Even so, proposed mitigation (Mitigation Measure AQUA-42a through AQUA-42c) has the
32 potential to reduce the severity of impact, although not necessarily to a not adverse level.

33 ***CEQA Conclusion:***

34 **Upstream of the Delta**

35 In general, Alternative 8 would reduce migration conditions for winter-run Chinook salmon relative
36 to Existing Conditions.

37 ***Juveniles***

38 Flows in the Sacramento River upstream of Red Bluff were examined during the July through
39 November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
40 *Analysis*). Flows under A8_LL1 for juvenile migrants would be up to 30% lower in all month except
41 July.

1 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
2 examined during the July through November winter-run juvenile emigration period (Appendix 11D,
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
4 *Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 8 in
5 July through October depending on month, water year type, and location.

6 **Adults**

7 Flows under A8_LLT during the December through August adult migration period would generally
8 be similar to flows under NAA except during August in which flows would be up to 19% lower
9 depending on water year type period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
10 *Analysis*).

11 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
12 examined during the December through August winter-run upstream migration period (Appendix
13 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
14 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
15 between Existing Conditions and Alternative 8 during December through June, except for a 5%
16 increase under Alternative 8 in May of wet years at Bend Bridge. Mean monthly water temperature
17 would be up to 13% higher under Alternative 8 in July through August depending on month, water
18 year type, and location.

19 **Through-Delta**

20 **Juveniles**

21 Under Alternative 8 through-Delta survival of emigrating juvenile winter-run Chinook salmon as
22 modeled by DPM similar to Existing Conditions (Table 11-8-16). Migrating juveniles would face
23 potential predation losses, reduced flows and lost aquatic habitat at the three intake structures.

24 **Adults**

25 During the adult winter-run upstream migration period from December to June, the proportion of
26 Sacramento River water in the Delta would be reduced 11% to 12% in March and April, and slightly
27 reduced 5% to 8% in most other months compared to existing conditions (Table 11-8-17).
28 Sacramento River flow olfactory cues would also still be strong since Sacramento River water would
29 still represent 58–71% of Delta water under Alternative 8.

1 **Table 11-8-17. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
 2 **San Joaquin River during the Adult Chinook Migration Period for Alternative 8**

Month	EXISTING CONDITIONS	NAA	A8_LL	EXISTING CONDITIONS vs. A8_LL	NAA vs. A8_LL
Sacramento River					
September	60	65	61	1	-4
October	60	68	64	4	-4
November	60	66	66	6	0
December	67	66	69	2	3
January	76	75	71	-5	-4
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	61	-8	-4
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	1.44	1.1	1.3
October	0.2	0.3	4.87	4.7	4.6
November	0.4	1.0	8.2	7.8	7.2
December	0.9	1.0	6.29	5.4	5.3
Shading indicates a difference of 10% or greater in flow proportion.					

3

4 **Summary of CEQA Conclusion**

5 Collectively, the impact would be significant because Alternative 8 would reduce juvenile migration
 6 conditions for winter-run Chinook salmon relative to Existing Conditions due to reductions in flows
 7 during the majority of the period. Flows in the Sacramento River upstream of Red Bluff would be
 8 similar to Existing Conditions for most of the adult migration period. Through-Delta migration
 9 conditions would also be similar to Existing Conditions.

10 This impact is a result of the specific reservoir operations and resulting flows associated with this
 11 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
 12 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
 13 change the alternative, thereby making it a different alternative than that which has been modeled
 14 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
 15 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
 16 severity of impact though not necessarily to a less-than-significant level.

17 **Mitigation Measure AQUA-42a: Following Initial Operations of CM1, Conduct Additional**
 18 **Evaluation and Modeling of Impacts to Winter-Run Chinook Salmon to Determine**
 19 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

20 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
 21 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the
 22 best available scientific information at the time and may prove to have been overstated. Upon
 23 the commencement of operations of CM1 and continuing through the life of the permit, the

1 BDCP proponents will monitor effects on migration habitat in order to determine whether such
2 effects would be as extensive as concluded at the time of preparation of this document and to
3 determine any potentially feasible means of reducing the severity of such effects. This mitigation
4 measure requires a series of actions to accomplish these purposes, consistent with the
5 operational framework for Alternative 8.

6 The development and implementation of any mitigation actions shall be focused on those
7 incremental effects attributable to implementation of Alternative 8 operations only.
8 Development of mitigation actions for the incremental impact on migration habitat attributable
9 to climate change/sea level rise are not required because these changed conditions would occur
10 with or without implementation of Alternative 8.

11 **Mitigation Measure AQUA-42b: Conduct Additional Evaluation and Modeling of Impacts**
12 **on Winter-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

13 Following commencement of initial operations of CM1 and continuing through the life of the
14 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
15 modified operations could reduce impacts to rearing habitat under Alternative 8. The analysis
16 required under this measure may be conducted as a part of the Adaptive Management and
17 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

18 **Mitigation Measure AQUA-42c: Consult with NMFS, USFWS, and CDFW to Identify and**
19 **Implement Potentially Feasible Means to Minimize Effects on Winter-Run Chinook**
20 **Salmon Migration Conditions Consistent with CM1**

21 In order to determine the feasibility of reducing the effects of CM1 operations on winter-run
22 Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the
23 Department of Fish and Wildlife to identify and implement any feasible operational means to
24 minimize effects on migration habitat. Any such action will be developed in conjunction with the
25 ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-
26 42a.

27 If feasible means are identified to reduce impacts on migration habitat consistent with the
28 overall operational framework of Alternative 8 without causing new significant adverse impacts
29 on other covered species, such means shall be implemented. If sufficient operational flexibility
30 to reduce effects on winter-run Chinook salmon habitat is not feasible under Alternative 8
31 operations, achieving further impact reduction pursuant to this mitigation measure would not
32 be feasible under this Alternative, and the impact on winter-run Chinook salmon would remain
33 significant and unavoidable.

34 **Restoration Measures (CM2, CM4–CM7, and CM10)**

35 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
36 differences in restoration-related fish effects are anticipated anywhere in the affected environment
37 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
38 restoration measures described for winter-run Chinook salmon under Alternative 1A (Impact
39 AQUA-43 through Impact AQUA-45) also appropriately characterize effects under Alternative 8.

40 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

1 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**
2 **(Winter-Run ESU)**

3 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**
4 **Salmon (Winter-Run ESU)**

5 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**
6 **ESU)**

7 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms
8 on winter-run Chinook salmon, are the same for Alternative 8, as those described under Alternative
9 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-44, the effects
10 of contaminants on winter-run Chinook salmon with respect to selenium, copper, ammonia and
11 pesticides would not be adverse. The effects of methylmercury on winter-run Chinook salmon are
12 uncertain.

13 *CEQA Conclusion:* All three of the impact mechanisms listed above would be at least slightly
14 beneficial, or less than significant, and no mitigation is required, for the reasons identified for
15 Alternative 1A.

16 **Other Conservation Measures (CM12–CM19 and CM21)**

17 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
18 differences in other conservation-related fish effects are anticipated anywhere in the affected
19 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
20 effects of other conservation measures described for winter-run Chinook salmon under Alternative
21 1A (Impact AQUA-46 through Impact AQUA-54) also appropriately characterize effects under
22 Alternative 8.

23 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

24 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**
25 **ESU) (CM12)**

26 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
27 **(Winter-Run ESU) (CM13)**

28 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**
29 **Run ESU) (CM14)**

30 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
31 **(Winter-Run ESU) (CM15)**

32 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**
33 **(CM16)**

34 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**
35 **(CM17)**

1 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**
2 **(CM18)**

3 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**
4 **ESU) (CM19)**

5 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
6 **(Winter-Run ESU) (CM21)**

7 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
8 adverse effect, or beneficial effects on winter-run Chinook salmon for NEPA purposes, for the
9 reasons identified for Alternative 1A.

10 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
11 less than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for
12 Alternative 1A, and no mitigation is required.

13 **Spring-Run Chinook Salmon**

14 **Construction and Maintenance of CM1**

15 The construction- and maintenance-related effects of Alternative 8 would be identical for all four
16 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the
17 discussion of these effects for winter-run Chinook.

18 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
19 **(Spring-Run ESU)**

20 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on spring-run
21 Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-55) except
22 that Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the
23 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
24 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
25 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
26 shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-
27 55, environmental commitments and mitigation measures would be available to avoid and minimize
28 potential effects, and the effect would not be adverse for spring-run Chinook salmon.

29 *CEQA Conclusion:* As described Alternative 1A, Impact AQUA-55, the impact of the construction of
30 water conveyance facilities on Chinook salmon would be less than significant except for
31 construction noise associated with pile driving. Potential pile driving impacts would be less than
32 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
33 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
34 less than significant.

35 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
36 **of Pile Driving and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise

Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Spring-Run ESU)

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-56, except that only three intakes would need to be maintained under Alternative 8 rather than five under Alternative 1A. As concluded in Alternative 1A, Impact AQUA-56, the effect would not be adverse for Chinook salmon.

CEQA Conclusion: As described Alternative 1A, Impact AQUA-56, the impact of the maintenance of water conveyance facilities on Chinook salmon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run ESU)

Water Exports from SWP/CVP South Delta Facilities

Alternative 8 would reduce overall entrainment of juvenile spring-run Chinook salmon at the south Delta export facilities by 94% compared to NAA (Table 11-8-18). Entrainment would be eliminated in critical years, and nearly eliminated in dry years (~30 fish entrained) under Alternative 8. In wet years, entrained would be reduced 88% (~81,400 fish; Table 11-8-18) compared to NAA. Pre-screen losses, typically attributed to predation, would be expected to decrease commensurate with decreased entrainment at the south Delta facilities.

The proportion of the annual spring-run Chinook population (assumed to be 750,000 juveniles approaching the Delta) lost at the south Delta facilities across all years averaged about 5% under the NAA, and would decrease to <0.5% under Alternative 8.

Table 11-8-18. Juvenile Spring-Run Chinook Salmon Annual Entrainment Index^a at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 8

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
Wet	-77,797 (-88%)	-81,425 (-88%)
Above Normal	-25,409 (-95%)	-28,477 (-96%)
Below Normal	-5,932 (-93%)	-6,727 (-94%)
Dry	-16,419 (-100%)	-17,612 (-100%)
Critical	-11,876 (-100%)	-10,255 (-100%)
All Years	-35,408 (-94%)	-37,018 (-94%)

Shading indicates 10% or greater increased entrainment.

^a Estimated annual number of fish lost, based on normalized data.

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 As described under Alternative 1A, potential entrainment of juvenile salmonids at the north Delta
3 intakes would be greater than baseline, but the effects would be minimal because the north Delta
4 intakes would have state-of-the-art screens to exclude juvenile fish.

5 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

6 Potential entrainment and impingement effects for juvenile salmonids would be minimal because
7 intakes would have state-of-the-art screens installed. In conclusion, Alternative 8 would reduce the
8 total numbers of juvenile Chinook salmon of all races entrained relative to NAA, which would be
9 slightly beneficial. Therefore, this effect would not be adverse and would provide some benefit to
10 the species because of the reductions in entrainment loss and mortality.

11 **NEPA Effects:** The overall effect on entrainment and entrainment-related predation on juvenile
12 Chinook salmon would not be adverse.

13 **CEQA Conclusion:** Alternative 8 would substantially reduce entrainment and associated pre-screen
14 losses of juvenile spring-run Chinook salmon by 94% at the south Delta facilities across all water
15 year types compared to Existing Conditions (Table 11-8-18). Overall, impacts on spring-run Chinook
16 salmon would be beneficial because of the reductions in entrainment loss at the south Delta facilities
17 and at agricultural diversions. No mitigation would be required.

18 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
19 **Chinook Salmon (Spring-Run ESU)**

20 In general, Alternative 8 would not affect the quantity and quality of spawning and egg incubation
21 habitat for spring-run Chinook salmon relative to the NAA.

22 **Sacramento River**

23 Flows in the Sacramento River upstream of Red Bluff during the spring-run Chinook salmon
24 spawning and incubation period (September through January) under A8_LLT would generally be
25 lower than those under NAA during September through November (up to 27% lower) (Appendix
26 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during December and
27 January would generally be greater than those under NAA, except during December in above normal
28 years (9%) and January in dry and critical years (7% and 11% lower, respectively).

29 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam
30 during the spring-run spawning and egg incubation period (September through January). Storage
31 volume at the end of September under A8_LLT would be similar to or greater than storage under
32 NAA in all water year types (Table 11-8-19).

1 **Table 11-8-19. Difference and Percent Difference in September Water Storage Volume (thousand**
2 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
Wet	-477 (-14%)	35 (1%)
Above Normal	-488 (-15%)	127 (5%)
Below Normal	-353 (-12%)	1 (0%)
Dry	-478 (-19%)	33 (2%)
Critical	-345 (-29%)	39 (5%)

3
4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
5 examined during the September through January spring-run Chinook salmon spawning period
6 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
7 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
8 temperature between NAA and Alternative 8 in any month or water year type throughout the period
9 at either location.

10 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
11 determined for each month (May through September At Bend Bridge and October through April at
12 Red Bluff) and year of the 82-year modeling period (Table 11-8-10). The combination of number of
13 days and degrees above the 56°F threshold were further assigned a “level of concern” as defined in
14 Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern
15 across all months and all 82 modeled years are presented in Table 11-8-12 for Bend Bridge and in
16 Table 11-8-20 for Red Bluff. There would be no difference in levels of concern between NAA and
17 Alternative 8 at Bend Bridge. At Red Bluff, there would be 3 (7%) and 4 (50%) fewer years with a
18 “red” and “yellow” level of concern, respectively, and 7 (35%) more with an “orange” level of
19 concern under Alternative 8.

20 **Table 11-8-20. Differences between Baseline and Alternative 8 Scenarios in the Number of Years**
21 **in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**
22 **Sacramento River at Red Bluff, October through April**

Level of Concern ^a	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
Red	33 (275%)	-3 (-7%)
Orange	14 (233%)	7 (35%)
Yellow	-5 (-38%)	-4 (-50%)
None	-42 (-82%)	0 (0%)

^a For definitions of levels of concern, see Table 11-8-11.

23
24 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge
25 during May through September and at Red Bluff during October through April. At Bend Bridge, total
26 degree-days under Alternative 8 would be up to 12% lower than those under NAA during May and
27 up to 34% higher during June through September (Table 11-8-13). At Red Bluff, total degree-days
28 under Alternative 8 would be up to 32% lower to those under NAA during November, March and
29 April and would be the same or similar during October and December through February (Table 11-
30 8-21).

1
2
3

Table 11-8-21. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River at Red Bluff, October through April

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLTT	NAA vs. A8_LLTT
October	Wet	994 (387%)	-175 (-12%)
	Above Normal	521 (200%)	44 (6%)
	Below Normal	823 (394%)	117 (13%)
	Dry	1,003 (204%)	-68 (-4%)
	Critical	931 (155%)	8 (1%)
	All	4,272 (235%)	-74 (-1%)
November	Wet	69 (6,900%)	-21 (-23%)
	Above Normal	29 (NA)	-32 (-52%)
	Below Normal	49 (NA)	1 (2%)
	Dry	136 (1,700%)	-15 (-9%)
	Critical	78 (1,950%)	-32 (-28%)
	All	361 (2,777%)	-99 (-21%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	10 (NA)	1 (11%)
	Above Normal	2 (NA)	-2 (-50%)
	Below Normal	9 (100%)	-12 (-40%)
	Dry	30 (214%)	-34 (-44%)
	Critical	27 (2,700%)	0 (0%)
	All	78 (325%)	-47 (-32%)
April	Wet	200 (174%)	-61 (-16%)
	Above Normal	66 (47%)	-163 (-44%)
	Below Normal	124 (157%)	-106 (-34%)
	Dry	157 (84%)	-163 (-32%)
	Critical	156 (1,300%)	5 (3%)
	All	703 (132%)	-488 (-28%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
2 Sacramento River under A8_LLT would be up to 38% greater than mortality under NAA (Table 11-8-
3 22). However, the absolute increase in the percent of spring-run population subject to mortality
4 would be 2% in all but below normal water years. Therefore, the increase in mortality from NAA to
5 A8_LLT, although relatively large in most years, would be negligible at an absolute scale to the
6 winter-run population.

7 **Table 11-8-22. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**
8 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	17 (166%)	2 (8%)
Above Normal	24 (179%)	2 (5%)
Below Normal	45 (378%)	16 (38%)
Dry	58 (294%)	1 (2%)
Critical	23 (31%)	1 (1%)
All	33 (146%)	4 (8%)

9
10 SacEFT predicts that there would be the percentage of years with good spawning availability,
11 measured as weighted usable area, under A8_LLT would increase relative to NAA (Table 11-8-23).
12 SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd
13 scour risk under A8_LLT relative to NAA. SacEFT predicts that there would be a 15% decrease in the
14 percentage of years with good (lower) egg incubation conditions under A8_LLT relative to NAA.
15 SacEFT predicts that there would be an 18% increase in the percentage of years with good (lower)
16 redd dewatering risk under A8_LLT relative to NAA.

17 **Table 11-8-23. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
18 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Spawning WUA	-12 (-17%)	9 (18%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-57 (-66%)	-5 (-15%)
Redd Dewatering Risk	-9 (-18%)	6 (18%)
Juvenile Rearing WUA	3 (14%)	3 (14%)
Juvenile Stranding Risk	-5 (-26%)	0 (0%)

WUA = Weighted Usable Area.

19
20 **Clear Creek**
21 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
22 (September through January) under A8_LLT would generally be similar to or greater than flows
23 under NAA, except in critical years during December (5% lower) (Appendix 11C, *CALSIM II Model*
24 *Results utilized in the Fish Analysis*).

25 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
26 comparing the magnitude of flow reduction each month over the incubation period compared to the

1 flow in September when spawning is assumed to occur. The greatest reduction in flows under
2 A8_LLT would be the same as that under NAA in all water year types (Table 11-8-24).

3 Water temperatures were not modeled in Clear Creek.

4 **Table 11-8-24. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
5 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
6 **January Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

7

8 **Feather River**

9 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)
10 where spring-run Chinook primarily spawn during September through January (Appendix 11C,
11 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would not differ from NAA
12 because minimum Feather River flows are included in the FERC settlement agreement and would be
13 met for all model scenarios.

14 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam
15 during the spring-run spawning and egg incubation period. Storage under A8_LLT would be greater
16 than storage under NAA in all water year types except below normal years (7% lower) (Table 11-8-
17 25). This indicates that the majority of reduction in storage volume would be due to climate change
18 rather than Alternative 8.

19 **Table 11-8-25. Difference and Percent Difference in September Water Storage Volume (thousand**
20 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-775 (-27%)	239 (13%)
Above Normal	-697 (-29%)	94 (6%)
Below Normal	-709 (-35%)	-100 (-7%)
Dry	-198 (-15%)	155 (15%)
Critical	-30 (-3%)	158 (20%)

21

22 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
23 comparing the magnitude of flow reduction each month over the egg incubation period compared to
24 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel

during October through January were identical for A8_LLT, and NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 8 on redd dewatering in the Feather River low-flow channel.

Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8 in any month or water year type throughout the period, except for a 6% increase in below normal years during September.

The percent of months exceeding the 56°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table 11-8-26). The percent of months exceeding the threshold under Alternative 8 would generally be lower (up to 20% lower on an absolute scale) than the percent under NAA during September through November and similar during the other two months.

Table 11-8-26. Differences between Baseline and Alternative 8 Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River above Thermalito Afterbay Exceed the 56°F Threshold, September through January

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
September	0 (0%)	1 (1%)	7 (8%)	25 (34%)	47 (115%)
October	62 (278%)	67 (900%)	54 (880%)	43 (1,750%)	40 (1,600%)
November	53 (2,150%)	41 (3,300%)	28 (2,300%)	22 (NA)	14 (NA)
December	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
NAA vs. A8_LLT					
September	0 (0%)	0 (0%)	0 (0%)	1 (1%)	5 (6%)
October	-2 (-3%)	9 (13%)	5 (9%)	-4 (-8%)	2 (6%)
November	-11 (-17%)	-17 (-29%)	-20 (-40%)	-10 (-31%)	-11 (-45%)
December	-2 (-67%)	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

Total degree-days exceeding 56°F were summed by month and water year type above Thermalito Afterbay (low-flow channel) during September through January (Table 11-8-27). Total degree-months would be higher under Alternative 8 than under NAA during September and October, lower under Alternative 8 than NAA during November and December, and the same between Alternative 8 and NAA during January.

1 **Table 11-8-27. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the Feather River above Thermalito Afterbay, September through January**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
September	Wet	37 (34%)	12 (9%)
	Above Normal	30 (70%)	20 (38%)
	Below Normal	81 (135%)	50 (55%)
	Dry	118 (171%)	30 (19%)
	Critical	66 (102%)	4 (3%)
	All	332 (96%)	116 (21%)
October	Wet	76 (1,520%)	-20 (-20%)
	Above Normal	46 (460%)	11 (24%)
	Below Normal	76 (1,086%)	22 (36%)
	Dry	65 (929%)	-15 (-17%)
	Critical	66 (825%)	25 (51%)
	All	327 (884%)	21 (6%)
November	Wet	31 (NA)	-25 (-45%)
	Above Normal	25 (833%)	0 (0%)
	Below Normal	39 (3,900%)	5 (14%)
	Dry	31 (NA)	-20 (-39%)
	Critical	33 (NA)	5 (18%)
	All	159 (3,975%)	-35 (-18%)
December	Wet	0 (NA)	-1 (-100%)
	Above Normal	0 (NA)	-1 (-100%)
	Below Normal	1 (NA)	-2 (-67%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	1 (NA)	-4 (-80%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4
 5 **NEPA Effects:** Based on these results, it is concluded that the effect would not be adverse because
 6 habitat would not be substantially reduced. Reservoir storage would increase at Shasta and Folsom
 7 Reservoirs. There would be no changes to flows in Clear Creek or the Feather River and water
 8 temperatures would not substantially change due to Alternative 8 in the Sacramento and Feather
 9 Rivers. Flows in the Sacramento River would be lower in some months, SacEFT predicts a 5%
 10 reduction in “good” egg incubation habitat, and the egg mortality predicts an increase in egg
 11 mortality in below normal water years. Regardless of these changes, the weight of evidence
 12 indicates that the effect would not be adverse.

1 **CEQA Conclusion:** In general, Alternative 8 would not affect the quantity and quality of spawning
2 and egg incubation habitat for spring-run Chinook salmon relative to Existing Conditions.

3 **Sacramento River**

4 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook
5 salmon spawning and incubation period (September through January). Flows under A8_LLT would
6 be generally lower than those under Existing Conditions during September through November (up
7 to 30% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under
8 A8_LLT during December and January would generally be similar to or greater than those under
9 Existing Conditions, except in above normal and dry years (8% and 6% lower).

10 Shasta Reservoir Storage volume at the end of September would be 12% to 29% lower under
11 A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-19).

12 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
13 examined during the September through January spring-run Chinook salmon spawning period
14 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
15 *utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 8 during September and
16 October would be 6% and 5% greater, respectively, than those under Existing Conditions, but not
17 different in other months during the period. At Red Bluff, temperatures under Alternative 8 during
18 October would be 5% greater than those under Existing Conditions, but would not be different in
19 other months during the period.

20 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
21 determined for each month (May through September At Bend Bridge and October through April at
22 Red Bluff) and year of the 82-year modeling period (Table 11-8-10). The combination of number of
23 days and degrees above the 56°F threshold were further assigned a “level of concern” as defined in
24 Table 11-8-11. Differences between baselines and Alternative 8 in the highest level of concern
25 across all months and all 82 modeled years are presented in Table 11-8-12 for Bend Bridge and in
26 Table 11-8-20 for Red Bluff. At Bend Bridge, there would be a 67% increase in the number of years
27 with a “red” level of concern under Alternative 8 relative to Existing Conditions. At Red Bluff, there
28 would be 275% and 233% increases in the number of years with “red” and “orange” levels of
29 concern under Alternative 8 relative to Existing Conditions.

30 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge
31 during May through September and at Red Bluff during October through April. At Bend Bridge, total
32 degree-days under Alternative 8 would be up to 144% to 328% higher than those under Existing
33 Conditions depending on the month (Table 11-8-13). At Red Bluff, total degree-days under
34 Alternative 8 would be 132% to 2,777% higher than those under Existing Conditions during
35 October, November, March, and April, and similar during December through February (Table 11-8-
36 21). The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in
37 the Sacramento River under A8_LLT would be 31% to 378% greater than mortality under Existing
38 Conditions, depending on water year type (Table 11-8-22).

39 SacEFT predicts that there would be a 17% decrease in the percentage of years with good spawning
40 availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table
41 11-8-23). SacEFT predicts that there would be no difference in the percentage of years with good
42 (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there
43 would be a 66% decrease in the percentage of years with good (lower) egg incubation conditions

1 under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be an 18% decrease
2 in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to Existing
3 Conditions. These results indicate that spawning and egg incubation conditions for spring-run
4 Chinook salmon would be poor relative to Existing Conditions.

5 **Clear Creek**

6 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
7 (September through January) under A8_LLT would nearly always be similar to or greater than flows
8 under Existing Conditions, except in critical years during September (19% lower) (Appendix 11C,
9 *CALSIM II Model Results utilized in the Fish Analysis*).

10 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
11 comparing the magnitude of flow reduction each month over the incubation period compared to the
12 flow in September when spawning is assumed to occur. The greatest reduction in flows under
13 A8_LLT would be 50% in critical water years, though reductions would occur in above normal and
14 dry years (percentages not calculated because dividing by zero) (Table 11-8-24).

15 Water temperatures were not modeled in Clear Creek.

16 **Feather River**

17 Flows in the Feather River low-flow channel under A8_LLT are not different from Existing
18 Conditions during the spring-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
19 *Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be
20 equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

21 Oroville Reservoir storage volume at the end of September would be 3% to 35% lower under
22 A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-25).

23 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
24 comparing the magnitude of flow reduction each month over the incubation period compared to the
25 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
26 during October through January were identical between A8_LLT and Existing Conditions (Appendix
27 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of
28 Alternative 8 on redd dewatering in the Feather River low-flow channel.

29 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream
30 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water*
31 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

32 Temperatures under Alternative 8 would be 7% to 11% greater than those under Existing
33 Conditions in all months and water year types during the period except wet and above normal years
34 in September.

35 The percent of months exceeding the 56°F temperature threshold in the Feather River above
36 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table
37 11-8-26). The percent of months exceeding the threshold under Alternative 8 would be similar to or
38 up to 67% higher (absolute scale) than under Existing Conditions during September through
39 November. There would be almost no difference in the percent of months exceeding the threshold
40 between Existing Conditions and Alternative 8 during December and January.

1 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
2 Afterbay (low-flow channel) during September through January (Table 11-8-27). Total degree-
3 months exceeding the threshold under Alternative 8 would be 96% to 3,975% greater than those
4 under Existing Conditions during September through November. There would be essentially no
5 difference in total degree-months between Existing Conditions and Alternative 8 during December
6 and January.

7 **Summary of CEQA Conclusion**

8 Collectively, the results of the Impact AQUA-58 CEQA analysis indicate that the difference between
9 the CEQA baseline and Alternative 8 could be significant because, when compared to the CEQA
10 baseline, the alternative could substantially reduce suitable spawning habitat and substantially
11 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth
12 above, which is directly related to the inclusion of climate change effects in Alternative 8. There
13 would be substantial decreases in reservoir storage in the Sacramento and Feather Rivers,
14 substantial increases in egg mortality predicted by the Reclamation egg mortality model, substantial
15 reductions in spawning and egg incubation conditions predicted by SacEFT, and reduced water
16 temperature conditions under Alternative 8.

17 These results are primarily caused by four factors: differences in sea level rise, differences in climate
18 change, future water demands, and implementation of the alternative. The analysis described above
19 comparing Existing Conditions to H3 does not partition the effect of implementation of the
20 alternative from those of sea level rise, climate change and future water demands using the model
21 simulation results presented in this chapter. However, the increment of change attributable to the
22 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
23 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
24 implementation period, which does include future sea level rise, climate change, and water
25 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
26 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
27 effect of the alternative from those of sea level rise, climate change, and water demands.

28 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
29 Conditions in the late long-term implementation period and H3 indicates that flows and reservoir
30 storage in the locations and during the months analyzed above would generally be similar between
31 future conditions without the BDCP (NAA) and H3. This indicates that the differences between
32 Existing Conditions and Alternative 8 found above would generally be due to climate change, sea
33 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
34 Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
35 conclusion, and therefore would not in itself result in a significant impact on spawning and egg
36 incubation habitat for spring-run Chinook salmon. This impact is found to be less than significant
37 and no mitigation is required.

38 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring- 39 Run ESU)**

40 In general, Alternative 8 would affect the quantity and quality of rearing habitat for fry and juvenile
41 spring-run Chinook salmon relative to the NAA.

1 **Sacramento River**

2 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
3 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
4 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during this period
5 would generally be similar to or greater than those under NAA, with few exceptions (up to 11%
6 lower).

7 May Shasta storage volume under A8_LLT would generally be lower compared to storage under NAA
8 in above and below normal water years by 6% and 10%, respectively, and similar to NAA in wet,
9 dry, and critical water years (Table 11-8-9).

10 Shasta storage volume at the end of September would be similar to or greater than storage under
11 NAA in all water year types (Table 11-8-19).

12 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
13 examined during the November through March spring-run Chinook salmon juvenile rearing period
14 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
15 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
16 temperature between NAA and Alternative 8 in any month or water year type throughout the period
17 at either location.

18 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under
19 A8_LLT would be 14% greater than that under NAA (Table 11-8-23). The percentage of years with
20 good (lower) juvenile stranding risk conditions under A8_LLT would be identical to that under NAA.

21 SALMOD predicts that spring-run smolt equivalent habitat-related mortality would be similar to
22 NAA (<5% difference).

23 **Clear Creek**

24 Flows in Clear Creek during the November through March rearing period under A8_LLT would
25 generally be similar to or greater than flows under NAA, with some exceptions, mostly in critical
26 years (5% to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 Water temperatures were not modeled in Clear Creek.

28 **Feather River**

29 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
30 channel) during November through June were reviewed to determine flow-related effects on larval
31 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
32 *Analysis*). Relatively constant flows in the low-flow channel throughout this period under A8_LLT
33 would not differ from those under NAA. In the high-flow channel, flows under A8_LLT would be
34 lower (up to 50% lower) during November, December, and June compared to NAA. Flows under
35 A8_LLT would be similar to or greater than flows under NAA during January through May.

36 May Oroville storage under A8_LLT would be 8% to 36% lower than storage under NAA in all water
37 years (Table 11-8-28).

38 September Oroville storage volume would generally be greater than under NAA, except in below
39 normal years (7% lower) (Table 11-8-25). Storage under A8_LLT would.

1 **Table 11-8-28. Difference and Percent Difference in May Water Storage Volume (thousand**
2 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-689 (-20%)	-643 (-19%)
Above Normal	-1,168 (-33%)	-1,012 (-30%)
Below Normal	-1,414 (-43%)	-1,061 (-36%)
Dry	-1,064 (-39%)	-544 (-24%)
Critical	-436 (-24%)	-120 (-8%)

3
4 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at
5 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix
6 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
7 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
8 between NAA and Alternative 8 in any month or water year type throughout the period at either
9 location.

10 The percent of months exceeding the 63°F temperature threshold in the Feather River above
11 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-8-29).
12 The percent of months exceeding the threshold under Alternative 8 would generally be similar to
13 the percent under NAA during May and July, similar to or lower (up to 12% lower on an absolute
14 scale) than the percent under NAA during May, and similar to or higher (up to 14% higher on an
15 absolute scale) than the percent under NAA during August.

16 **Table 11-8-29. Differences between Baseline and Alternative 8 Scenarios in Percent of Months**
17 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
18 **River above Thermalito Afterbay Exceed the 63°F Threshold, May through August**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
May	4 (NA)	2 (NA)	1 (NA)	0 (NA)	0 (NA)
June	31 (56%)	38 (141%)	37 (750%)	22 (NA)	6 (NA)
July	0 (0%)	0 (0%)	1 (1%)	27 (37%)	57 (144%)
August	0 (0%)	12 (14%)	42 (72%)	60 (213%)	60 (613%)
NAA vs. A8_LLT					
May	-2 (-40%)	0 (0%)	0 (0%)	0 (NA)	0 (NA)
June	-2 (-3%)	-12 (-16%)	-5 (-11%)	1 (6%)	1 (25%)
July	0 (0%)	0 (0%)	0 (0%)	1 (1%)	2 (3%)
August	0 (0%)	0 (0%)	1 (1%)	7 (9%)	14 (24%)

19
20 Total degree-months exceeding 63°F were summed by month and water year type above Thermalito
21 Afterbay (low-flow channel) during May through August (Table 11-8-30). Total degree-months
22 under Alternative 8 would be similar to those under NAA during May and up to 19% higher than
23 those under NAA during June through August.

1 **Table 11-8-30. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in**
 3 **the Feather River above Thermalito Afterbay, May through August**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	0 (NA)	-1 (-100%)
	Above Normal	0 (NA)	-1 (-100%)
	Below Normal	0 (NA)	0 (NA)
	Dry	3 (NA)	1 (50%)
	Critical	4 (NA)	0 (0%)
	All	7 (NA)	-1 (-13%)
June	Wet	32 (213%)	3 (7%)
	Above Normal	20 (143%)	3 (10%)
	Below Normal	28 (215%)	6 (17%)
	Dry	41 (178%)	8 (14%)
	Critical	26 (433%)	1 (3%)
	All	146 (206%)	20 (10%)
July	Wet	61 (51%)	20 (12%)
	Above Normal	29 (66%)	9 (14%)
	Below Normal	41 (69%)	13 (15%)
	Dry	55 (77%)	19 (18%)
	Critical	43 (83%)	11 (13%)
	All	229 (66%)	72 (14%)
August	Wet	61 (69%)	28 (23%)
	Above Normal	29 (116%)	11 (26%)
	Below Normal	49 (129%)	20 (30%)
	Dry	70 (175%)	17 (18%)
	Critical	43 (102%)	3 (4%)
	All	252 (108%)	79 (19%)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because habitat
 6 would be substantially reduced. Rearing habitat conditions in the Sacramento River would be
 7 reduced by Alternative 8 as a result of consistently lower flows. Further, flows in the Feather River,
 8 habitat conditions would be lower under Alternative 8 relative to the NAA due to substantially lower
 9 (8% to 36% lower) reservoir storage and substantially lower flows (up to 50% lower) during three
 10 months of eight-month rearing period that would increase exposure to higher water temperatures
 11 according to the NMFS threshold analyses. This effect is a result of the specific reservoir operations
 12 and resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir
 13 operations in order to alter the flows) to the extent necessary to reduce this effect to a level that is
 14 not adverse would fundamentally change the alternative, thereby making it a different alternative
 15 than that which has been modeled and analyzed. As a result, this would be an unavoidable adverse
 16 effect because there is no feasible mitigation available. Even so, proposed mitigation (Mitigation
 17 Measure AQUA-59a through AQUA-59c) has the potential to reduce the severity of impact, although
 18 not necessarily to a not adverse level.

1 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of rearing habitat
2 for fry and juvenile spring-run Chinook salmon relative to Existing Conditions.

3 **Sacramento River**

4 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
5 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
6 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November at
7 both locations under A8_LLT would be generally lower than those under Existing Conditions
8 (between 3 and 18% lower), while all other months would be similar to or greater than flows under
9 Existing Conditions, with some exceptions (up to 19% lower) (Appendix 11C, *CALSIM II Model*
10 *Results utilized in the Fish Analysis*).

11 Shasta Reservoir storage volume at the end of May under A8_LLT would be generally lower (8% to
12 21% lower) than Existing Conditions, in all water year types except wet years, in which storage
13 would be similar to Existing Conditions (Table 11-8-9). As reported in Impact AQUA-58, storage
14 volume at the end of September under A8_LLT would be 12% to 29% lower relative to Existing
15 Conditions, depending on water year type (Table 11-8-19).

16 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
17 examined during the November through March spring-run Chinook salmon juvenile rearing period
18 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
19 *utilized in the Fish Analysis*). At both locations, there would be no differences (<5%) in mean
20 monthly water temperature between Existing Conditions and Alternative 8.

21 SacEFT predicts that there would be a 17% decrease in the percentage of years with good spawning
22 availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table
23 11-8-23). SacEFT predicts that there would be no difference in the percentage of years with good
24 (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there
25 would be a 66% decrease in the percentage of years with good (lower) egg incubation conditions
26 under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be an 18% decrease
27 in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to Existing
28 Conditions.

29 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A8_LLT would be
30 31% lower than under Existing Conditions.

31 **Clear Creek**

32 Flows in Clear Creek during the November through March rearing period under A8_LLT would
33 nearly always be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM*
34 *II Model Results utilized in the Fish Analysis*).

35 Water temperatures were not modeled in Clear Creek.

36 **Feather River**

37 Relatively constant flows in the low-flow channel throughout the November through June period
38 under A8_LLT would not differ from those under Existing Conditions. In the high-flow channel, flows
39 under A8_LLT would be nearly always lower during June, November, and December (up to 44%
40 lower) relative to Existing Conditions, and always greater relative to Existing Conditions during
41 January through May.

1 May Oroville storage volume under A8_LLTT would be lower than Existing Conditions by 20% to 43%
2 throughout the year (Table 11-8-28).

3 As reported in Impact AQUA-58, September Oroville storage volume would be 15% to 35% lower
4 under A8_LLTT relative to Existing Conditions in all water years except critical years, in which storage
5 would be similar to Existing Conditions (Table 11-8-25).

6 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at
7 Thermalito Afterbay (high-flow channel) were evaluated during the November through June
8 juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation
9 Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 8
10 would be 5% to 9% greater than those under Existing Conditions during November through
11 February, but similar (<5% difference) during March through June.

12 The percent of months exceeding the 63°F temperature threshold in the Feather River above
13 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-8-29).
14 The percent of months exceeding the threshold under Alternative 8 would be similar to those under
15 Existing Conditions during May, but up to 613% greater during June through August.

16 Total degree-months exceeding 63°F were summed by month and water year type above Thermalito
17 Afterbay (low-flow channel) during May through August (Table 11-8-30). Total degree-months
18 under Alternative 8 would be similar to those under Existing Conditions during May, but 66% to
19 206% higher during June through August.

20 **Summary of CEQA Conclusion**

21 These results indicate that the impact would be significant because it has the potential to
22 substantially reduce the amount of suitable habitat. Spring-run Chinook salmon fry and juveniles
23 rear in both the high-flow and low-flow channels of the Feather River. Flows and water
24 temperatures in the low-flow channel would be unchanged by Alternative 8. However, flows in the
25 high-flow channel would be mostly lower by up to 77% during half of the fry and juvenile rearing
26 period. This frequency, duration, and magnitude of flow reduction is expected to have a significant
27 effect on rearing fry and juveniles. In addition, flows would be lower during parts of the rearing
28 period in the Sacramento River. This impact is a result of the specific reservoir operations and
29 resulting flows associated with this alternative. Applying mitigation (e.g., changing reservoir
30 operations in order to alter the flows) to the extent necessary to reduce this impact to a less-than-
31 significant level would fundamentally change the alternative, thereby making it a different
32 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
33 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation
34 that has the potential to reduce the severity of impact though not necessarily to a less-than-
35 significant level.

36 **Mitigation Measure AQUA-59a: Following Initial Operations of CM1, Conduct Additional 37 Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine 38 Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

39 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
40 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the
41 best available scientific information at the time and may prove to have been overstated. Upon
42 the commencement of operations of CM1 and continuing through the life of the permit, the

1 BDCP proponents will monitor effects on rearing habitat in order to determine whether such
2 effects would be as extensive as concluded at the time of preparation of this document and to
3 determine any potentially feasible means of reducing the severity of such effects. This mitigation
4 measure requires a series of actions to accomplish these purposes, consistent with the
5 operational framework for Alternative 8.

6 The development and implementation of any mitigation actions shall be focused on those
7 incremental effects attributable to implementation of Alternative 8 operations only.
8 Development of mitigation actions for the incremental impact on rearing habitat attributable to
9 climate change/sea level rise are not required because these changed conditions would occur
10 with or without implementation of Alternative 8.

11 **Mitigation Measure AQUA-59b: Conduct Additional Evaluation and Modeling of Impacts**
12 **on Spring-Run Chinook Salmon Rearing Habitat Following Initial Operations of CM1**

13 Following commencement of initial operations of CM1 and continuing through the life of the
14 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
15 modified operations could reduce impacts to rearing habitat under Alternative 8. The analysis
16 required under this measure may be conducted as a part of the Adaptive Management and
17 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

18 **Mitigation Measure AQUA-59c: Consult with NMFS, USFWS, and CDFW to Identify and**
19 **Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon**
20 **Rearing Habitat Consistent with CM1**

21 In order to determine the feasibility of reducing the effects of CM1 operations on spring-run
22 Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the
23 Department of Fish and Wildlife to identify and implement any feasible operational means to
24 minimize effects on rearing habitat. Any such action will be developed in conjunction with the
25 ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-
26 59a.

27 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall
28 operational framework of Alternative 8 without causing new significant adverse impacts on
29 other covered species, such means shall be implemented. If sufficient operational flexibility to
30 reduce effects on spring-run Chinook salmon habitat is not feasible under Alternative 8
31 operations, achieving further impact reduction pursuant to this mitigation measure would not
32 be feasible under this Alternative, and the impact on spring-run Chinook salmon would remain
33 significant and unavoidable.

34 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon**
35 **(Spring-Run ESU)**

36 **Upstream of the Delta**

37 In general, Alternative 8 would reduce migration conditions for spring-run Chinook salmon relative
38 to the NAA.

1 **Sacramento River**

2 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through
3 May juvenile Chinook salmon spring-run migration period. Flows under A8_LLT would generally
4 always be similar to or greater than flows under NAA, except during December in above normal
5 years (9% lower) and during January in dry and critical years (7% and 11% lower, respectively)
6 (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

7 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
8 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
10 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
11 NAA and Alternative 8 in any month or water year type throughout the period.

12 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through
13 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*
14 *Model Results utilized in the Fish Analysis*). Flows during April through June under A8_LLT would
15 nearly always be similar to or greater than flows under NAA except in dry years during June (9%
16 lower), but would be generally lower during July and August (up to 18% lower) (Appendix 11C,
17 *CALSIM II Model Results utilized in the Fish Analysis*).

18 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
19 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,
20 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
21 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
22 NAA and Alternative 8 in any month or water year type throughout the period.

23 **Clear Creek**

24 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
25 migration period under A8_LLT would generally be similar to or greater than flows under NAA, with
26 some exceptions (up to 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
27 *Analysis*).

28 Flows in Clear Creek during April through August under A8_LLT would nearly always be similar to
29 or greater than flows under NAA except in critical water years during April and June (8% lower for
30 both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Water temperatures were not modeled in Clear Creek.

32 **Feather River**

33 Flows in the Feather River at the confluence with the Sacramento River were examined during the
34 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
35 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during November and
36 December would nearly always be lower relative to NAA (up to 35% lower), and would always be
37 similar to or greater than NAA during January through May.

38 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
39 were examined during the November through May juvenile spring-run Chinook salmon migration
40 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
41 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water

1 temperature between NAA and Alternative 8 in any month or water year type throughout the
 2 period. Flows in the Feather River at the confluence with the Sacramento River were examined
 3 during the April through August adult spring-run Chinook salmon upstream migration period
 4 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during June, July, and
 5 August under A8_LLT would nearly always be lower than flows under NAA (up to 85% lower), and
 6 would always be similar to or greater than flows under NAA during April and May.

7 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
 8 were examined during the April through August adult spring-run Chinook salmon upstream
 9 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
 10 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperature would be
 11 higher (up to 6% higher depending on water year type) in July under Alternative 8 than under NAA.
 12 There would be no differences (<5%) in mean monthly water temperature between NAA and
 13 Alternative 8 in any other month or water year type throughout the period.

14 **Through-Delta**

15 The effects on through-Delta migration were evaluated using the approach described in Alternative
 16 1A, Impact AQUA-42.

17 **Juveniles**

18 Juvenile salmonids migrating down the Sacramento River would generally experience lower flows
 19 below the north Delta intakes compared to baseline. Predation and aquatic habitat loss at the north
 20 Delta would be increased at the three new intake structures, as described for Alternative 4.
 21 Estimated predation losses would range from less than 2% (bioenergetics model) (Table 11-4-11) to
 22 11.8% (cumulative loss based on a fixed 5% loss per intake) of annual juvenile production. The
 23 latter estimate is uncertain and represents an upper bound estimate. For further discussion of this
 24 topic see Impact AQUA-42 for Alternative 1A.

25 Through-Delta survival by emigrating juvenile spring-run Chinook salmon under Alternative 8
 26 (A8_LLT) would average 30.3% across all years, 25.3% in drier years, and 38.8% in wetter years
 27 (Table 11-8-31). Modeled survival was similar to NAA.

28 **Table 11-8-31. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon**
 29 **under Alternative 8**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A8	EXISTING CONDITIONS vs. A8	NAA vs. A8
Wetter Years	42.1	40.4	38.8	-3.3 (-8%)	-1.6 (-4%)
Drier Years	24.8	24.3	25.3	0.5 (2%)	1.0 (4%)
All Years	31.3	30.3	30.3	-0.9 (-3%)	0.0 (0%)

Note: Delta Passage Model results for survival to Chipps Island.
 Wetter = Wet and above normal water years (6 years).
 Drier = Below normal, dry and critical water years (10 years).

1 **Adults**

2 During the overall spring-run upstream migration from March–June, the proportion of Sacramento
3 River in the Delta would be reduced by 11–12% in March–April, and similar (<5% difference) in
4 May and June compared to NAA when climate change effects are incorporated (Table 11-8-32).
5 Furthermore, olfactory cues for spring-run adults would be strong, as the proportion of Sacramento
6 River under Alternative 8 would represent 58–67% of Delta outflows. This topic is discussed in
7 further detail in Impact AQUA-42 for Alternative 1A.

8 **Table 11-8-32. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
9 **San Joaquin River during the Adult Chinook Migration Period for Alternative 8**

Month	EXISTING CONDITIONS	NAA	A8_LL1	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
Sacramento River					
September	60	65	61	1	-4
October	60	68	64	4	-4
November	60	66	66	6	0
December	67	66	69	2	3
January	76	75	71	-5	-4
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	61	-8	-4
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	1.44	1.1	1.3
October	0.2	0.3	4.87	4.7	4.6
November	0.4	1.0	8.2	7.8	7.2
December	0.9	1.0	6.29	5.4	5.3

10

11 **NEPA Effects:** Upstream of the Delta, these results indicate that the impact would be adverse
12 because it has the potential to substantially reduce migration habitat conditions for spring-run
13 Chinook salmon and interfere with the movement of fish. Flows in the Feather River would be up to
14 35% lower under Alternative 8 during two of seven months of the juvenile migration period, and up
15 to 85% lower during three of five months of the adult upstream migration period in most water year
16 types relative to NAA. These effects could reduce successful migration and increase adult straying.
17 Because the majority of spring-run Chinook salmon spawn in the Feather River, this reduction in
18 flows would affect a large proportion of the spring-run population. There would be no reduction in
19 migration habitat conditions in the Sacramento River or Clear Creek. Near-field effects of Alternative
20 8 NDD on spring-run Chinook salmon related to impingement and predation associated with three
21 new intake structures could result in negative effects on juvenile migrating spring-run Chinook
22 salmon, although there is high uncertainty regarding the overall effects. It is expected that the level
23 of near-field impacts would be directly correlated to the number of new intake structures in the
24 river and thus the level of impacts associated with 3 new intakes would be considerably lower than
25 those expected from having 5 new intakes in the river. Estimates within the effects analysis range
26 from very low levels of effects (<1% mortality) to more significant effects (~ 12% mortality above

1 current baseline levels). CM15 would be implemented with the intent of providing localized and
2 temporary reductions in predation pressure at the NDD. Additionally, several pre-construction
3 surveys to better understand how to minimize losses associated with the three new intake
4 structures will be implemented as part of the final NDD screen design effort. Alternative 8 also
5 includes an Adaptive Management Program and Real-Time Operational Decision-Making Process to
6 evaluate and make limited adjustments intended to provide adequate migration conditions for
7 spring-run Chinook. However, at this time, due to the absence of comparable facilities anywhere in
8 the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the
9 NDD remains highly uncertain.

10 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
11 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
12 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8
13 predict improvements in smolt condition and survival associated with increased access to the Yolo
14 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
15 of each of these factors and how they might interact and/or offset each other in affecting salmonid
16 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

17 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
18 all of these elements of BDCP operations and conservation measures to predict smolt migration
19 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
20 migration survival under Alternative 8 would be similar to those estimated for NAA. Further
21 refinement and testing of the DPM, along with several ongoing and planned studies related to
22 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
23 future. These efforts are expected to improve our understanding of the relationships and
24 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
25 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

26 Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 8 on
27 spring-run Chinook salmon migration conditions would be adverse.

28 This effect is a result of the specific reservoir operations and resulting flows associated with this
29 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
30 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change
31 the alternative, thereby making it a different alternative than that which has been modeled and
32 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
33 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-60a through AQUA-
34 60c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
35 level.

36 ***CEQA Conclusion:***

37 **Upstream of the Delta**

38 In general, Alternative 8 would reduce migration conditions for spring-run Chinook salmon relative
39 to Existing Conditions.

40 ***Sacramento River***

41 Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-
42 run Chinook salmon migration period under A8_LL1T would generally be similar to or greater than

1 flows under Existing Conditions, except during December in above normal and dry years (8% and
2 6% lower, respectively) and wet years during May (8% lower, respectively) (Appendix 11C, *CALSIM*
3 *II Model Results utilized in the Fish Analysis*).

4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
5 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
8 Existing Conditions and Alternative 8 in any month or water year type throughout the period. Flows
9 in the Sacramento River upstream of Red Bluff were examined during the April through August
10 adult spring-run Chinook salmon upstream migration period. Flows under A8_LLT would generally
11 be lower than Existing Conditions during August (up to 19% lower) and similar to or greater than
12 Existing Conditions during the rest of the period, except in wet years during May (8% lower) and
13 below normal and critical years during July (11% and 10% lower, respectively).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
15 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
18 Existing Conditions and Alternative 8 during April through June. Mean monthly water temperatures
19 under Alternative 8 would be 5% and 7% greater relative to Existing Conditions during July and
20 August, respectively.

21 **Clear Creek**

22 Flows in Clear Creek were examined during the November through May juvenile Chinook salmon
23 spring-run migration period. Flows under A8_LLT would always be similar to or greater than flows
24 under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 Flows in Clear Creek were examined during the April through August adult spring-run Chinook
26 salmon upstream migration period. Flows under A8_LLT would nearly always be similar to or
27 greater than flows under Existing Conditions except during August in critical water years (17%
28 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 Water temperatures were not modeled in Clear Creek.

30 **Feather River**

31 Flows were examined for the Feather River at the confluence with the Sacramento River during the
32 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
33 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November and December under
34 A8_LLT would generally be lower than flows under Existing Conditions by up to 44%. Flows during
35 the rest of the period would always be similar to or greater than flows under Existing Conditions.

36 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
37 were examined during the November through May juvenile spring-run Chinook salmon migration
38 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
39 *Results utilized in the Fish Analysis*). Water temperatures under Alternative 8 would be 5% greater
40 than those under Existing Conditions in January, but similar during November and December and
41 February through May. Flows were examined for the Feather River at the confluence with the
42 Sacramento River during the April through August adult spring-run Chinook salmon upstream

1 migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during
2 April and May under A8_LLTP would always be similar to or greater than flows under Existing
3 Conditions, but flows during June through August under A8_LLTP would always be lower by up to
4 85% than flows under Existing Conditions.

5 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
6 were examined during the April through August adult spring-run Chinook salmon upstream
7 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
8 *Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 8
9 would be similar to those under Existing Conditions during April and May, but would be up to 9%
10 higher during June through August

11 **Through-Delta**

12 Through-Delta migration under Alternative 8 would be similar or slightly lower (3.3% lower in
13 wetter years, an 8% relative decrease) compared to Existing Conditions (Table 11-8-31). Based on
14 the proportion of Sacramento River flows, olfactory cues would be similar (<10% difference) to
15 Existing Conditions during most of the year, but reduced slightly (11–12%) in March, April, and July.
16 These months overlap with the migration periods for adult spring-run Chinook salmon. Sacramento
17 River flow olfactory cues would also still be strong since Sacramento River water would still
18 represent 54–71% of Delta water under Alternative 8. Because the impact under Alternative 1A was
19 determined to be small, the Alternative 8 impact on adult Chinook salmon upstream migration
20 through the Delta would also be small.

21 **Summary of CEQA Conclusion**

22 Collectively, these results indicate that the impact would be significant because it has the potential
23 to substantially reduce migration habitat conditions for spring-run Chinook salmon and interfere
24 with the movement of fish. Flows in the Feather River would be up to 35% lower under Alternative
25 8 during two of seven months of the juvenile migration period and up to 85% lower during three of
26 five months of the adult upstream migration period in most water year types relative to Existing
27 Conditions. This magnitude and frequency of these flow reductions would reduce the ability for
28 juveniles to move downstream towards the ocean and for adults to sense olfactory cues from natal
29 spawning areas in the Feather River. Both effects could reduce successful migration and increase
30 adult straying. Through-Delta migration under Alternative 8 would be similar or slightly greater
31 (0.5% more in drier years) compared to Existing Conditions, for juvenile spring-run Chinook
32 salmon. Sacramento River olfactory cues would still be strong and the flows generally increased
33 downstream of Rio Vista, so the impact under Alternative 8 would be similar or improved relative to
34 Alternative 1A. Because the impact under Alternative 1A was determined to be small, the Alternative
35 8 impact on adult Chinook salmon upstream migration through the Delta would also be small.

36 This impact is a result of the specific reservoir operations and resulting flows associated with this
37 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
38 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
39 change the alternative, thereby making it a different alternative than that which has been modeled
40 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
41 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
42 severity of impact though not necessarily to a less-than-significant level.

1 **Mitigation Measure AQUA-60a: Following Initial Operations of CM1, Conduct Additional**
2 **Evaluation and Modeling of Impacts to Spring-Run Chinook Salmon to Determine**
3 **Feasibility of Mitigation to Reduce Impacts to Migration Conditions**

4 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
5 significant and unavoidable adverse effects on migration habitat, this conclusion was based on
6 the best available scientific information at the time and may prove to have been overstated.
7 Upon the commencement of operations of CM1 and continuing through the life of the permit, the
8 BDCP proponents will monitor effects on migration habitat in order to determine whether such
9 effects would be as extensive as concluded at the time of preparation of this document and to
10 determine any potentially feasible means of reducing the severity of such effects. This mitigation
11 measure requires a series of actions to accomplish these purposes, consistent with the
12 operational framework for Alternative 8.

13 The development and implementation of any mitigation actions shall be focused on those
14 incremental effects attributable to implementation of Alternative 8 operations only.
15 Development of mitigation actions for the incremental impact on migration habitat attributable
16 to climate change/sea level rise are not required because these changed conditions would occur
17 with or without implementation of Alternative 8.

18 **Mitigation Measure AQUA-60b: Conduct Additional Evaluation and Modeling of Impacts**
19 **on Spring-Run Chinook Salmon Migration Conditions Following Initial Operations of CM1**

20 Following commencement of initial operations of CM1 and continuing through the life of the
21 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
22 modified operations could reduce impacts to migration habitat under Alternative 8. The analysis
23 required under this measure may be conducted as a part of the Adaptive Management and
24 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

25 **Mitigation Measure AQUA-60c: Consult with NMFS, USFWS, and CDFW to Identify and**
26 **Implement Potentially Feasible Means to Minimize Effects on Spring-Run Chinook Salmon**
27 **Migration Conditions Consistent with CM1**

28 In order to determine the feasibility of reducing the effects of CM1 operations on spring-run
29 Chinook salmon habitat, the BDCP proponents will consult with NMFS, USFWS and the
30 Department of Fish and Wildlife to identify and implement any feasible operational means to
31 minimize effects on migration habitat. Any such action will be developed in conjunction with the
32 ongoing monitoring and evaluation of habitat conditions required by Mitigation Measure AQUA-
33 60a.

34 If feasible means are identified to reduce impacts on migration habitat consistent with the
35 overall operational framework of Alternative 8 without causing new significant adverse impacts
36 on other covered species, such means shall be implemented. If sufficient operational flexibility
37 to reduce effects on spring-run Chinook salmon habitat is not feasible under Alternative 8
38 operations, achieving further impact reduction pursuant to this mitigation measure would not
39 be feasible under this Alternative, and the impact on spring-run Chinook salmon would remain
40 significant and unavoidable.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
3 differences in restoration-related fish effects are anticipated anywhere in the affected environment
4 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
5 restoration measures described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-
6 61 through Impact AQUA-63) also appropriately characterize effects under Alternative 8.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

8 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**
9 **(Spring-Run ESU)**

10 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**
11 **Salmon (Spring-Run ESU)**

12 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

13 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms
14 on spring-run Chinook salmon are the same for Alternative 8, as those described under Alternative
15 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-62, the effects
16 of contaminants on spring-run Chinook salmon with respect to selenium, copper, ammonia and
17 pesticides would not be adverse. The effects of methylmercury on spring-run Chinook salmon are
18 uncertain.

19 *CEQA Conclusion:* All three of the impact mechanisms listed above would be at least slightly
20 beneficial, or less than significant, for the reasons identified for Alternative 1A, and no mitigation is
21 required.

22 **Other Conservation Measures (CM12–CM19 and CM21)**

23 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
24 differences in other conservation-related fish effects are anticipated anywhere in the affected
25 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
26 effects of other conservation measures described for spring-run Chinook salmon under Alternative
27 1A (Impact AQUA-64 through Impact AQUA-72) also appropriately characterize effects under
28 Alternative 8.

29 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

30 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**
31 **ESU) (CM12)**

32 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
33 **(Spring-Run ESU) (CM13)**

34 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**
35 **Run ESU) (CM14)**

36 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
37 **(Spring-Run ESU) (CM15)**

1 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**
2 **(CM16)**

3 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**
4 **(CM17)**

5 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**
6 **(CM18)**

7 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**
8 **ESU) (CM19)**

9 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
10 **(Spring-Run ESU) (CM21)**

11 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
12 adverse effect, or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the
13 reasons identified for Alternative 1A.

14 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
15 less than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for
16 Alternative 1A, and no mitigation is required.

17 **Fall-/Late Fall–Run Chinook Salmon**

18 **Construction and Maintenance of CM1**

19 The construction- and maintenance-related effects of Alternative 8 would be identical for all four
20 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the
21 discussion of these effects for winter-run Chinook.

22 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
23 **(Fall-/Late Fall–Run ESU)**

24 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on fall-run/late
25 fall-run Chinook salmon would be similar to those described for Alternative 1A (Impact AQUA-73)
26 except that Alternative 8 would include three intakes compared to five intakes under Alternative 1A,
27 so the effects would be proportionally less under this alternative. This would convert about 7,450
28 lineal feet of existing shoreline habitat into intake facility structures and would require about 17.1
29 acres of dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet
30 of shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact
31 AQUA-73, environmental commitments and mitigation measures would be available to avoid and
32 minimize potential effects, and the effect would not be adverse for fall-run/late fall-run Chinook
33 salmon.

34 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-37, the impact of the construction of
35 water conveyance facilities on Chinook salmon would be less than significant except for
36 construction noise associated with pile driving. Potential pile driving impacts would be less than
37 Alternative 1A because only three intakes would be constructed rather than five. Implementation of

1 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
2 less than significant.

3 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
4 **of Pile Driving and Other Construction-Related Underwater Noise**

5 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

6 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
7 **and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

9 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
10 **(Fall-/Late Fall-Run ESU)**

11 *NEPA Effects:* The potential effects of the maintenance of water conveyance facilities under
12 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-38, except that
13 only three intakes would need to be maintained under Alternative 8 rather than five under
14 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-38, the effect would not be adverse for
15 Chinook salmon.

16 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance
17 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
18 would be required.

19 **Water Operations of CM1**

20 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**
21 **Fall-Run ESU)**

22 ***Water Exports from SWP/CVP South Delta Facilities***

23 ***Fall-Run***

24 Overall entrainment of juvenile fall-run Chinook salmon at the south Delta export facilities would be
25 reduced under Alternative 8 compared to NAA. Under Alternative 8, juvenile fall-run Chinook
26 salmon entrainment would be reduced by 92–93% (~51,000 fish) (Table 11-8-33) across all water
27 year types compared to NAA. As discussed for Alternative 1A, Impact AQUA-75, entrainment for fall-
28 run Chinook salmon would be highest in wet years and lowest in below normal years. The greatest
29 net reduction in juvenile fall-run Chinook salmon entrainment under Alternative 8 would occur in
30 wet years (~111,000–116,000 less fish, an 87% reduction), while entrainment in dry and critical
31 years would be virtually eliminated (fewer than 25 fish entrained). Pre-screen losses, typically
32 attributed to predation, would be expected to decrease commensurate with decreased entrainment
33 at the south Delta facilities.

34 The proportion of the annual juvenile fall-run population (assumed to be 23 million) lost at the
35 south Delta facilities is very low (<0.6%) under NAA, for all water year types, and reduced to
36 negligible levels under Alternative 8

1 **Table 11-8-33. Juvenile Fall-Run and Late Fall-Run Chinook Salmon Annual Entrainment Index^a at**
 2 **the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 8**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Fall-run Chinook Salmon		
Wet	-110,928 (-87%)	-111,105 (-87%)
Above Normal	-29,639 (-90%)	-30,113 (-90%)
Below Normal	-12,096 (-89%)	-12,456 (-89%)
Dry	-19,622 (-100%)	-21,270 (-100%)
Critical	-40,890 (-100%)	-35,712 (-100%)
All Years	-50,643 (-92%)	-50,699 (-92%)
Late Fall-Run Chinook Salmon		
Wet	-4,706 (-79%)	-4,620 (-78%)
Above Normal	-516 (-90%)	-501 (-89%)
Below Normal	-51 (-91%)	-47 (-90%)
Dry	-136 (-99%)	-120 (-99%)
Critical	-164 (-100%)	-151 (-100%)
All Years	-1,716 (-89%)	-1,635 (-88%)

Shading indicates 10% or greater increased entrainment.

^a Estimated annual number of fish lost, based on normalized data.

3

4 *Late Fall-Run*

5 Overall entrainment of juvenile late fall-run Chinook salmon at the south Delta export facilities
 6 would be reduced under Alternative 8 compared to NAA. Under Alternative 8, juvenile late fall-run
 7 Chinook salmon entrainment would be reduced by 88% (~1,600 fish) (Table 11-8-33) across all
 8 water year types compared to NAA. As discussed for Alternative 1A, Impact AQUA-75, entrainment
 9 for late fall-run Chinook salmon would be highest in wet years and lowest in below normal years.
 10 The greatest net reduction in juvenile late fall-run Chinook salmon entrainment under Alternative 8
 11 would occur in wet years (~111,000–116,000 less fish, an 87% reduction), while entrainment in dry
 12 and critical years would be eliminated.

13 The proportion of the annual juvenile fall-run population (assumed to be 1 million) lost at the south
 14 Delta facilities is very low (<0.6%) under NAA for all water year types, and reduced to negligible
 15 levels under Alternative 8.

16 **Water Exports from SWP/CVP North Delta Intake Facilities**

17 *Fall-Run*

18 As described for Alternative 1A, potential entrainment of juvenile salmonids at the north Delta
 19 intakes would be greater than baseline, but the effects would be minimal because the north Delta
 20 intakes would have state-of-the-art screens to exclude juvenile fish.

1 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

2 As described for Alternative 1A, potential entrainment and impingement effects for juvenile
3 salmonids would be minimal because intakes would have state-of-the-art screens installed.

4 **NEPA Effects:** In conclusion, Alternative 8 would reduce the total numbers of juvenile Chinook
5 salmon of all races entrained relative to NAA, which would be slightly beneficial. Therefore, this
6 effect would not be adverse and would likely provide some benefit to the species because of the
7 reductions in entrainment loss and mortality at the south Delta export facilities and at agricultural
8 diversions.

9 **CEQA Conclusion:** Entrainment and associated pre-screen losses of juvenile Chinook salmon at the
10 south Delta facilities would always be substantially reduced under Alternative 8 for all salmon races
11 and water year types compared to Existing Conditions. The reduction in entrainment would be a
12 beneficial impact (Table 11-8-33). Overall, impacts on juvenile fall-run and late fall-run Chinook
13 salmon would be beneficial because of the reductions in entrainment loss at the south Delta facilities
14 and at agricultural diversions. No mitigation would be required.

15 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
16 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

17 In general, Alternative 8 would not reduce the quantity and quality of spawning and egg incubation
18 habitat for fall-/late fall-run Chinook salmon relative to the NAA.

19 **Sacramento River**

20 *Fall-Run*

21 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-
22 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
23 *utilized in the Fish Analysis*). Flows under A8_LLТ would be lower than flows under NAA during
24 October and November (up to 24% lower). Flows during December through January under A8_LLТ
25 would generally be similar to or greater than flows under NAA except in above normal years during
26 December (9% lower) and dry and critical years during January (7% and 11% lower, respectively).

27 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning
28 and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir
29 storage would be similar to or greater under A8_LLТ relative to NAA in all water year types (Table
30 11-8-19).

31 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
32 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
33 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
34 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
35 between NAA and Alternative 8 in any month or water year type throughout the period.

36 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
37 increments was determined for each month during October through April and year of the 82-year
38 modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F
39 threshold were further assigned a "level of concern" as defined in Table 11-8-11. Differences
40 between baselines and Alternative 8 in the highest level of concern across all months and all 82
41 modeled years are presented in Table 11-8-20. There would be 7 (35%) more years with an

1 “orange” level of concern and 4 (50%) fewer years with a “yellow” level of concern under
2 Alternative 8 relative to NAA.

3 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
4 October through April. Total degree-days under Alternative 8 would be up to 32% lower to those
5 under NAA during November, March and April and would be the same or similar during October and
6 December through February (Table 11-8-21).The Reclamation egg mortality model predicts that
7 fall-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be lower than
8 or similar to mortality under NAA in all water year types (Table 11-8-34). Although there is an 8%
9 increase in mortality during below normal years, this is only a 2% increase of the fall-run Chinook
10 population in the Sacramento River and, therefore, would not affect the fall-run at a population level.
11 These results indicate that Alternative 8 would have negligible effects on fall-run Chinook salmon
12 egg mortality.

13 **Table 11-8-34. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
14 **Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	10 (98%)	0 (0%)
Above Normal	10 (92%)	-1 (-5%)
Below Normal	13 (120%)	2 (8%)
Dry	16 (109%)	-1 (-3%)
Critical	9 (31%)	-1 (-2%)
All	11 (82%)	-0.1 (-1%)

15
16 SacEFT predicts that there would be a 57% increase in the percentage of years with good spawning
17 availability for fall-run Chinook salmon, measured as weighted usable area, under A8_LLT relative to
18 NAA (Table 11-8-35). SacEFT predicts that there would be a 12% reduction in the percentage of
19 years with good (lower) redd scour risk under A8_LLT relative to NAA. SacEFT predicts that there
20 would be an increase in the percentage of years with good (lower) egg incubation conditions under
21 A8_LLT relative to NAA. SacEFT predicts that there would be a 22% increase in the percentage of
22 years with good (lower) redd dewatering risk under A8_LLT relative to NAA.

23 **Table 11-8-35. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
24 **for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Spawning WUA	7 (15%)	20 (57%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-20 (-21%)	5 (7%)
Redd Dewatering Risk	6 (22%)	6 (22%)
Juvenile Rearing WUA	-8 (-24%)	-15 (-38%)
Juvenile Stranding Risk	1 (3%)	12 (60%)

WUA = Weighted Usable Area.

25

1 *Late Fall-Run*

2 Sacramento River flows upstream of Red Bluff were examined for the February through May late
3 fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model*
4 *Results utilized in the Fish Analysis*). Flows under A8_LLT would nearly always be greater than or
5 similar to flows under NAA, except in wet years during May (8% lower).

6 Shasta Reservoir storage at the end of September would affect flows during the late fall-run
7 spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta
8 Reservoir storage would be similar to or greater than storage under NAA in all water year types
9 (Table 11-8-19).

10 The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the
11 Sacramento River under A8_LLT would be similar to mortality under NAA in all water years,
12 resulting in negligible changes in the late fall-run Chinook population (Table 11-8-36).

13 **Table 11-8-36. Difference and Percent Difference in Percent Mortality of Late Fall-Run Chinook**
14 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	3 (162%)	-1 (-15%)
Above Normal	2 (76%)	-3 (-39%)
Below Normal	3 (190%)	-1 (-22%)
Dry	4 (147%)	-1 (-12%)
Critical	3 (138%)	-0.1 (-3%)
All	3 (145%)	-1 (-18%)

15
16 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
17 February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix
18 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
19 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
20 between NAA and Alternative 8 in any month or water year type throughout the period.

21 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
22 increments was determined for each month during October through April and year of the 82-year
23 modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F
24 threshold were further assigned a “level of concern”, as defined in Table 11-8-11. Differences
25 between baselines and Alternative 8 in the highest level of concern across all months and all 82
26 modeled years are presented in Table 11-8-20. There would be 7 (35%) more and 4 (50%) fewer
27 years with a “red” and “yellow” level of concern, respectively, under Alternative 8 relative to NAA.

28 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
29 October through April. Total degree-days under Alternative 8 would be up to 32% lower to those
30 under NAA during November, March and April and would be the same or similar during October and
31 December through February (Table 11-8-21). SacEFT predicts that there would be 4%, 3%, and 2%
32 reductions in the percentage of years with good spawning availability, redd scour risk, and egg
33 incubation, respectively, for late fall-run Chinook salmon, measured as weighted usable area, under
34 A8_LLT relative to NAA (Table 11-8-37). SacEFT predicts that there would be no difference in the
35 percentage of years with good (low) redd dewatering risk under A8_LLT compared to NAA.

1 **Table 11-8-37. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
2 **for Late Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Spawning WUA	-6 (-12%)	-2 (-4%)
Redd Scour Risk	-8 (-10%)	-2 (-3%)
Egg Incubation	-2 (-2%)	-2 (-2%)
Redd Dewatering Risk	-5 (-8%)	0 (0%)
Juvenile Rearing WUA	-7 (-16%)	-25 (-40%)
Juvenile Stranding Risk	-23 (-32%)	3 (7%)

WUA = Weighted Usable Area.

3

4 **Clear Creek**

5 No water temperature modeling was conducted in Clear Creek.

6 *Fall-Run*

7 Clear Creek flows below Whiskeytown Reservoir were examined for the September through
8 February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
9 *Model Results utilized in the Fish Analysis*). Flows under A8_LLT would nearly always be similar to or
10 greater than flows under NAA, except in critical years during December (5% lower).

11 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
12 flow reduction each month over the incubation period compared to the flow in September when
13 spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during
14 September through February under A8_LLT would be in the same as the reduction under NAA for all
15 water year types (Table 11-8-38).

16 **Table 11-8-38. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
17 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
18 **February Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

19

1 **Feather River**

2 *Fall-Run*

3 Flows in the Feather River in the low-flow and high-flow channels were examined for the October
4 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,
5 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A8_LLT
6 would be identical to those under NAA. Flows in the high-flow channel under A8_LLT would nearly
7 always be lower than under NAA during October through December (up to 50% lower), but would
8 be similar to or greater than flows under NAA during January.

9 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
10 comparing the magnitude of flow reduction each month over the incubation period compared to the
11 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during
12 November through January were identical between A8_LLT and NAA (Appendix 11C, *CALSIM II*
13 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 8 on
14 redd dewatering in the Feather River low-flow channel.

15 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow
16 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October
17 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,
18 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
19 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
20 NAA and Alternative 8 in any month or water year type throughout the period at either location.

21 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley
22 was evaluated during October through April (Table 11-8-39). The percent of months exceeding the
23 threshold under Alternative 8 would similar to the percent under NAA during December through
24 February, but up to 41% lower (absolute scale) than the percent under NAA during the other
25 months of the spawning and egg incubation period.

1 **Table 11-8-39. Differences between Baseline and Alternative 8 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
 3 **River at Gridley Exceed the 56°F Threshold, October through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LL1					
October	2 (3%)	14 (16%)	23 (32%)	53 (130%)	67 (360%)
November	52 (1,400%)	31 (2,500%)	21 (NA)	12 (NA)	10 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	7 (100%)	6 (167%)	5 (400%)	1 (NA)	1 (NA)
April	-10 (-14%)	-5 (-9%)	1 (4%)	9 (50%)	9 (78%)
NAA vs. A8_LL1					
October	0 (0%)	0 (0%)	0 (0%)	5 (6%)	7 (10%)
November	-6 (-10%)	-9 (-21%)	-11 (-35%)	-6 (-33%)	4 (60%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-4 (-100%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-30 (-67%)	-19 (-65%)	-5 (-44%)	-6 (-83%)	-2 (-67%)
April	-30 (-33%)	-28 (-35%)	-41 (-56%)	-33 (-56%)	-19 (-48%)

NA = could not be calculated because the denominator was 0.

4

5 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during
 6 October through April (Table 11-8-40). Total degree-months would be similar between NAA and
 7 Alternative 8 for November through February, but 47% and 38% lower during March and April,
 8 respectively, and 8% higher for October.

1
2
3

Table 11-8-40. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at Gridley, October through April

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
October	Wet	106 (145%)	4 (2%)
	Above Normal	44 (100%)	8 (10%)
	Below Normal	68 (124%)	19 (18%)
	Dry	72 (136%)	1 (1%)
	Critical	60 (146%)	16 (19%)
	All	349 (131%)	47 (8%)
November	Wet	30 (NA)	-7 (-19%)
	Above Normal	21 (1,050%)	2 (10%)
	Below Normal	30 (3,000%)	9 (41%)
	Dry	24 (NA)	-7 (-23%)
	Critical	26 (2,600%)	8 (42%)
	All	130 (3,250%)	4 (3%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	-2 (-100%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	-2 (-100%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	-1 (-100%)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	-1 (-50%)
	All	1 (NA)	-2 (-67%)
March	Wet	2 (NA)	-3 (-60%)
	Above Normal	-1 (-100%)	-3 (-100%)
	Below Normal	6 (600%)	-15 (-68%)
	Dry	7 (175%)	-16 (-59%)
	Critical	17 (425%)	0 (0%)
	All	31 (310%)	-37 (-47%)
April	Wet	1 (7%)	-37 (-71%)
	Above Normal	-3 (-13%)	-30 (-60%)
	Below Normal	-7 (-18%)	-32 (-49%)
	Dry	17 (35%)	-24 (-27%)
	Critical	35 (121%)	4 (7%)
	All	106 (145%)	-119 (-38%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
2 Feather River under A8_LLT would be generally lower than mortality under NAA, except in below
3 normal years (49% greater) (Table 11-8-41). Although the relative increase in dry years is 12%, this
4 is only a 3% increase of the entire fall-run population in the Feather River. Therefore, the increase in
5 dry years would not affect Feather River fall-run Chinook salmon at a population level.

6 **Table 11-8-41. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
7 **Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	10 (697%)	-9 (-46%)
Above Normal	8 (712%)	-4 (-32%)
Below Normal	20 (1,144%)	7 (49%)
Dry	21 (967%)	3 (12%)
Critical	21 (438%)	-2 (-7%)
All	16 (737%)	-2 (-11%)

8

9 **American River**

10 *Fall-Run*

11 Flows in the American River at the confluence with the Sacramento River were examined during the
12 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
13 *Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be similar to or
14 greater than flows under NAA during all months with some exceptions (up to 33% lower).

15 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
16 comparing the magnitude of flow reduction each month over the incubation period compared to the
17 flow in October when spawning is assumed to occur. The greatest monthly reduction in American
18 River flows during October through January under A8_LLT would be of greater magnitude by up to
19 138% relative to the greatest reduction under NAA in all water years except wet and dry years
20 (Table 11-8-42).

21 **Table 11-8-42. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
22 **in Instream Flow in the American River at Nimbus Dam during the October through January**
23 **Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-26 (-119%)	-1 (-2%)
Above Normal	-65 (-216%)	-55 (-138%)
Below Normal	-75 (-388%)	-47 (-101%)
Dry	32 (68%)	29 (66%)
Critical	-16 (-30%)	-28 (-68%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

24

1 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
 2 during the October through January fall-run Chinook salmon spawning and egg incubation period
 3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
 4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
 5 temperature between NAA and Alternative 8 in any month or water year type throughout the
 6 period.

7 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
 8 Avenue Bridge was evaluated during November through April (Table 11-8-43). The percent of
 9 months exceeding the threshold under Alternative 8 would similar to that under NAA during
 10 December through February, but would be up to 53% lower (absolute scale) during November,
 11 March, and April.

12 **Table 11-8-43. Differences between Baseline and Alternative 8 Scenarios in Percent of Months**
 13 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**
 14 **River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
November	10 (22%)	5 (18%)	7 (55%)	10 (400%)	9 (700%)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	2 (20%)	2 (33%)	4 (150%)	0 (0%)	1 (NA)
April	-10 (-14%)	-10 (-16%)	-14 (-30%)	-6 (-19%)	-7 (-27%)
NAA vs. A8_LLT					
November	-37 (-40%)	-53 (-62%)	-53 (-72%)	-44 (-78%)	-31 (-76%)
December	-1 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-4 (-100%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
March	-35 (-70%)	-22 (-69%)	-10 (-62%)	-11 (-90%)	-4 (-75%)
April	-36 (-37%)	-41 (-44%)	-48 (-60%)	-46 (-64%)	-37 (-65%)
NA = could not be calculated because the denominator was 0.					

15
 16 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
 17 Avenue Bridge during November through April (Table 11-8-44). Total degree-months would be
 18 similar between NAA and Alternative 8 for all months.

1 **Table 11-8-44. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the American River at the Watt Avenue Bridge, November through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
November	Wet	76 (304%)	-6 (-6%)
	Above Normal	29 (264%)	-7 (-15%)
	Below Normal	40 (500%)	-3 (-6%)
	Dry	47 (362%)	-4 (-6%)
	Critical	29 (181%)	-9 (-17%)
	All	221 (303%)	-29 (-9%)
December	Wet	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	4 (NA)	2 (100%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	1 (NA)	1 (NA)
	Critical	4 (NA)	0 (0%)
	All	5 (NA)	1 (25%)
March	Wet	10 (500%)	-2 (-14%)
	Above Normal	9 (NA)	0 (0%)
	Below Normal	13 (433%)	2 (14%)
	Dry	21 (525%)	-4 (-14%)
	Critical	23 (230%)	3 (10%)
	All	76 (400%)	-1 (-1%)
April	Wet	57 (204%)	-1 (-1%)
	Above Normal	35 (159%)	1 (2%)
	Below Normal	38 (106%)	-3 (-4%)
	Dry	38 (50%)	-7 (-6%)
	Critical	29 (49%)	-6 (-6%)
	All	196 (89%)	-17 (-4%)

NA = could not be calculated because the denominator was 0.

4
 5 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
 6 American River under A8_LLТ would be similar to or lower than mortality under NAA in all water
 7 years (Table 11-8-45).

1 **Table 11-8-45. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
2 **Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
Wet	24 (161%)	1 (2%)
Above Normal	23 (215%)	0 (0%)
Below Normal	22 (181%)	0.3 (1%)
Dry	14 (83%)	-3 (-9%)
Critical	7 (35%)	-2 (-8%)
All	19 (125%)	-1 (-2%)

3

4 **Stanislaus River**

5 *Fall-Run*

6 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
7 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
8 *Model Results utilized in the Fish Analysis*). Flows under A8_LLТ would nearly always be similar to or
9 greater than flows under NAA, except in below normal years during December (9% lower). This
10 indicates that changes in flows in the future would be due to climate change and not Alternative 8.

11 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 8
12 throughout the October through January period (Appendix 11D, *Sacramento River Water Quality*
13 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

14 **San Joaquin River**

15 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
16 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
17 *utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to flows under NAA
18 throughout the period.

19 Water temperature modeling was not conducted in the San Joaquin River.

20 **Mokelumne River**

21 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
22 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
23 *utilized in the Fish Analysis*). Flows under Alternative 8 would be similar to flows under NAA
24 throughout the period.

25 Water temperature modeling was not conducted in the Mokelumne River.

26 **NEPA Effects:** Collectively, it is concluded that the effect would not be adverse because habitat
27 conditions are not substantially reduced. Flows would be reduced due to Alternative 8 in the
28 Sacramento River, but this would not translate into biological effects, as evidenced by results of
29 SacEFT and the Reclamation egg mortality model. Flows would be reduced in the Feather River, as
30 well, but water temperature conditions and egg mortality as predicted by the Reclamation egg
31 mortality model would not substantially change.

1 **CEQA Conclusion:** In general, Alternative 8 would not affect the quantity and quality of spawning
2 and egg incubation habitat for fall-/late fall-run Chinook salmon relative to Existing Conditions.

3 **Sacramento River**

4 *Fall-Run*

5 Flows in the Sacramento River upstream of Red Bluff were examined during the October through
6 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
7 *Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than
8 Existing Conditions during October and November (up to 23% lower) and generally similar to or
9 greater than flows under Existing Conditions during December and January, except in above normal
10 and dry years during December (8% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model*
11 *Results utilized in the Fish Analysis*).

12 Storage volume at the end of September would be 12% to 29% lower under A8_LLT relative to
13 Existing Conditions (Table 11-8-19).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
15 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
16 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
17 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
18 between Existing Conditions and Alternative 8 during the period, except during October, in which
19 temperatures would be 5% higher under Alternative 8.

20 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
21 increments was determined for each month during October through April and year of the 82-year
22 modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F
23 threshold were further assigned a “level of concern”, as defined in Table 11-8-11. Differences
24 between baselines and Alternative 8 in the highest level of concern across all months and all 82
25 modeled years are presented in Table 11-8-20. There would be 275% and 233% increases in the
26 number of years with “red” and “orange” levels of concern, respectively, under Alternative 8 relative
27 to Existing Conditions.

28 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
29 October through April. Total degree-days under Alternative 8 would be 132% to 2,777% higher than
30 those under Existing Conditions during October, November, March, and April, and would be similar
31 during December through February (Table 11-8-21). The Reclamation egg mortality model predicts
32 that fall-run Chinook salmon egg mortality in the Sacramento River under A8_LLT would be 31% to
33 120% greater than mortality under Existing Conditions, which is a 9% to 15% increase on an
34 absolute scale (Table 11-8-34).

35 SacEFT predicts that there would be a 15% increase in the percentage of years with good spawning
36 availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table
37 11-8-35). SacEFT predicts that there would be a 5% reduction in the percentage of years with good
38 (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there
39 would be a 21% decrease in the percentage of years with good (lower) egg incubation conditions
40 under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be a 22% increase in
41 the percentage of years with good (lower) redd dewatering risk under A8_LLT relative to Existing
42 Conditions.

1 *Late Fall-Run*

2 Flows in the Sacramento River upstream of Red Bluff were examined during the February through
3 May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
4 *Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be greater than or
5 similar to flows under Existing Conditions, except in wet years during May (8% lower).

6 Storage volume at the end of September would be 12% to 29% lower under A8_LLT relative to
7 Existing Conditions (Table 11-8-19).

8 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
9 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix
10 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
11 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
12 between Existing Conditions and Alternative 8 in any month or water year type throughout the
13 period.

14 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
15 increments was determined for each month during October through April and year of the 82-year
16 modeling period (Table 11-8-10). The combination of number of days and degrees above the 56°F
17 threshold were further assigned a “level of concern”, as defined in Table 11-8-11. Differences
18 between baselines and Alternative 8 in the highest level of concern across all months and all 82
19 modeled years are presented in Table 11-8-20. There would be 275% and 233% increases in the
20 number of years with “red” and “orange” levels of concern, respectively, under Alternative 8 relative
21 to Existing Conditions.

22 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
23 October through April. Total degree-days under Alternative 8 would be 132% to 2,777% higher than
24 those under Existing Conditions during October, November, March, and April, and would be similar
25 during December through February (Table 11-8-21).

26 The Reclamation egg mortality model predicts that late fall–run Chinook salmon egg mortality in the
27 Sacramento River under A8_LLT would be 76% to 190% greater than mortality under Existing
28 Conditions (Table 11-8-36). However, absolute differences in the percent of the late-fall population
29 subject to mortality would be negligible (<5%) in all years.

30 SacEFT predicts that there would be a 12% decrease in the percentage of years with good spawning
31 availability, measured as weighted usable area, under A8_LLT relative to Existing Conditions (Table
32 11-8-37). SacEFT predicts that there would be a 10% decrease in the percentage of years with good
33 (lower) redd scour risk under A8_LLT relative to Existing Conditions. SacEFT predicts that there
34 would be negligible difference in the percentage of years with good (lower) egg incubation
35 conditions under A8_LLT relative to Existing Conditions. SacEFT predicts that there would be an 8%
36 decrease in the percentage of years with good (lower) redd dewatering risk under A8_LLT relative
37 to Existing Conditions.

38 **Clear Creek**

39 No water temperature modeling was conducted in Clear Creek.

1 **Fall-Run**

2 Flows in Clear Creek below Whiskeytown Reservoir under A8_LLT during the September through
3 February fall-run spawning and egg incubation period would always be similar to or greater than
4 flows under Existing Conditions.

5 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
6 flow reduction each month over the incubation period compared to the flow in September when
7 spawning occurred. The greatest monthly reduction in Clear Creek flows during September through
8 February under A8_LLT would be similar to or lower than the reduction under Existing Conditions
9 in wet and below normal water years, but 27%, 67%, and 33% (absolute, not relative, differences)
10 greater in above normal, dry, and critical water years, respectively (Table 11-8-38).

11 **Feather River**

12 **Fall-Run**

13 Flows in the low-flow channel during October through January under A8_LLT would be identical to
14 those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
15 Flows in the high-flow channel under A8_LLT during October through December would always be
16 lower by up to 50% than flows under Existing Conditions, but would always be greater than flows
17 under Existing Conditions during January.

18 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
19 comparing the magnitude of flow reduction each month over the incubation period compared to the
20 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were
21 identical between A8_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in*
22 *the Fish Analysis*). Therefore, there would be no effect of Alternative 8 on redd dewatering in the
23 Feather River low-flow channel.

24 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow
25 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October
26 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,
27 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
28 *Fish Analysis*). Mean monthly water temperatures under Alternative 8 relative to Existing Conditions
29 would be 6% to 9% higher in the low-flow channel and 5% to 8% higher in the high-flow channel,
30 depending on month.

31 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley
32 was evaluated during October through April (Table 11-8-39). The percent of months exceeding the
33 threshold under Alternative 8 would similar to or up to 67% higher (absolute scale) than the
34 percent under Existing Conditions during all months except December through February, during
35 which there would be no difference in the percent of months exceeding the threshold.

36 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during
37 October through April (Table 11-8-40). Total degree-months under Alternative 8 would be 131% to
38 3,250% higher than total degree-months under Existing Conditions, except during December
39 through February, when there would be no differences. The Reclamation egg mortality model
40 predicts that fall-run Chinook salmon egg mortality in the Feather River under A8_LLT would be
41 438% to 1,144% greater than mortality under Existing Conditions (Table 11-8-41).

1 **American River**

2 *Fall-Run*

3 Flows in the American River at the confluence with the Sacramento River were examined during the
4 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
5 *Model Results utilized in the Fish Analysis*). Flows under A8_LLTP would generally be similar to or
6 greater than flows under Existing Conditions during October, but generally lower by up to 36% than
7 flows under Existing Conditions during November through January.

8 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
9 during the October through January fall-run Chinook salmon spawning and egg incubation period
10 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
11 *utilized in the Fish Analysis*). Mean monthly temperatures under Alternative 8 would be 5% to 12%
12 greater than those under Existing Conditions depending on month. The percent of months exceeding
13 the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated
14 during November through April (Table 11-8-43). The percent of months exceeding the threshold
15 under Alternative 8 would be up to 10% greater (absolute scale) than the percent under Existing
16 Conditions during November, up to 14% lower (absolute scale) during April, and similar to the
17 percent under Existing Conditions during December through March.

18 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
19 Avenue Bridge during November through April (Table 11-8-44). Total degree-months under
20 Alternative 8 would be 89% to 400% greater than total degree-months under Existing Conditions
21 during November, March and April and similar to total degree months under Existing Conditions
22 during December through February.

23 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
24 comparing the magnitude of flow reduction each month over the incubation period compared to the
25 flow in October when spawning is assumed to occur. The greatest monthly reduction in American
26 River flows during October through January under A8_LLTP would be up to 388% greater magnitude
27 than those under Existing Conditions in all years except dry (68% lower magnitude) (Table 11-8-
28 42).

29 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
30 American River under A8_LLTP would be 35% to 215% greater than mortality under Existing
31 Conditions (Table 11-8-45).

32 **Stanislaus River**

33 *Fall-Run*

34 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
35 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
36 *Model Results utilized in the Fish Analysis*). Flows under A8_LLTP would generally be lower than flows
37 under Existing Conditions throughout the period by up to 18%.

38 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were
39 examined during the October through January fall-run spawning and egg incubation period
40 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
41 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would not be

1 different from those under Existing Conditions during October, but 6% higher during November
2 through January.

3 ***San Joaquin River***

4 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
5 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
6 *utilized in the Fish Analysis*). Flows under Alternative 8 would be 5% lower than flows under Existing
7 Conditions during October, similar during November and December, and 6% greater during January.

8 Water temperature modeling was not conducted in the San Joaquin River.

9 ***Mokelumne River***

10 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
11 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
12 *utilized in the Fish Analysis*). Flows under Alternative 8 would be 5% and 9% lower than flows under
13 NAA during October and November, respectively, and 13% and 14% greater during December and
14 January, respectively.

15 Water temperature modeling was not conducted in the Mokelumne River.

16 **Summary of CEQA Conclusion**

17 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between
18 the CEQA baseline and Alternative 8 could be significant because, when compared to the CEQA
19 baseline, the alternative could substantially reduce suitable spawning habitat and substantially
20 reduce the number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth
21 above, which is directly related to the inclusion of climate change effects in Alternative 8. There
22 would be substantial decreases in reservoir storage in the Sacramento and Feather Rivers,
23 substantial flow reductions in the Feather, American, and Stanislaus Rivers, substantial increases in
24 egg mortality predicted by the Reclamation egg mortality model, substantial reductions in spawning
25 and egg incubation conditions predicted by SacEFT, and reduced water temperature conditions
26 under Alternative 8.

27 These results are primarily caused by four factors: differences in sea level rise, differences in climate
28 change, future water demands, and implementation of the alternative. The analysis described above
29 comparing Existing Conditions to H3 does not partition the effect of implementation of the
30 alternative from those of sea level rise, climate change and future water demands using the model
31 simulation results presented in this chapter. However, the increment of change attributable to the
32 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
33 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
34 implementation period, which does include future sea level rise, climate change, and water
35 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
36 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
37 effect of the alternative from those of sea level rise, climate change, and water demands.

38 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
39 Conditions in the late long-term implementation period and H3 indicates that flows and reservoir
40 storage in the locations and during the months analyzed above would generally be similar between
41 future conditions without the BDCP (NAA) and H3. This indicates that the differences between

1 Existing Conditions and Alternative 8 found above would generally be due to climate change, sea
2 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
3 Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
4 conclusion, and therefore would not in itself result in a significant impact on spawning and egg
5 incubation habitat for fall-/late fall-run Chinook salmon. This impact is found to be less than
6 significant and no mitigation is required.

7 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon**
8 **(Fall-/Late Fall-Run ESU)**

9 In general, Alternative 8 would not affect the quantity and quality of larval and juvenile rearing
10 habitat for fall-/late fall-run Chinook salmon relative to the NAA.

11 ***Sacramento River***

12 *Fall-Run*

13 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
14 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
15 *Analysis*). Flows in the Sacramento River upstream of Red Bluff under A8_LLT would nearly always
16 be greater than or similar to flows under NAA, except in dry and critical years during January (7%
17 and 11% lower, respectively).

18 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and
19 juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage
20 would be similar to or greater than storage under NAA in all water year types (Table 11-8-19).

21 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
22 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
23 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
24 There would be no differences (<5%) in mean monthly water temperature between NAA and
25 Alternative 8 in any month or water year type throughout the period. SacEFT predicts that there
26 would be a 38% decrease in the percentage of years with good juvenile rearing availability for fall-
27 run Chinook salmon, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-
28 35). SacEFT predicts that there would be a 60% increase in the percentage of years with “good”
29 (lower) juvenile stranding risk under A8_LLT relative to NAA.

30 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A8_LLT would be
31 similar to mortality under NAA.

32 *Late Fall-Run*

33 Sacramento River flows upstream of Red Bluff were examined for the late fall-run Chinook salmon
34 juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*
35 *Fish Analysis*). Flows during July under A8_LLT would be generally lower than those under NAA (up
36 to 13% lower). Flows during the rest of the period would be generally similar to or greater under
37 A8_LLT than under NAA, with some exceptions (up to 11% lower).

38 Shasta Reservoir storage at the end of September and May would affect flows during the late fall-
39 run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta

1 Reservoir storage would be similar to or greater than storage under NAA in all water year types
2 (Table 11-8-19).

3 As reported in Impact AQUA-40, May Shasta storage volume under A8_LLT would generally be lower
4 compared to storage under NAA in above and below normal water years by 6% and 10%,
5 respectively, and similar to NAA in wet, dry, and critical water years (Table 11-8-9).

6 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
7 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento
8 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
9 There would be no differences (<5%) in mean monthly water temperature between NAA and
10 Alternative 8 in any month or water year type throughout the period. SacEFT predicts that there
11 would be a 40% decrease in the percentage of years with good juvenile rearing availability for late
12 fall–run Chinook salmon, measured as weighted usable area, under A8_LLT relative to NAA (Table
13 11-8-37). SacEFT predicts that there would be an increase in the percentage of years with “good”
14 (lower) juvenile stranding risk under A8_LLT relative to NAA.

15 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A8_LLT would
16 be similar to mortality under NAA.

17 **Clear Creek**

18 No water temperature modeling was conducted in Clear Creek.

19 *Fall-Run*

20 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-
21 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
22 Analysis*). Flows under A8_LLT would generally be similar to flows under NAA, with few exceptions
23 (up to 8% lower).

24 **Feather River**

25 *Fall-Run*

26 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
27 channel) during December through June were reviewed to determine flow-related effects on larval
28 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
29 Analysis*). Relatively constant flows in the low-flow channel throughout this period under A8_LLT
30 would not differ from those under NAA. In the high-flow channel, flows under A8_LLT would be
31 generally lower (up to 50% lower) during December and June and generally similar to or greater
32 than flows under NAA during January through May.

33 As reported in Impact AQUA-59, May Oroville storage volume under A8_LLT would be 8% to 36%
34 lower than storage under NAA depending on water year type (Table 11-8-24).

35 As reported in Impact AQUA-58, September Oroville storage volume would be generally similar to or
36 greater than NAA, except in below normal years (7% lower) (Table 11-8-25).

37 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
38 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run
39 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*

1 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences
2 (<5%) in mean monthly water temperature between NAA and Alternative 8 in any month or water
3 year type throughout the period at either location.

4 **American River**

5 *Fall-Run*

6 Flows in the American River at the confluence with the Sacramento River were examined for the
7 January through May fall-run larval and juvenile rearing period (*Appendix 11C, CALSIM II Model*
8 *Results utilized in the Fish Analysis*). Flows under A8_LLTP would generally be greater relative to NAA
9 would generally be similar to or greater with few exceptions (up to 33% lower).

10 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
11 during the January through May fall-run Chinook salmon juvenile rearing period (*Appendix 11D,*
12 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
13 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
14 NAA and Alternative 8 in any month or water year type throughout the period.

15 **Stanislaus River**

16 *Fall-Run*

17 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
18 January through May fall-run larval and juvenile rearing period (*Appendix 11C, CALSIM II Model*
19 *Results utilized in the Fish Analysis*). Flows under A8_LLTP would be similar to flows under NAA
20 throughout the period, regardless of water year type.

21 Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA
22 and Alternative 8 throughout the January through May fall-run rearing period (*Appendix 11D,*
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
24 *Fish Analysis*).

25 **San Joaquin River**

26 Flows in the San Joaquin River at Vernalis for Alternative 8 are not different from those under NAA,
27 for the January through May fall-run larval and juvenile rearing period (*Appendix 11C, CALSIM II*
28 *Model Results utilized in the Fish Analysis*)

29 Water temperature modeling was not conducted in the San Joaquin River.

30 **Mokelumne River**

31 Flows in the Mokelumne River at the Delta for Alternative 8 are not different from those under NAA,
32 for the January through May fall-run larval and juvenile rearing period (*Appendix 11C, CALSIM II*
33 *Model Results utilized in the Fish Analysis*)

34 Water temperature modeling was not conducted in the Mokelumne River.

35 **NEPA Effects:** Taken together, these results indicate that the effect would not be adverse because it
36 does not have the potential to substantially reduce the amount of suitable habitat for fish. Flows and
37 water temperatures would generally be similar under Alternative 8 relative to the NEPA point of
38 comparison with few exceptions that would not rise to the level of adverse. SaccEFT predicts that

1 there would be a 38% and 40% reduction in years with good juvenile rearing habitat availability for
2 fall- and late fall–run Chinook salmon, respectively, although SacEFT also predicts a 60% increase in
3 years with good stranding risk conditions for fall-run Chinook salmon.

4 **CEQA Conclusion:** In general, Alternative 8 would not affect the quantity and quality of larval and
5 juvenile rearing habitat for fall-/late fall–run Chinook salmon relative to the Existing Conditions.

6 **Sacramento River**

7 *Fall-Run*

8 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
9 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
10 *Analysis*). Flows under A8_LLT would nearly always be greater than or similar to flows under
11 Existing Conditions, except in wet years during May (8% lower).

12 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 29%
13 lower under A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-19).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
15 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
16 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
17 There would be no differences (<5%) in mean monthly water temperature between Existing
18 Conditions and Alternative 8 in any month or water year type throughout the period. SacEFT
19 predicts that there would be an 24% decrease in the percentage of years with good juvenile rearing
20 availability for fall-run Chinook salmon, measured as weighted usable area, under A8_LLT relative to
21 Existing Conditions (Table 11-8-35). SacEFT predicts that the percentage of years with “good”
22 (lower) juvenile stranding risk under A8_LLT would be similar to that under Existing Conditions.

23 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A8_LLT would be
24 7% lower than mortality under Existing Conditions.

25 *Late Fall-Run*

26 Sacramento River flows upstream of Red Bluff were examined for the late fall–run Chinook salmon
27 juvenile March through July rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*
28 *Fish Analysis*). Flows during the period under A8_LLT would generally be similar to or greater than
29 those under Existing Conditions, with some exceptions (up to 12% lower).

30 As reported in] Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 29%
31 lower under A8_LLT relative to Existing Conditions, depending on water year type (Table 11-8-19).

32 As reported in Impact AQUA-40, Shasta Reservoir storage volume at the end of May under A8_LLT
33 would be generally lower than Existing Conditions (up to 21% lower) in all water years except wet,
34 in which storage would be similar between A8_LLT and Existing Conditions (Table 11-8-9).

35 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
36 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
37 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
38 There would be no differences (<5%) in mean monthly water temperature between Existing
39 Conditions and Alternative 8 in any month throughout the period, except for a 5% increase during
40 July. SacEFT predicts that there would be a 16% reduction in the percentage of years with good

1 juvenile rearing availability for late fall–run Chinook salmon, measured as weighted usable area,
2 under A8_LLT relative to Existing Conditions (Table 11-8-37). SacEFT predicts that there would be a
3 32% reduction in the percentage of years with “good” (lower) juvenile stranding risk under A8_LLT
4 relative to Existing Conditions.

5 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A8_LLT would
6 be similar (<5% difference) to mortality under Existing Conditions.

7 **Clear Creek**

8 No temperature modeling was conducted in Clear Creek.

9 *Fall-Run*

10 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-
11 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
12 *Analysis*). Flows under A8_LLT would always be similar to or greater than flows under Existing
13 Conditions for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 **Feather River**

15 *Fall-Run*

16 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
17 channel) during December through June were reviewed to determine flow-related effects on larval
18 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
19 *Analysis*). Relatively constant flows in the low-flow channel throughout the period under A8_LLT
20 would not differ from those under Existing Conditions. In the high-flow channel, flows under A8_LLT
21 would always be lower (up to 50% lower) during December and June, and always greater than flows
22 under Existing Conditions during the rest of the period.

23 As reported under Impact AQUA-59, May Oroville storage volume under A8_LLT would be lower
24 than Existing Conditions in all water year types (20% to 43% lower) (Table 11-8-28).

25 As reported in Impact AQUA-58, September Oroville storage volume would be 15% to 35% lower
26 under A8_LLT relative to Existing Conditions in all water year types except critical years, during
27 which storage would be similar to that under Existing Conditions (Table 11-8-25).

28 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
29 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run
30 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*
31 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean
32 monthly water temperatures under Alternative 8 would be 6% to 9% higher than those under
33 Existing Conditions during December through February, but not different from those under Existing
34 Conditions during March through June. In the high-flow channel, mean monthly water temperatures
35 under Alternative 8 would be 5% to 8% higher than those under Existing Conditions during
36 December through February, but not different from those under Existing Conditions during March
37 through June.

1 **American River**

2 *Fall-Run*

3 Flows in the American River at the confluence with the Sacramento River were examined for the
4 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
5 *Results utilized in the Fish Analysis*). Flows under A8_LLTP would generally be lower than flows under
6 Existing Conditions during January (up to 35% lower), and generally similar to or greater than flows
7 under Existing Conditions during the rest of the period with few exceptions (up to 32% lower).

8 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
9 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,
10 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
11 *Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% to 7% higher
12 than those under Existing Conditions in all months during the period except April, in which
13 temperatures would not differ between Alternative 8 and Existing Conditions.

14 **Stanislaus River**

15 *Fall-Run*

16 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
17 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
18 *Results utilized in the Fish Analysis*). Flows under A8_LLTP throughout the period would be nearly
19 always lower than flows under Existing Conditions, by up to 36%.

20 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
21 River were examined during the January through May fall-run Chinook salmon juvenile rearing
22 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
23 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would
24 be 6% higher than those under Existing Conditions in all months during the period.

25 **San Joaquin River**

26 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run
27 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*
28 *the Fish Analysis*). Flows under Alternative 8 would be similar to flows under Existing Conditions
29 throughout the period except during January, in which flows would be 6% greater under Alternative
30 8.

31 Water temperature modeling was not conducted in the San Joaquin River.

32 **Mokelumne River**

33 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook
34 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
35 *Analysis*). Mean monthly flows under Alternative 8 would be 14% and 12% greater than flows under
36 Existing Conditions during January and February, similar to flows under Existing Conditions during
37 March, and 8% to 12% lower than flows under Existing Conditions during April and May.

38 Water temperature modeling was not conducted in the Mokelumne River.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 8 could be significant because, when compared to the CEQA
4 baseline, the alternative could substantially reduce suitable rearing habitat, contrary to the NEPA
5 conclusion set forth above, which is directly related to the inclusion of climate change effects in
6 Alternative 8. There would be substantial changes in reservoir storage, flows, and water
7 temperatures in multiple waterways that will reduce the availability and quality of juvenile rearing
8 habitat for fall-/late fall-run Chinook salmon.

9 These results are primarily caused by four factors: differences in sea level rise, differences in climate
10 change, future water demands, and implementation of the alternative. The analysis described above
11 comparing Existing Conditions to H3 does not partition the effect of implementation of the
12 alternative from those of sea level rise, climate change and future water demands using the model
13 simulation results presented in this chapter. However, the increment of change attributable to the
14 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
15 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
16 implementation period, which does include future sea level rise, climate change, and water
17 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
18 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
19 effect of the alternative from those of sea level rise, climate change, and water demands.

20 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
21 Conditions in the late long-term implementation period and H3 indicates that flows and reservoir
22 storage in the locations and during the months analyzed above would generally be similar between
23 future conditions without the BDCP (NAA) and H3. This indicates that the differences between
24 Existing Conditions and Alternative 8 found above would generally be due to climate change, sea
25 level rise, and future demand, and not the alternative. As a result, the CEQA conclusion regarding
26 Alternative 8, if adjusted to exclude sea level rise and climate change, is similar to the NEPA
27 conclusion, and therefore would not in itself result in a significant impact on rearing habitat for fall-
28 /late fall-run Chinook salmon. This impact is found to be less than significant and no mitigation is
29 required.

30 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**
31 **(Fall-/Late Fall-Run ESU)**

32 In general, Alternative 8 would reduce migration conditions for fall-/late fall-run Chinook salmon
33 relative to the NAA.

34 **Upstream of the Delta**

35 ***Sacramento River***

36 ***Fall-Run***

37 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February
38 through May under A8_LLTT would nearly always be similar to or greater than those under NAA
39 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

40 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
41 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,

1 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
2 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
3 NAA and Alternative 8 in any month or water year type throughout the period.

4 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon
5 upstream migration period (September through October) under A8_LLT would generally be lower
6 than those under NAA throughout the period (up to 27% lower).

7 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
8 September through October adult fall-run Chinook salmon upstream migration period (Appendix
9 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
10 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
11 between NAA and Alternative 8 in any month or water year type throughout the period.

12 *Late Fall-Run*

13 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January
14 through March) under A8_LLT would nearly always be similar to or greater than flows under NAA,
15 except in dry and critical years during January (7% and 11% lower, respectively) (Appendix 11C,
16 *CALSIM II Model Results utilized in the Fish Analysis*).

17 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
18 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,
19 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
20 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
21 NAA and Alternative 8 in any month or water year type throughout the period.

22 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon
23 upstream migration period (December through February) under A8_LLT would generally be similar
24 to or greater than those under NAA, except in above normal years during December (9% lower) and
25 dry and critical years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II*
26 *Model Results utilized in the Fish Analysis*).

27 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
28 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,
29 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
30 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
31 NAA and Alternative 8 in any month or water year type throughout the period.

32 **Clear Creek**

33 Water temperature modeling was not conducted in Clear Creek.

34 *Fall-Run*

35 Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run
36 migrants during February through May. Flows under A8_LLT would generally be similar to or
37 greater than those under NAA, with few exceptions (up to 8% lower).

38 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon
39 upstream migration period (September through October) under A8_LLT would always be similar to

1 or greater than those under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
2 *Analysis*).

3 **Feather River**

4 *Fall-Run*

5 Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile
6 migration period (February through May) under A8_LLTT would always be similar to or greater than
7 flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
9 were examined during the February through May juvenile fall-run Chinook salmon migration period
10 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
11 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
12 temperature between NAA and Alternative 8 in any month or water year type throughout the
13 period.

14 Flows in the Feather River at the confluence with the Sacramento River during the September
15 through October fall-run Chinook salmon adult migration period under A8_LLTT would be lower by
16 up to 58% than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*
17 *utilized in the Fish Analysis*).

18 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
19 were examined during the September through October fall-run Chinook salmon adult upstream
20 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
21 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
22 mean monthly water temperature between NAA and Alternative 8 in any month or water year type
23 throughout the period.

24 **American River**

25 *Fall-Run*

26 Flows in the American River at the confluence with the Sacramento River were examined during the
27 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
28 *Model Results utilized in the Fish Analysis*). Flows under A8_LLTT during February through May would
29 generally be similar to or greater than flows under NAA in February, April, and May, except in
30 critical years during February (11% lower). Flows under A8_LLTT during March would generally be
31 lower by up to 14%.

32 Mean monthly water temperatures in the American River at the confluence with the Sacramento
33 River were examined during the February through May juvenile fall-run Chinook salmon migration
34 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
35 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
36 temperature between NAA and Alternative 8 in any month or water year type throughout the period.

37 Flows in the American River at the confluence with the Sacramento River were examined during the
38 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
39 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLTT would generally be similar
40 to or greater than those under NAA throughout the period, except during below normal and critical

1 years during September (16% and 10% lower, respectively) and below normal years during October
2 (10% lower).

3 Mean monthly water temperatures in the American River at the confluence with the Sacramento
4 River were examined during the September and October adult fall-run Chinook salmon upstream
5 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation
6 Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
7 mean monthly water temperature between NAA and Alternative 8 in any month or water year type
8 throughout the period.

9 **Stanislaus River**

10 *Fall-Run*

11 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
12 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II
13 Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to flows under NAA
14 throughout the period.

15 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
16 River were examined during the February through May juvenile fall-run Chinook salmon migration
17 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model
18 Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
19 temperature between NAA and Alternative 8 in any month or water year type throughout the
20 period.

21 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
22 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
23 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT would be similar to flows
24 under NAA throughout the period.

25 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
26 River were examined during the September and October adult fall-run Chinook salmon upstream
27 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation
28 Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
29 mean monthly water temperature between NAA and Alternative 8 in any month or water year type
30 throughout the period.

31 **San Joaquin River**

32 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
33 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
34 Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months and water
35 year types throughout the period.

36 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
37 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized
38 in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months
39 and water year types throughout the period.

40 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 Flows in the Mokelumne River at the Delta were examined during the February through May
3 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
4 *the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months and
5 water year types throughout the period.

6 Flows in the Mokelumne River at the Delta were examined during the September and October adult
7 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
8 *in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months
9 and water year types throughout the period. Flows under Alternative 8 would be similar to those
10 under NAA in all months and water year types throughout the period.

11 Water temperature modeling was not conducted in the Mokelumne River.

12 **Through Delta**

13 The effects on through-Delta migration were evaluated using the approach described in Alternative
14 1A, Impact AQUA-42.

15 **Sacramento River**

16 *Fall-Run*

17 *Juveniles*

18 Predation at the north Delta would be increased due to the installation of the three proposed
19 SWP/CVP water export facilities on the Sacramento River. Bioenergetics modeling with a median
20 predator density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a
21 predation loss of about 1.2% fall-run and 3.2% late fall-run population, as analyzed for Alternative 4
22 (Impact AQUA-78) (Appendix 5F, *Biological Stressors*). The overall effect of the predation and
23 habitat loss associated with the three intake structures is not considered substantial.

24 Through-Delta survival by emigrating fall-run Chinook salmon juveniles under Alternative 8
25 (A8_LLTT) would average 25% across all years, 22% in drier years, and 30% in wetter years (Table
26 11-8-46). Average survival across all years under Alternative 8 would be similar for the Sacramento
27 River compared to NAA. Survival would be slightly greater for the Mokelumne River (2.4% greater
28 survival, or 15% relative increase), particularly in wetter years (3.7% more). Overall, Alternative 8
29 would not have an adverse effect on fall-run Chinook salmon juvenile due to minor differences in
30 survival across all water years.

1 **Table 11-8-46. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**
2 **Alternative 8**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A8	EXISTING CONDITIONS vs. A8	NAA vs. A8
Sacramento River					
Wetter Years	34.5	31.1	30.4	-4.1 (-12%)	-0.7 (-2%)
Drier Years	20.6	20.8	21.6	1.0 (5%)	0.8 (4%)
All Years	25.8	24.7	24.9	-0.9 (-4%)	0.2 (1%)
Mokelumne River					
Wetter Years	17.2	15.7	19.4	2.3 (13%)	3.7 (24%)
Drier Years	15.6	15.9	17.6	2.0 (13%)	1.6 (10%)
All Years	16.2	15.9	18.3	2.1 (13%)	2.4 (15%)
San Joaquin River^a					
Note: Delta Passage Model results for survival to Chipps Island.					
Wetter = Wet and above normal water years (6 years).					
Drier = Below normal, dry and critical water years (10 years).					
^a DPM results are anomalous for Alternative 8 San Joaquin River.					

3

4 *Adults*

5 The adult fall-run migration extends from September–December. The proportion of Sacramento
6 River water in the Delta under Alternative 8 would be similar (<10% change) NAA throughout the
7 adult fall-run migration through the Delta (Table 11-8-47). The proportion of Sacramento River
8 under Alternative 8 would represent 61–69% of Delta outflows during this period, and would thus
9 still provide strong olfactory cues. This topic is further discussed in Impact AQUA-42 in Alternative
10 1A. Because the proportion of Sacramento River water in the Delta would not substantially change
11 during the peak adult migration period under Alternative 8, it would not have an adverse effect on
12 adult fall-run migration success through the Delta.

13 *Late Fall-Run*

14 *Juveniles*

15 Through-Delta survival by late fall–run Chinook salmon juveniles under Alternative 8 (A8_LLT)
16 would be similar to NAA.

17 *Adults*

18 The adult late fall–run migration is from November through March, peaking in January through
19 March. The proportion of Sacramento River water in the Delta would be similar to NAA, during the
20 adult migration period (Table 11-8-47).

1 ***San Joaquin River***

2 *Fall-Run*

3 *Juveniles*

4 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of
5 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.
6 There would be no flow changes associated with the Alternative 8. Although the Delta Passage
7 Model is used to estimate through-Delta survival for most Chinook salmon runs, it can be
8 problematic applying the DPM to San Joaquin River salmon for certain Alternatives and operations
9 scenarios with highly reduced south Delta exports (such as Alternatives 6A, 7, 8 and 9). These issues
10 are discussed further in Impact AQUA-78 under Alternative 6A. A qualitative assessment is more
11 appropriate given this modeling limitation. There is a beneficial effect of Alternative 8 to all San
12 Joaquin River basin fish due to positive Old and Middle River flows during migratory months
13 resulting in San Joaquin water moving westward and contributing to Delta outflow. This is expected
14 to decrease entrainment at South Delta facilities and reduce predation hotspots to promote greater
15 survival to Chipps Island. Furthermore under Alternative 8, entrainment and entrainment-related
16 mortality at the South Delta Facilities would be reduced.

17 Additionally, under Alternative 8, the reduction of entrainment at the South Delta Facilities would
18 alleviate one of the primary concerns related to potential Old and Middle River corridor habitat
19 restoration. Successful restoration in this area would be expected to enhance rearing habitat, food
20 availability, and overall salmonid fitness and survival.

21 *Adults*

22 Alternative 8 would slightly increase the proportion of San Joaquin River water in the Delta in
23 September through December by 7.6% compared to NAA (Table 11-8-47). The increase in the
24 proportion of San Joaquin River water in the Delta would be mainly due to the reduction in
25 Sacramento River flows in the Delta. The migration conditions for San Joaquin River basin fall-run
26 Chinook salmon under Alternative 8 would be similar to or slightly improved relative to NAA.
27 Alternative 8 would have no effect on the fall-run adult migration because flow levels and olfactory
28 cues would be effectively unchanged.

1 **Table 11-8-47. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
 2 **San Joaquin River during the Adult Chinook Migration Period for Alternative 8**

Month	EXISTING CONDITIONS			EXISTING CONDITIONS	
	NAA	A8_LL	vs. A8_LL	NAA vs. A8_LL	
Sacramento River					
September	60	65	61	1	-4
October	60	68	64	4	-4
November	60	66	66	6	0
December	67	66	69	2	3
January	76	75	71	-5	-4
February	75	72	67	-8	-5
March	78	76	67	-11	-9
April	77	75	65	-12	-10
May	69	65	61	-8	-4
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	1.4	1.1	1.3
October	0.2	0.3	4.9	4.7	4.6
November	0.4	1.0	8.2	7.8	7.2
December	0.9	1.0	6.3	5.4	5.3
Shading indicates greater than 10% reduction in the proportion of river flows.					

3

4 **NEPA Effects:** Upstream of the Delta, these results indicate that the impact would be adverse
 5 because it would substantially reduce migration conditions and interfere with the movement of fish.
 6 Flows during September and October in the Sacramento and Feather rivers would be lower in most
 7 water year types throughout the adult migration period under Alternative 8. However, there would
 8 be no other effects of Alternative 8 in these rivers and no effects in any other upstream waterway.

9 Near-field effects of Alternative 8 NDD on fall- and late fall-run Chinook salmon related to
 10 impingement and predation associated with three new intake structures could result in negative
 11 effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high
 12 uncertainty regarding the overall effects. It is expected that the level of near-field impacts would be
 13 directly correlated to the number of new intake structures in the river and thus the level of impacts
 14 associated with 3 new intakes would be considerably lower than those expected from having 5 new
 15 intakes in the river. Estimates within the effects analysis range from very low levels of effects (<1%
 16 mortality) to more significant effects (~ 13% mortality above current baseline levels). CM15 would
 17 be implemented with the intent of providing localized and temporary reductions in predation
 18 pressure at the NDD. Additionally, several pre-construction surveys to better understand how to
 19 minimize losses associated with the three new intake structures will be implemented as part of the
 20 final NDD screen design effort. Alternative 8 also includes an Adaptive Management Program and
 21 Real-Time Operational Decision-Making Process to evaluate and make limited adjustments intended
 22 to provide adequate migration conditions for fall- and late fall-run Chinook. However, at this time,
 23 due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the
 24 degree of mortality expected from near-field effects at the NDD remains highly uncertain.

1 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
2 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
3 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8
4 predict improvements in smolt condition and survival associated with increased access to the Yolo
5 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
6 of each of these factors and how they might interact and/or offset each other in affecting salmonid
7 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

8 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
9 all of these elements of BDCP operations and conservation measures to predict smolt migration
10 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
11 migration survival under Alternative 8 would be similar to those estimated for NAA. Further
12 refinement and testing of the DPM, along with several ongoing and planned studies related to
13 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
14 future. These efforts are expected to improve our understanding of the relationships and
15 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
16 around the potential effects of BDCP implementation on migration conditions for Chinook salmon.

17 Collectively, these results indicate that the effect of Alternative 8 would be adverse because it has
18 the potential to substantially migration conditions and interfere with the movement of fish
19 upstream of the Delta.

20 This effect is a result of the specific reservoir operations and resulting flows associated with this
21 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
22 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change
23 the alternative, thereby making it a different alternative than that which has been modeled and
24 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
25 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-78a through AQUA-
26 78c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
27 level.

28 **CEQA Conclusion:** In general, Alternative 8 would reduce migration conditions for fall-/late fall-run
29 Chinook salmon, relative to Existing Conditions.

30 **Upstream of the Delta**

31 ***Sacramento River***

32 *Fall-Run*

33 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February
34 through May under A8_LLT would nearly always be similar to or greater than those under Existing
35 Conditions, except in wet water years during May (8% lower) (Appendix 11C, *CALSIM II Model*
36 *Results utilized in the Fish Analysis*).

37 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
38 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,
39 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
40 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
41 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

1 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon
2 upstream migration period (September through October) under A8_LLT would generally be lower
3 than those under Existing Conditions throughout the period (up to 30% lower) (Appendix 11C,
4 *CALSIM II Model Results utilized in the Fish Analysis*).

5 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
6 September through October adult fall-run Chinook salmon upstream migration period (Appendix
7 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
8 *the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6% and 5%
9 greater than those under Existing Conditions during September and October, respectively.

10 *Late Fall–Run*

11 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall–run migrants (January
12 through March) under A8_LLT would always be similar to or greater than flows under Existing
13 Conditions (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
15 January through March juvenile late fall–run Chinook salmon emigration period (Appendix 11D,
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
18 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

19 Flows in the Sacramento River upstream of Red Bluff during the adult late fall–run Chinook salmon
20 upstream migration period (December through February) under A8_LLT would generally be similar
21 to or greater than those under Existing Conditions, except in above normal and dry years during
22 December (8% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the*
23 *Fish Analysis*).

24 **Clear Creek**

25 Water temperature modeling was not conducted in Clear Creek.

26 *Fall-Run*

27 Flows in Clear Creek below Whiskeytown Reservoir during the juvenile fall–run Chinook salmon
28 upstream migration period (February through May) under A8_LLT would be similar to or greater
29 than those under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results*
30 *utilized in the Fish Analysis*).

31 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall–run Chinook salmon
32 upstream migration period (September through October) under A8_LLT would nearly always be
33 similar to or greater than those under Existing Conditions, except in critical years during September
34 (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 **Feather River**

36 *Fall-Run*

37 Flows in the Feather River at the confluence with the Sacramento River during the fall–run juvenile
38 migration period (February through May) under A8_LLT would always be similar to or greater than
39 flows under (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
2 were examined during the February through May juvenile fall-run Chinook salmon migration period
3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
5 temperature between Existing Conditions and Alternative 8 in any month or water year type
6 throughout the period.

7 Flows in the Feather River at the confluence with the Sacramento River during the September
8 through October fall-run Chinook salmon adult migration period under A8_LLT would nearly always
9 be lower than flows under Existing Conditions (up to 37% lower).

10 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
11 were examined during the September through October fall-run Chinook salmon adult upstream
12 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
13 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under
14 Alternative 8 would be 5% greater than those under Existing Conditions during September and
15 October.

16 **American River**

17 *Fall-Run*

18 Flows in the American River at the confluence with the Sacramento River were examined during the
19 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
20 *Model Results utilized in the Fish Analysis*). Flows under A8_LLT during February through May would
21 generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to
22 32% lower).

23 Mean monthly water temperatures in the American River at the confluence with the Sacramento
24 River were examined during the February through May juvenile fall-run Chinook salmon migration
25 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
26 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would
27 be 5% and 7% higher than under Existing Conditions in February and March, respectively, and
28 during April and May there would be little difference (<5%).

29 Flows in the American River at the confluence with the Sacramento River were examined during the
30 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
31 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during September would
32 be 6% to 62% lower than flows under Existing Conditions. Flows under A8_LLT during October
33 would generally be similar to or greater than those under Existing Conditions, except in wet and dry
34 water years (9% and 19% lower, respectively).

35 Mean monthly water temperatures in the American River at the confluence with the Sacramento
36 River were examined during the September and October adult fall-run Chinook salmon upstream
37 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
38 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under
39 Alternative 8 would be 6% and 10% higher than those under Existing Conditions during September
40 and October, respectively.

1 **Stanislaus River**

2 *Fall-Run*

3 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
4 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
5 *Model Results utilized in the Fish Analysis*). Flows under A8_LLT would predominantly be lower than
6 flows under Existing Conditions, by up to 36%.

7 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
8 River were examined during the February through May juvenile fall-run Chinook salmon migration
9 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
10 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would
11 be 6% higher than those under Existing Conditions in every month of the period.

12 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
13 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
14 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during September would
15 generally be similar to flows under Existing Conditions, except during wet and critical years (17%
16 and 6% lower, respectively). Flows under A8_LLT during October would be 5% to 7% lower than
17 flows under Existing Conditions.

18 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
19 River were examined during the September and October adult fall-run Chinook salmon upstream
20 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
21 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under
22 Alternative 8 would be 6% higher than those under Existing Conditions during September but there
23 would be no difference in mean monthly water temperatures between Alternative 8 and Existing
24 Conditions during October.

25 **San Joaquin River**

26 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
27 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
28 *Analysis*). Flows under Alternative 8 would be similar to Existing Conditions but with lower flows in
29 two water years during February, and would be lower than Existing Conditions by up to 15% during
30 March, April and May.

31 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
32 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
33 *in the Fish Analysis*). Flows under Alternative 8 would be lower than Existing Conditions by up to
34 11% during both months.

35 Water temperature modeling was not conducted in the San Joaquin River.

36 **Mokelumne River**

37 Flows in the Mokelumne River at the Delta were examined during the February through May
38 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
39 *the Fish Analysis*). Flows under Alternative 8 would be similar to those under Existing Conditions
40 during February and March, but up to 18% lower than flows under Existing Conditions during April
41 and May.

1 Flows in the Mokelumne River at the Delta were examined during the September and October adult
2 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
3 *in the Fish Analysis*). Flows under Alternative 8 would be similar to those under NAA in all months
4 and water year types throughout the period. Flows under Alternative 8 would be up to 29% lower
5 than those under Existing Conditions depending on water year type.

6 Water temperature modeling was not conducted in the Mokelumne River.

7 **Through-Delta**

8 Predation at the north Delta would be increased due to the installation of the three proposed
9 SWP/CVP water export facilities on the Sacramento River. Bioenergetics modeling with a median
10 predator density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a
11 predation loss of about 1.2% fall-run and 3.2% late fall-run population, as analyzed for Alternative 4
12 (Impact AQUA-78). The overall effect of the predation and habitat loss associated with the three
13 intake structures is not considered substantial.

14 For fall-run Chinook salmon juveniles, DPM results show a small increase in survival from the
15 Mokelumne River (2.1% compared to Existing Conditions) and similar survival from the Sacramento
16 River under Alternative 8. Late fall-run Chinook survival was similar to Existing Conditions. The
17 impact on juvenile Chinook salmon migration through the Delta would not be substantial.

18 Based on the proportion of Sacramento River flows, olfactory cues would be similar (<10%
19 difference) to Existing Conditions during most of the year, but reduced slightly (11–12%) in March,
20 April, and July (Table 11-8-47). These months overlap with the migration periods for late fall-run
21 adult Chinook salmon. Sacramento River flow olfactory cues would also still be strong since
22 Sacramento River water would still represent 54–71% of Delta water under Alternative 8.

23 **Summary of CEQA Conclusion**

24 These results indicate that the impact would be significant because it has the potential to reduce
25 migration habitat and interfere with the movement of fish. Through-Delta migration conditions for
26 fall-/late fall-run Chinook salmon in the Sacramento and San Joaquin rivers would not be
27 substantially affected by Alternative 8 relative to Existing Conditions. In the Sacramento River,
28 Alternative 8 would not substantially reduce olfactory cues for Sacramento River Chinook salmon
29 and Mokelumne River flows would be slightly increased. Alternative 8 also would not substantially
30 increase predation and remove important instream habitat as the result of the presence of three
31 NDD structures. Through-Delta survival of emigrating juveniles would not be expected to be
32 reduced, compared to Existing Conditions. Therefore, it is concluded that the through-Delta impact
33 on the Sacramento River is less than significant and no mitigation would be required. In the San
34 Joaquin River, because of similar and olfactory attraction cues, the impact of Alternative 8 on fall-run
35 Chinook salmon migration would be less than significant and no mitigation would be required.

36 Flows in all waterways upstream of the Delta except Clear Creek under Alternative 8 would be lower
37 than those under Existing Conditions during one or both months of the September through October
38 adult migration period. These flow reductions would reduce the ability of fall-run Chinook salmon
39 adult migrants to sense olfactory cues from their natal spawning grounds, potentially delaying or
40 preventing them from reaching these spawning grounds. In addition, temperatures would be
41 slightly, but consistently, higher in the Sacramento, Feather, American, and Stanislaus Rivers under
42 Alternative 8.

1 This impact is a result of the specific reservoir operations and resulting flows associated with this
2 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
3 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
4 change the alternative, thereby making it a different alternative than that which has been modeled
5 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
6 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
7 severity of impact though not necessarily to a less-than-significant level.

8 **Mitigation Measure AQUA-78a: Following Initial Operations of CM1, Conduct Additional**
9 **Evaluation and Modeling of Impacts to Fall-/Late Fall-Run Chinook Salmon to Determine**
10 **Feasibility of Mitigation to Reduce Impacts to Rearing Habitat**

11 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
12 significant and unavoidable adverse effects on migration conditions, this conclusion was based
13 on the best available scientific information at the time and may prove to have been overstated.
14 Upon the commencement of operations of CM1 and continuing through the life of the permit, the
15 BDCP proponents will monitor effects on rearing habitat in order to determine whether such
16 effects would be as extensive as concluded at the time of preparation of this document and to
17 determine any potentially feasible means of reducing the severity of such effects. This mitigation
18 measure requires a series of actions to accomplish these purposes, consistent with the
19 operational framework for Alternative 8.

20 The development and implementation of any mitigation actions shall be focused on those
21 incremental effects attributable to implementation of Alternative 8 operations only.
22 Development of mitigation actions for the incremental impact on rearing habitat attributable to
23 climate change/sea level rise are not required because these changed conditions would occur
24 with or without implementation of Alternative 8.

25 **Mitigation Measure AQUA-78b: Conduct Additional Evaluation and Modeling of Impacts**
26 **on Fall-/Late Fall-Run Chinook Salmon Migration Conditions Following Initial Operations**
27 **of CM1**

28 Following commencement of initial operations of CM1 and continuing through the life of the
29 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
30 modified operations could reduce impacts to rearing habitat under Alternative 8. The analysis
31 required under this measure may be conducted as a part of the Adaptive Management and
32 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

33 **Mitigation Measure AQUA-78c: Consult with NMFS, USFWS, and CDFW to Identify and**
34 **Implement Potentially Feasible Means to Minimize Effects on Fall-/Late Fall-Run Chinook**
35 **Salmon Migration Conditions Consistent with CM1**

36 In order to determine the feasibility of reducing the effects of CM1 operations on steelhead
37 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
38 Wildlife to identify and implement any feasible operational means to minimize effects on rearing
39 habitat. Any such action will be developed in conjunction with the ongoing monitoring and
40 evaluation of habitat conditions required by Mitigation Measure AQUA-78a.

1 If feasible means are identified to reduce impacts on migration conditions consistent with the
2 overall operational framework of Alternative 8 without causing new significant adverse impacts
3 on other covered species, such means shall be implemented. If sufficient operational flexibility
4 to reduce effects on fall-/late fall-run Chinook salmon migration conditions is not feasible under
5 Alternative 8 operations, achieving further impact reduction pursuant to this mitigation
6 measure would not be feasible under this Alternative, and the impact on fall-/late fall-run
7 Chinook salmon would remain significant and unavoidable.

8 **Restoration Measures (CM2, CM4–CM7, and CM10)**

9 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
10 differences in restoration-related fish effects are anticipated anywhere in the affected environment
11 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
12 restoration measures described for fall- and late fall-run Chinook salmon under Alternative 1A
13 (Impact AQUA-79 through Impact AQUA-81) also appropriately characterize effects under
14 Alternative 8.

15 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

16 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon** 17 **(Fall-/Late Fall–Run ESU)**

18 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook** 19 **Salmon (Fall-/Late Fall–Run ESU)**

20 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–** 21 **Run ESU)**

22 *NEPA Effects:* Detailed discussions regarding the potential effects of these three impact mechanisms
23 on fall- and late fall-run Chinook salmon are the same for Alternative 8, as those described under
24 Alternative 1A. The effects would not be adverse, and generally beneficial. Specifically for AQUA-80,
25 the effects of contaminants on fall- and late fall-run Chinook salmon with respect to selenium,
26 copper, ammonia and pesticides would not be adverse. The effects of methylmercury on fall- and
27 late fall-run Chinook salmon are uncertain.

28 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or
29 less than significant, and no mitigation is required.

30 **Other Conservation Measures (CM12–CM19 and CM21)**

31 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
32 differences in other conservation-related fish effects are anticipated anywhere in the affected
33 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
34 effects of other conservation measures described for fall- and late fall-run Chinook salmon under
35 Alternative 1A (Impact AQUA-82 through Impact AQUA-90) also appropriately characterize effects
36 under Alternative 8.

37 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

38 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–** 39 **Run ESU) (CM12)**

1 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
2 **(Fall-/Late Fall-Run ESU) (CM13)**

3 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-**
4 **/Late Fall-Run ESU) (CM14)**

5 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
6 **(Fall-/Late Fall-Run ESU) (CM15)**

7 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-**
8 **Run ESU) (CM16)**

9 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run**
10 **ESU) (CM17)**

11 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run**
12 **ESU) (CM18)**

13 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late**
14 **Fall-Run ESU) (CM19)**

15 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
16 **(Fall-/Late Fall-Run ESU) (CM21)**

17 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
18 adverse effect, or beneficial effects on fall and late fall-run Chinook salmon for NEPA purposes, for
19 the reasons identified for Alternative 1A.

20 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
21 less than significant, or beneficial on fall and late fall-run Chinook salmon, for the reasons identified
22 for Alternative 1A, and no mitigation is required.

23 **Steelhead**

24 **Construction and Maintenance of CM1**

25 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

26 *NEPA Effects:* The potential effects of construction of the water conveyance facilities on steelhead
27 would be similar to those described for Alternative 1A (Impact AQUA-91) except that Alternative 8
28 would include three intakes compared to five intakes under Alternative 1A, so the effects would be
29 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
30 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
31 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
32 would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-91,
33 environmental commitments and mitigation measures would be available to avoid and minimize
34 potential effects, and the effect would not be adverse for steelhead.

35 *CEQA Conclusion:* As described in for Alternative 1A, Impact AQUA-91, the impact of the
36 construction of water conveyance facilities on steelhead would be less than significant except for

1 construction noise associated with pile driving. Potential pile driving impacts would be less than
2 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
3 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
4 less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

11 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

12 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
13 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-92, except that
14 only three intakes would be maintained under Alternative 8 rather than five under Alternative 1A.
15 As concluded in for Alternative 1A, Impact AQUA-92, the effect would not be adverse for steelhead.

16 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-92, the impact of the maintenance
17 of water conveyance facilities on steelhead would be less than significant and no mitigation would
18 be required.

19 **Water Operations of CM1**

20 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

21 ***Water Exports from SWP/CVP South Delta Facilities***

22 Alternative 8 would substantially reduce entrainment losses of juvenile steelhead at the SWP/CVP
23 south Delta export facilities, similar to Alternative 1A, Impact AQUA-93. Alternative 8 would result
24 in overall reduced entrainment of juvenile steelhead at the south Delta export facilities, estimated by
25 the salvage density method, by about 82% compared to NAA (Table 11-8-48). Entrainment under
26 Alternative 8, when broken down by water year type, would range from a reduction of 75% in wet
27 years to 99% in critical years compared to NAA. Pre-screen losses, typically attributed to predation,
28 would be expected to decrease commensurate with decreased entrainment at the south Delta
29 facilities. This effect would be beneficial to steelhead.

30 ***Water Exports from SWP/CVP North Delta Intake Facilities***

31 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
32 entrainment of juvenile salmonids at the north Delta intakes would be greater than baseline, but the
33 effects would be minimal because the north Delta intakes would have state-of-the-art screens to
34 exclude juvenile fish.

35 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

36 As described for winter-run Chinook salmon under Alternative 1A (Impact AQUA-39), potential
37 entrainment and impingement effects for juvenile salmonids would be minimal because intakes

would have state-of-the-art screens installed. For juvenile steelhead, changes at the NBA would have minimal effect because steelhead are generally not present in this area so would have minimal risk of entrainment under Existing Conditions. Overall, the effect on steelhead under Alternative 8 would not be adverse and may provide a small benefit to the species because entrainment would be reduced, especially at the south Delta facilities.

NEPA Effects: Entrainment and associated pre-screen predation losses would be substantially reduced at the south Delta facilities, compared to NAA. The effect under Alternative 8 would not be adverse.

CEQA Conclusion: Entrainment losses of juvenile steelhead would be substantially reduced under Alternative 8 compared to Existing Conditions (Table 11-8-48). Overall, impacts would be beneficial to steelhead because of the reduction in entrainment loss and mortality. No mitigation would be required.

Table 11-8-48. Juvenile Steelhead Annual Entrainment Index^a at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 8

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LLTT	NAA vs. A8_LLTT
Wet	-4,670 (-75%)	-4,762 (-75%)
Above Normal	-10,306 (-79%)	-10,650 (-80%)
Below Normal	-9,748 (-82%)	-9,018 (-81%)
Dry	-7,349 (-98%)	-6,759 (-97%)
Critical	-5,820 (-99%)	-5,470 (-99%)
All Years	-7,356 (-82%)	-7,214 (-82%)

^a Estimated annual number of fish lost, based on non-normalized data.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, effects of Alternative 8 on steelhead spawning habitat would be negligible relative to the NAA.

Sacramento River

Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where the majority of steelhead spawning occurs, were examined during the primary steelhead spawning and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality. Flows under A8_LLTT throughout the period would generally be similar to or higher those under NAA except during January in dry (-7%) and critical (-11%) years.

Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water

1 temperature between NAA and Alternative 8 in any month or water year type throughout the period
2 at either location

3 SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning
4 availability, measured as weighted usable area, under A8_LLT relative to NAA (Table 11-8-49).
5 SacEFT predicts that there would be a small decrease in suitable spawning area (-6%) between NAA
6 and A8_LLT, negligible (<5%) effects on redd scour risk and dewatering risk, and no effect (0%) on
7 egg incubation compared to NAA. These results indicate that there would be a low effect of
8 Alternative 8 on spawning habitat quantity but no difference in redd scour risk or temperature-
9 related egg incubation conditions.

10 Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg
11 incubation in the Sacramento River would be negligible.

12 **Table 11-8-49. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
13 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Spawning WUA	0 (0%)	-3 (-6%)
Redd Scour Risk	-5 (-6%)	-2 (-3%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-1 (-2%)	2 (4%)
Juvenile Rearing WUA	-12 (-29%)	-16 (-36%)
Juvenile Stranding Risk	0 (0%)	14 (70%)

WUA = Weighted Usable Area.

14

15 **Clear Creek**

16 No water temperature modeling was conducted in Clear Creek.

17 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
18 (January through April). Flows under A8_LLT would generally be similar to flows under NAA
19 throughout the period, except in wet years during January (7% lower), below normal and critical
20 years in March (6% and 8% lower, respectively) and critical years during April (8% lower)
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 Results of the flow analyses for the risk of redd dewatering indicate the greatest monthly flow
23 reduction would be identical between NAA and A8_LLT for all water years except for a 67 cfs
24 decrease in critical years (Table 11-8-50).

25 Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg
26 incubation habitat in Clear Creek would be negligible.

1 **Table 11-8-50. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**
 2 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**
 3 **Incubation Period^a**

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	-67 (NA)	-67 (NA)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

4

5 **Feather River**

6 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
 7 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
 8 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
 9 Flows in the low-flow channel under A8_LLT would not differ from NAA because minimum Feather
 10 River flows are included in the FERC settlement agreement and would be met for all model
 11 scenarios (California Department of Water Resources 2006). Flows under A8_LLT at Thermalito
 12 Afterbay would be greater than flows under NAA (up to 566% higher).

13 Oroville Reservoir storage volume at the end of September and end of May influences flows
 14 downstream of the dam during the steelhead spawning and egg incubation period. May Oroville
 15 storage under A8_LLT would be lower than storage under NAA (up to 36%) (Table 11-8-51). Storage
 16 volume at the end of September under A8_LLT would be greater than storage under NAA (up to
 17 24%) depending on water year type except for below normal years (7% lower) (Table 11-8-52).

18 **Table 11-8-51. May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model**
 19 **Scenarios**

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wet	-689 (-20%)	-643 (-19%)
Above Normal	-1,168 (-33%)	-1,012 (-30%)
Below Normal	-1,414 (-43%)	-1,061 (-36%)
Dry	-1,064 (-39%)	-544 (-24%)
Critical	-436 (-24%)	-120 (-8%)

20

1 **Table 11-8-52. September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for**
2 **Model Scenarios**

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wet	-775 (-27%)	239 (13%)
Above Normal	-697 (-29%)	94 (6%)
Below Normal	-709 (-35%)	-100 (-7%)
Dry	-198 (-15%)	155 (15%)
Critical	-30 (-3%)	158 (20%)

3
4 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito
5 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January
6 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*
7 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There
8 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8
9 in any month or water year type throughout the period at either location.

10 The percent of months exceeding the 56°F temperature threshold in the Feather River above
11 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-8-
12 53). The percent of months exceeding the threshold under Alternative 8 would generally be similar
13 to or lower (up to 17% lower on an absolute scale) than the percent under NAA depending on
14 month and degrees above the threshold.

15 **Table 11-8-53. Differences between Baseline and Alternative 8 Scenarios in Percent of Months**
16 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
17 **River above Thermalito Afterbay Exceed the 56°F Threshold, January through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	1 (100%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
April	21 (243%)	10 (200%)	9 (NA)	2 (NA)	1 (NA)
NAA vs. A8_LLT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-7 (-75%)	-2 (-100%)	-1 (-100%)	-1 (-100%)	-1 (-100%)
April	-23 (-44%)	-17 (-54%)	-9 (-50%)	-4 (-60%)	0 (0%)

NA = could not be calculated because the denominator was 0.

18
19 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
20 Afterbay (low-flow channel) during January through April (Table 11-8-54). Total degree-months
21 would be similar between NAA and Alternative 8 during January and February, but would be 69%
22 lower under Alternative 8 than NAA during March and 28% lower during April.

1 **Table 11-8-54. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the Feather River above Thermalito Afterbay, January through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLTT	NAA vs. A8_LLTT
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	-1 (-50%)
	Dry	1 (NA)	-1 (-50%)
	Critical	1 (100%)	-7 (-78%)
	All	3 (300%)	-9 (-69%)
April	Wet	1 (NA)	-2 (-67%)
	Above Normal	5 (250%)	-6 (-46%)
	Below Normal	7 (175%)	-9 (-45%)
	Dry	16 (320%)	-10 (-32%)
	Critical	22 (NA)	-1 (-4%)
	All	51 (464%)	-28 (-31%)

NA = could not be calculated because the denominator was 0.

4

5 Overall for the Feather River, these results indicate that project-related effects of Alternative 8 on
 6 mean monthly flow would consist of no effects (0% difference) in the low-flow channel and
 7 substantial increases in flow (to 566%) that would have beneficial effects on spawning conditions
 8 below Thermalito Afterbay. Project-related effects of Alternative 8 would consist of negligible (<5%)
 9 or beneficial effects on water temperatures. Project-related effects on storage in Oroville Reservoir
 10 (i.e., coldwater pool availability) would consist of decreases in storage in May (to -36%) when the
 11 egg incubation period is over, and increases in storage in September (to 20%) that would have a
 12 beneficial effect heading toward the onset of spawning in the winter months. These results indicate
 13 that effects of Alternative 8 on flow and water temperature would not have biologically meaningful
 14 negative effects on steelhead spawning conditions in the Feather River.

15 **American River**

16 Flows in the American River at the confluence with the Sacramento River were examined for the
 17 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
 18 *Model Results utilized in the Fish Analysis*). Flows under A8_LLTT would generally be similar to or

1 larger than flows under NAA during the period except in critical years during January, February and
2 March (9%, 11% and 14%, respectively) and dry years during January and March (5% and 12%,
3 respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated
5 during the January through April steelhead spawning and egg incubation period (Appendix 11D,
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
8 NAA and Alternative 8 in any month or water year type throughout the period.

9 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
10 Avenue Bridge was evaluated during November through April (Table 11-8-43). Steelhead spawn and
11 eggs incubate in the American River between January and April. The percent of months exceeding
12 the threshold under Alternative 8 would be similar to that under NAA during January and February, but
13 would be up to 53% lower (absolute scale) during March and April, depending on month and
14 threshold level.

15 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
16 Avenue Bridge during November through April (Table 11-8-44). During the January through April
17 steelhead spawning and egg incubation period, total degree-months would be similar between NAA
18 and Alternative 8.

19 ***San Joaquin River***

20 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

21 ***Stanislaus River***

22 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
23 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
24 *Model Results utilized in the Fish Analysis*). Flows under A8_LL1T would be similar to flows under
25 NAA.

26 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 8
27 throughout the January through April steelhead spawning and egg incubation period (Appendix
28 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
29 *the Fish Analysis*).

30 ***Mokelumne River***

31 Flows in the Mokelumne River at the confluence were examined for the January through April
32 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
33 *Fish Analysis*). Flows under A8_LL1T would be the same as flows under NAA.

34 ***NEPA Effects:*** Collectively, these results indicate that the effect would not be adverse because it
35 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
36 as a result of egg development. Project-related effects of flow, including water temperatures, under
37 Alternative 8 would have small and inconsistent effects on steelhead spawning conditions in the
38 upstream waterways evaluated, with beneficial effects in some locations (i.e., a prevalence of
39 increases in mean monthly flow of up to 44% in all rivers analyzed and up to 566% in the Feather
40 River, and a 20% increase in cold-water pool storage in Oroville Reservoir in September) and
41 negligible or small-scale effects on spawning metrics calculated with SacEFT (up to 6%). There

1 would be an increase in the greatest monthly flow reduction in Clear Creek in critical years (-67 cfs),
2 although, based on the remaining results, this isolated effect is not expected to have biologically
3 meaningful effects on spawning success.

4 **CEQA Conclusion:** In general, under Alternative 8 water operations, the quantity and quality of
5 spawning habitat for steelhead would not be reduced relative to the CEQA baseline.

6 **Sacramento River**

7 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
8 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
9 and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized*
10 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
11 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows
12 under A8_LLT would generally be similar to or greater than flows under Existing Conditions during
13 this period (up to 47% higher) with some exceptions. Upstream of Red Bluff Diversion Dam, flows
14 under A8_LLT would generally be similar to or higher (up to 29% higher) than Existing Conditions
15 throughout the period except for wet years during April (8% lower).

16 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were
17 examined during the January through April primary steelhead spawning and egg incubation period
18 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
19 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
20 temperature between Existing Conditions and Alternative 8 in any month or water year type
21 throughout the period at either location.

22 SacEFT predicts no or negligible differences in spawning habitat, egg incubation, and redd
23 dewatering risk between Existing Conditions and Alternative 8 and a small change (-6%) in years
24 considered “good” in terms of redd scour risk (Table 11-8-49).

25 Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg
26 incubation habitat in the Sacramento River would be negligible.

27 **Clear Creek**

28 No water temperature modeling was conducted in Clear Creek.

29 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
30 (January through April). Flows under A8_LLT would be similar to or greater than flows under
31 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*
32 *Fish Analysis*).

33 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
34 monthly flow reduction would be identical between Existing Conditions and A8_LLT for all water
35 year types except wet, in which the greatest reduction would be 38% lower (worse) under A8_LLT
36 than under Existing Conditions (Table 11-8-50).

37 Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg
38 incubation habitat in Clear Creek would be negligible.

1 **Feather River**

2 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
3 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
4 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
5 Flows in the low-flow channel under A8_LLT would not differ from Existing Conditions because
6 minimum Feather River flows are included in the FERC settlement agreement and would be met for
7 all model scenarios (California Department of Water Resources 2006). Flows under A8_LLT at
8 Thermalito Afterbay would be greater than flows under Existing Conditions throughout the period
9 (up to 565%).

10 Oroville Reservoir storage volume at the end of September and end of May influences flows
11 downstream of the dam during the steelhead spawning and egg incubation period. Oroville
12 Reservoir storage volume at the end of September would be 3% to 35% lower under A8_LLT
13 relative to Existing Conditions depending on water year type (Table 11-8-52). May Oroville storage
14 volume under A8_LLT would be lower than Existing Conditions by 20% to 43% depending on water
15 year type (Table 11-8-51).

16 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito
17 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January
18 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River
19 Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the
20 low-flow channel, mean monthly water temperatures under Alternative 8 would be 6% and 7%
21 greater than those under Existing Conditions during January and February, respectively, and similar
22 to temperatures under Existing Conditions during March and April. In the high-flow channel, mean
23 monthly water temperatures under Alternative 8 would be 5% and 7% greater than those under
24 Existing Conditions during January and February, respectively, and similar to temperatures under
25 Existing Conditions during March and April.

26 The percent of months exceeding the 56°F temperature threshold in the Feather River above
27 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-8-
28 53). The percent of months exceeding the threshold under Alternative 8 would be similar to the
29 percent under Existing Conditions during January through March and similar to or up to 21%
30 greater (absolute scale) than the percent under Existing Conditions depending on degrees above the
31 threshold during April.

32 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
33 Afterbay (low-flow channel) during January through April (Table 11-8-54). Total degree-months
34 would be similar between Existing Conditions and Alternative 8 during January through March and
35 464% higher under Alternative 8 compared to Existing Conditions during April.

36 **American River**

37 Flows in the American River at the confluence with the Sacramento River were examined for the
38 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II
39 Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows
40 under Existing Conditions during January and greater than flows under Existing Conditions during
41 February, March and April with some exceptions.

42 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated
43 during the January through April steelhead spawning and egg incubation period (Appendix 11D,

1 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
2 *Fish Analysis*). Mean monthly water temperature under Alternative 8 would be 5% to 7% higher
3 than those under Existing Conditions during January through March, and temperatures would not
4 differ between Alternative 8 and Existing Conditions during April.

5 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
6 Avenue Bridge was evaluated during November through April (Table 11-8-43). Steelhead spawn and
7 eggs incubate in the American River between January and April.

8 During January through March, the percent of month exceeding the threshold under Existing
9 Conditions and Alternative 8 would be similar. During April the percent of months exceeding the
10 threshold under Alternative 8 would be up to 14% lower (absolute scale) than the percent under
11 Existing Conditions.

12 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
13 Avenue Bridge during November through April (Table 11-8-44). During January and February, there
14 would be no difference in total degree-months above the 56°F threshold between Existing
15 Conditions and Alternative 8. During March and April, total degree-months under Alternative 8
16 would be 400% and 89% greater, respectively, than those under Existing Conditions.

17 Overall, these results indicate that the effects of Alternative 8 on steelhead spawning and egg
18 incubation habitat in the American River would be moderate to substantial.

19 ***Stanislaus River***

20 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
21 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
22 *Model Results utilized in the Fish Analysis*). Flows under A8_LL1T would generally be lower than flows
23 under Existing Conditions during the entire period.

24 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was
25 evaluated during the January through April steelhead spawning and egg incubation period
26 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
27 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 6%
28 higher than those under Existing Conditions in all four months of the period.

29 Overall, these results indicate that the effect of Alternative 8 on steelhead spawning and egg
30 incubation in the Stanislaus River would be substantial.

31 ***San Joaquin River***

32 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

33 ***Mokelumne River***

34 Flows in the Mokelumne River at the Delta were examined during the January through April
35 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
36 *Fish Analysis*). Flows under Alternative 8 would generally be similar to flows under Existing
37 Conditions during March, up to 18% greater during February, and up to 14% lower during April.

38 Water temperature modeling was not conducted in the Mokelumne River.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce suitable spawning habitat and substantially reduce the
5 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above.
6 Alternative 8 would affect steelhead spawning conditions through reduced mean monthly flows in
7 the American River (decreases to -35% in drier water years for January through March) and the
8 Stanislaus River (decreases to -36% in most water years for January through April), and through
9 increased magnitude of monthly flow reductions in Clear Creek (-38% in wet years and a 39%
10 reduction in critical years), Effects of Alternative 8 would not affect spawning conditions in the
11 Sacramento and Feather Rivers, based on negligible effects on mean monthly flow, spawning metrics
12 calculated with SacEFT, NMFS temperature threshold analyses, and calculations of monthly flow
13 reductions.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate
15 change, future water demands, and implementation of the alternative. The analysis described above
16 comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the
17 alternative from those of sea level rise, climate change and future water demands using the model
18 simulation results presented in this chapter. However, the increment of change attributable to the
19 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
20 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
21 implementation period, which does include future sea level rise, climate change, and water
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
26 term implementation period and Alternative 8 indicates that flows in the locations and during the
27 months analyzed above would generally be similar between Existing Conditions during the LLT and
28 Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8
29 found above would generally be due to climate change, sea level rise, and future demand, and not
30 the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea
31 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
32 result in a significant impact on spawning habitat for steelhead. This impact is found to be less than
33 significant and no mitigation is required.

34 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

35 In general, Alternative 8 would reduce the quantity and quality of steelhead rearing habitat relative
36 to the NAA.

37 ***Sacramento River***

38 Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream
39 to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in
40 flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the
41 reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to
42 upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
43 *Analysis*). Flows would generally be similar to or greater (up to 25%) than flows under NAA during

1 February through June and December, and lower than flows under NAA (up to 26% lower) during
2 January and July through November.

3 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
4 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*
5 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There
6 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8
7 in any month or water year type throughout the period at either location. SacEFT predicts that the
8 percentage of years with good juvenile steelhead rearing WUA conditions under A8_LLT would be
9 36% lower than under NAA (Table 11-8-49). The percentage of years with good (lower) juvenile
10 stranding risk conditions under A8_LLT would be 70% higher than under NAA. These results
11 indicate that Alternative 8 would cause decreases in rearing habitat conditions but reductions in
12 juvenile mortality risk resulting from stranding in the Sacramento River.

13 **Clear Creek**

14 Water temperatures were not modeled in Clear Creek.

15 Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under
16 A8_LLT would generally be similar to or sometimes greater than flows under NAA, except for wet
17 years in January (7% lower) and below normal years in March (6% lower) and critical years in
18 March, April, June and December (all 8% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
19 *the Fish Analysis*).

20 It was assumed that habitat for juvenile steelhead rearing would be constrained by the month
21 having the lowest instream flows. Juvenile rearing habitat is assumed to increase as instream flows
22 increase, and therefore the lowest monthly instream flow was used as an index of habitat
23 constraints for juvenile rearing. Results of the analysis indicate that juvenile steelhead rearing
24 habitat, based on minimum instream flows, is comparable for Alternative 8 relative to NAA in all
25 water years except in wet years and critical years when they would be 7% and 10% higher,
26 respectively (Table 11-8-55).

27 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-
28 1A-4). The current Clear Creek management regime uses flows slightly lower than those
29 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being
30 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We
31 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.
32 No change in effect on steelhead in Clear Creek is anticipated.

33 Overall, these results indicate that Alternative 8 would not affect juvenile rearing conditions in Clear
34 Creek

Table 11-8-55. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period

Water Year Type	A8_LLT vs. EXISTING CONDITIONS	A8_LLT vs. NAA
Wet	6 (7%)	6 (7%)
Above Normal	0 (0%)	0 (0%)
Below Normal	0 (0%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	-7 (-8%)	7 (10%)

Note: Minimum flows occurred between October and March.

Feather River

Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al. 2003). Relatively constant flows in the low flow channel throughout the year under A8_LLT would not differ from those under NAA. In the high flow channel, flows under A8_LLT would be lower (up to 72%) during June through December, greater (up to 566%) than flows under NAA during January through May.

May Oroville storage under A8_LLT would be lower under NAA (up to 36% lower) (Table 11-8-51). September Oroville storage volume would be greater than under NAA (up to 20% greater) except for being 7% lower in below normal water years (Table 11-8-52).

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8 in most months and water year types throughout the period at either location. However, above Thermalito Afterbay mean monthly temperature was greater under Alternative 8 than NAA during September of below normal years and below Thermalito Afterbay mean monthly temperature was greater under Alternative 8 than NAA during July in all water year types except critical years, during August of above normal years and during September of wet and above normal years.

An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-flow channel, the percent of months exceeding the threshold under Alternative 8 would generally be similar to or lower (up to 12% lower on an absolute scale) than the percent under NAA, but would be higher (up to 14% higher on an absolute scale) during August, depending on threshold level (Table 11-8-29). At Gridley, the percent of months exceeding the threshold under Alternative 8 would similar to or up to 41% lower (absolute scale) than the percent under NAA (Table 11-8-39).

Total degree-months exceeding 63°F were summed by month and water year type in the Feather River above Thermalito Afterbay (low-flow channel) during May through August and total degree-months exceeding 56°F at Gridley during October through April. In the low-flow channel, total

1 degree-months under Alternative 8 would be similar to those under NAA during May and greater
2 (up to 19% greater) under Alternative 8 during June through August (Table 11-8-30). At Gridley,
3 total degree-months would be similar between NAA and Alternative 8 during November through
4 February, 8% higher under Alternative 8 during October, and 47% and 38% lower under
5 Alternative 8 during March and April, respectively (Table 11-8-40).

6 Overall, project-related effects of Alternative 8 on flow in the Feather River low-flow channel would
7 have negligible effects on mean monthly flow and relatively small effects on water temperatures that
8 would not affect steelhead rearing conditions. Effects of Alternative 8 in the Feather River below
9 Thermalito Afterbay would include substantial increases in mean monthly flow (to 566%) during
10 January through May in all water year types, and moderate to substantial reductions in flow (to -
11 76%) during June to December, including in drier water types, that would have negative effects on
12 juvenile steelhead rearing conditions in all water year types for the warmer summer months. The
13 effects of flow reductions would be offset by project-related increases in flows that would occur
14 prior to these months, including increases to 566% in below normal years, to 284% in dry years,
15 and to 106% in critical years. Effects on water temperatures would generally be negligible.

16 **American River**

17 Flows in the American River at the confluence with the Sacramento River were examined for the
18 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
19 *Analysis*). Flows under A8_LL1T would generally be similar to flows under NAA during February,
20 April, October and December, greater than flows under NAA during May and June, lower than flows
21 under NAA during March, July and November, and mixed with both higher and lower flows in
22 January, August and September.

23 Mean monthly water temperatures in the American River at the confluence with the Sacramento
24 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
26 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
27 temperature between NAA and Alternative 8 in any month or water year type throughout the
28 period.

29 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt
30 Avenue Bridge was evaluated during May through October (Table 11-8-56). During May, September,
31 and October, the percent of months exceeding the threshold under Alternative 8 would similar to or
32 up to 60% lower (absolute scale) than the percent under NAA. During June through September, the
33 percent of months exceeding the threshold would mostly be similar between NAA and Alternative 8
34 with one, two, or three degree categories in which there would be increases of up to 44% on an
35 absolute scale in percent of months exceeding the threshold under Alternative 8.

1 **Table 11-8-56. Differences between Baseline and Alternative 8 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**
 3 **River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LL1					
May	10 (50%)	4 (25%)	2 (22%)	4 (60%)	0 (0%)
June	32 (50%)	38 (72%)	44 (109%)	52 (168%)	52 (247%)
July	0 (0%)	1 (1%)	37 (59%)	64 (179%)	83 (479%)
August	0 (0%)	2 (3%)	19 (23%)	52 (108%)	69 (224%)
September	7 (9%)	32 (60%)	37 (115%)	36 (223%)	25 (333%)
October	16 (325%)	2 (100%)	2 (NA)	0 (NA)	0 (NA)
NAA vs. A8_LL1					
May	-35 (-54%)	-31 (-63%)	-26 (-66%)	-22 (-69%)	-12 (-71%)
June	-2 (-3%)	0 (0%)	4 (5%)	17 (26%)	25 (51%)
July	0 (0%)	0 (0%)	2 (3%)	28 (40%)	44 (80%)
August	0 (0%)	0 (0%)	0 (0%)	4 (4%)	10 (11%)
September	-7 (-7%)	-12 (-13%)	-16 (-19%)	-22 (-30%)	-28 (-47%)
October	-59 (-74%)	-60 (-92%)	-43 (-95%)	-30 (-100%)	-11 (-100%)

4
 5 Total degree-months exceeding 65°F were summed by month and water year type at the Watt
 6 Avenue Bridge during May through October (Table 11-8-57). During May, June, and October, total
 7 degree-months would be similar between NAA and Alternative 1A or up to 26% lower under
 8 Alternative 8. During July through September, there would be increases (up to 31%) in total degree-
 9 months exceeding the threshold.

1 **Table 11-8-57. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 65°F in**
 3 **the American River at the Watt Avenue Bridge, May through October**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
May	Wet	19 (317%)	-2 (-7%)
	Above Normal	23 (NA)	-4 (-15%)
	Below Normal	17 (567%)	-6 (-23%)
	Dry	13 (59%)	-21 (-38%)
	Critical	17 (89%)	-15 (-29%)
	All	89 (178%)	-48 (-26%)
June	Wet	62 (365%)	-6 (-7%)
	Above Normal	29 (121%)	-3 (-5%)
	Below Normal	42 (145%)	4 (6%)
	Dry	40 (59%)	0 (0%)
	Critical	40 (80%)	-10 (-10%)
	All	213 (113%)	-15 (-4%)
July	Wet	85 (109%)	36 (28%)
	Above Normal	36 (133%)	30 (91%)
	Below Normal	44 (129%)	23 (42%)
	Dry	76 (123%)	25 (22%)
	Critical	74 (91%)	28 (22%)
	All	316 (112%)	143 (31%)
August	Wet	114 (144%)	6 (3%)
	Above Normal	29 (71%)	-4 (-5%)
	Below Normal	34 (61%)	-3 (-3%)
	Dry	98 (144%)	17 (11%)
	Critical	67 (85%)	3 (2%)
	All	341 (106%)	18 (3%)
September	Wet	60 (250%)	-14 (-14%)
	Above Normal	33 (206%)	-3 (-6%)
	Below Normal	53 (189%)	6 (8%)
	Dry	94 (224%)	8 (6%)
	Critical	56 (114%)	3 (3%)
	All	296 (186%)	0 (0%)
October	Wet	44 (4,400%)	-10 (-18%)
	Above Normal	30 (NA)	4 (15%)
	Below Normal	25 (NA)	-14 (-36%)
	Dry	32 (NA)	-5 (-14%)
	Critical	24 (480%)	-6 (-17%)
	All	155 (2,583%)	-31 (-16%)

NA = could not be calculated because the denominator was 0.

4
 5 These results indicate that the effects of Alternative 8 on flow and water temperatures would reduce
 6 juvenile rearing conditions in the American River.

1 **Stanislaus River**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
3 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A8_LLТ would be similar to flows under NAA throughout the period.

5 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
6 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,
7 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
8 *Fish Analysis*). Mean monthly water temperatures under Alternatives 8 would be 6% greater than
9 those under Existing Conditions during January through May, September, November, and December
10 and would be similar to those under Existing Conditions in the remaining 4 months.

11 **San Joaquin River**

12 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing
13 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLТ
14 would be similar to flows under NAA throughout the period.

15 Water temperature modeling was not conducted in the San Joaquin River.

16 **Mokelumne River**

17 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing
18 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLТ
19 would be similar to flows under NAA throughout the period.

20 Water temperature modeling was not conducted in the Mokelumne River.

21 **NEPA Effects:** Collectively, these results indicate that the effect of Alternative 8 would be adverse
22 because it has the potential to substantially reduce rearing habitat. Flows and water temperatures in
23 the Sacramento, Feather, and American Rivers would be affected by Alternative 8. Although there
24 would be benefits to rearing juvenile steelhead during spring months, those rearing in summer and
25 fall months would experience reduced flows and higher temperatures. There would generally be no
26 effects in other waterways.

27 This effect is a result of the specific reservoir operations and resulting flows associated with this
28 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
29 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change
30 the alternative, thereby making it a different alternative than that which has been modeled and
31 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
32 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-95a through AQUA-
33 95c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
34 level.

35 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of steelhead
36 rearing habitat relative to Existing Conditions.

37 **Sacramento River**

38 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and
39 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM*

1 *II Model Results utilized in the Fish Analysis*). Flows during January through June under A8_LLT
2 would generally be similar to or greater than those under Existing Conditions. Flows during July
3 through December would generally be lower under A8_LLT than under Existing Conditions.

4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
5 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*
6 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At
7 both locations, mean monthly water temperatures under Alternative 8 would generally be similar to
8 those under Existing Conditions, except during July through October, during which temperatures
9 would be 5% to 7% higher under Alternative 8.

10 SacEFT predicts that there would be no change in juvenile stranding risk under Alternative 8
11 relative to Existing Conditions, but a 29% reduction in years classified as “good” in terms of juvenile
12 rearing habitat (Table 11-8-49).

13 Based on the incremental effects of reductions in mean monthly flows (up to 30% lower) for some
14 months during drier water year types, decreased occurrence of “good” juvenile habitat (-29%)
15 calculated with SacEFT, and persistent, moderate reductions in minimum instream flows (to -29%),
16 effects of Alternative 8 on flow would affect juvenile rearing conditions in the Sacramento River.

17 **Clear Creek**

18 Flows in Clear Creek during the year-round rearing period under A8_LLT would generally be similar
19 to or greater than flows under Existing Conditions, except for critical years in August and September
20 in which flows would be 17% to 38% lower, respectively (Appendix 11C, *CALSIM II Model Results*
21 *utilized in the Fish Analysis*).

22 No water temperature modeling was conducted in Clear Creek.

23 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and
24 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile
25 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream
26 flows affecting juvenile rearing habitat are shown in Table 11-8-55. Results indicate that Alternative
27 8 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to
28 Existing Conditions in all water years except for that they would be 8% lower in critical water years.

29 Based on the infrequency and relatively small magnitude (two occurrences to -14%) of flow
30 reductions under Alternative 8, only small-scale effects on minimum instream flows (-8%), and
31 negligible effects on water temperature, Alternative 8 would not have biologically meaningful effects
32 on juvenile steelhead rearing conditions in Clear Creek.

33 **Feather River**

34 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and
35 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 8 relative to Existing
36 Conditions in the low-flow channel during the year-round steelhead juvenile rearing period
37 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at
38 Thermalito Afterbay), flows under A8_LLT would be mostly lower (up to 77% lower) during June
39 through December and higher (up to 565% higher) in January through May.

40 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
41 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile

1 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*
2 *Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water
3 temperatures under Alternative 8 would be similar to those under Existing Conditions between
4 March and August, but would be 6% to 9% higher between September and February. In the high-
5 flow channel, mean monthly water temperatures under Alternative 8 would be similar to those
6 under Existing Conditions between March and June, but would be 5% to 8% in the remaining eight
7 months.

8 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in
9 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and
10 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-
11 flow channel, the percent of months exceeding the threshold under Alternative 8 would generally be
12 similar to the percent under Existing Conditions during May, and similar or up to 60% (absolute
13 scale) higher than the percent under Existing Conditions during June through August (Table 11-8-
14 29). At Gridley, the percent of months exceeding the threshold under Alternative 8 would be similar
15 to the percent under Existing Conditions during December through April, but similar to or up to
16 67% greater (absolute scale) than the percent under Existing Conditions in the other 2 months
17 (Table 11-8-39).

18 Total degree-months exceeding 63°F were summed by month and water year type in the Feather
19 River above Thermalito Afterbay (low-flow channel) during May through August and total degree-
20 months exceeding 56°F at Gridley during October through April. In the low-flow channel, total
21 degree-months under Alternative 8 would be similar to those under Existing Conditions during May
22 and 66% to 206% higher during June through August (Table 11-8-30). At Gridley, total degree-
23 months under Alternative 8 would be similar to those under Existing Conditions during December
24 through February and 131% to 3,250% greater than those under Existing Conditions in the
25 remaining four months (Table 11-8-40).

26 **American River**

27 Flows in the American River at the confluence with the Sacramento River were examined for the
28 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*). Flows under A8_LLТ would be generally lower than flows under Existing Conditions (up to
30 62% lower) in June through December, generally higher flows in February, April and May (up to
31 53% higher), and mixed higher and lower flows depending on water year during March and October
32 January.

33 Mean monthly water temperatures in the American River at the confluence with the Sacramento
34 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period
35 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
36 *utilized in the Fish Analysis*). There would be up to 83% increases in mean monthly water
37 temperature under Alternative 8 relative to Existing Conditions in all months examined.

38 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt
39 Avenue Bridge was evaluated during May through October (Table 11-8-56).

40 Total degree-months exceeding 65°F were summed by month and water year type at the Watt
41 Avenue Bridge during May through October (Table 11-8-57). There would be 106% to 2,583%
42 increases in total degree-months exceeding the threshold under Alternative 8 relative to Existing
43 Conditions in all months during the period examined.

1 These results indicate that Alternative 8 would affect flows and water temperatures in the American
2 River throughout most of the year.

3 ***Stanislaus River***

4 Flows in the Stanislaus River for Alternative 8 are generally lower than Existing Conditions in most
5 water years in all months except that they are higher in above normal years in January, in wet years
6 in March and June and in critical years in June. For a discussion of the topic see the analysis for
7 Alternative 1A.

8 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
9 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,
10 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
11 *Fish Analysis*). Mean monthly water temperatures under Alternatives 8 would be 6% greater than
12 those under Existing Conditions during January through May, September, November and December,
13 would be 5% greater during August, and would be similar during June, July, and October.

14 ***San Joaquin River***

15 Flows in the San Joaquin River for Alternative 8 are generally lower than Existing Conditions in most
16 water years in all months except that they higher during January except in critical years (6% lower)
17 and during November and December the flows are only slightly lower than Existing Conditions.

18 Water temperature modeling was not conducted in the San Joaquin River.

19 ***Mokelumne River***

20 Flows in the Mokelumne River for Alternative 8 are generally lower than Existing Conditions in all
21 months and all water years except that they are similar in March, and generally higher in January,
22 February and December (up to 18% higher depending on water year).

23 Water temperature modeling was not conducted in the Mokelumne River.

24 **Summary of CEQA Conclusion**

25 Collectively, these results indicate that the impact would be significant because it has the potential
26 to substantially reduce rearing habitat and substantially reduce the number of fish as a result of
27 ammocoete mortality. Effects of Alternative 8 on flow would negatively affect juvenile rearing
28 conditions in all locations analyzed with the exception of Clear Creek, based on persistent reductions
29 in mean monthly flow (to -30% in the Sacramento River, to -77% in the Feather River, to -62% in
30 the American River and to -36% in the Stanislaus River), negative effects on rearing conditions
31 based on SacEFT rearing metrics (29% reduction in occurrence of good habitat) and increases in
32 exceedance of critical water temperatures in the Sacramento, Feather, and American Rivers.
33 Degraded rearing conditions for juvenile steelhead would reduce their survival and growth in these
34 waterways.

35 This impact is a result of the specific reservoir operations and resulting flows associated with this
36 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
37 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
38 change the alternative, thereby making it a different alternative than that which has been modeled
39 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible

1 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
2 severity of impact though not necessarily to a less-than-significant level.

3 **Mitigation Measure AQUA-95a: Following Initial Operations of CM1, Conduct Additional**
4 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to**
5 **Reduce Impacts to Rearing Habitat**

6 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
7 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the
8 best available scientific information at the time and may prove to have been overstated. Upon
9 the commencement of operations of CM1 and continuing through the life of the permit, the
10 BDCP proponents will monitor effects on rearing habitat in order to determine whether such
11 effects would be as extensive as concluded at the time of preparation of this document and to
12 determine any potentially feasible means of reducing the severity of such effects. This mitigation
13 measure requires a series of actions to accomplish these purposes, consistent with the
14 operational framework for Alternative 8.

15 The development and implementation of any mitigation actions shall be focused on those
16 incremental effects attributable to implementation of Alternative 8 operations only.
17 Development of mitigation actions for the incremental impact on rearing habitat attributable to
18 climate change/sea level rise are not required because these changed conditions would occur
19 with or without implementation of Alternative 8.

20 **Mitigation Measure AQUA-95b: Conduct Additional Evaluation and Modeling of Impacts**
21 **on Steelhead Rearing Habitat Following Initial Operations of CM1**

22 Following commencement of initial operations of CM1 and continuing through the life of the
23 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
24 modified operations could reduce impacts to rearing habitat under Alternative 8. The analysis
25 required under this measure may be conducted as a part of the Adaptive Management and
26 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

27 **Mitigation Measure AQUA-95c: Consult with NMFS, USFWS, and CDFW to Identify and**
28 **Implement Potentially Feasible Means to Minimize Effects on Steelhead Rearing Habitat**
29 **Consistent with CM1**

30 In order to determine the feasibility of reducing the effects of CM1 operations on steelhead
31 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
32 Wildlife to identify and implement any feasible operational means to minimize effects on rearing
33 habitat. Any such action will be developed in conjunction with the ongoing monitoring and
34 evaluation of habitat conditions required by Mitigation Measure AQUA-95a.

35 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall
36 operational framework of Alternative 8 without causing new significant adverse impacts on
37 other covered species, such means shall be implemented. If sufficient operational flexibility to
38 reduce effects on steelhead habitat is not feasible under Alternative 8 operations, achieving
39 further impact reduction pursuant to this mitigation measure would not be feasible under this
40 Alternative, and the impact on steelhead would remain significant and unavoidable.

1 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

2 **Upstream of the Delta**

3 In general, Alternative 8 would reduce the quantity and quality of steelhead migration habitat
4 relative to the NAA.

5 ***Sacramento River***

6 *Juveniles*

7 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
8 May juvenile steelhead migration period. Flows under A8_LLTP would be higher than NAA in some
9 water years during January (up to 12% higher), similar to or greater than NAA during February,
10 March, April and May, lower than NAA (up to 21% lower) during October and November, and
11 similar to or lower than NAA during December (up to 9% lower) (Appendix 11C, *CALSIM II Model*
12 *Results utilized in the Fish Analysis*).

13 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
14 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*
15 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
16 There would be no differences (<5%) in mean monthly water temperature between NAA and
17 Alternative 8 in any month or water year type throughout the period.

18 *Adults*

19 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
20 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*
21 *the Fish Analysis*). Flows under A8_LLTP would be higher than NAA in some water years during
22 January (up to 12% higher), similar to or greater than NAA during February and March and May,
23 lower than NAA (up to 26% lower) during September, October and November, and similar to or
24 lower than NAA during December (up to 9% lower) (Appendix 11C, *CALSIM II Model Results utilized*
25 *in the Fish Analysis*).

26 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
27 during the September through March steelhead adult upstream migration period (Appendix 11D,
28 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
29 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
30 NAA and Alternative 8 in any month or water year type throughout the period.

31 *Kelt*

32 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
33 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
34 *Fish Analysis*). Flows under A8_LLTP would be similar to or greater than NAA during these two
35 months (up to 36% greater) and these two months would be minimally different between NAA and
36 A8_LLTP.

37 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
38 during the March through April steelhead kelt downstream migration period (Appendix 11D,
39 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*

1 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
2 NAA and Alternative 8 in any month or water year type throughout the period.

3 Overall in the Sacramento River, these results indicate that Alternative 8 would affect migration
4 conditions for juvenile and adult steelhead in the early portion of their respective migration periods,
5 particularly in drier water years (based on persistent, small to moderate flow reductions to -26%
6 during September, October, and December), and would not affect kelt steelhead migration
7 conditions.

8 **Clear Creek**

9 Water temperatures were not modeled in Clear Creek.

10 *Juveniles*

11 Flows in Clear Creek during the October through May juvenile steelhead migration period under
12 A8_LLT would generally be similar to or greater than flows under NAA except in critical years during
13 December (5% lower), wet years during February (7% lower), below normal years and critical years
14 during March (6% and 8% lower, respectively) and critical years in April (8% lower) (Appendix
15 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

16 *Adults*

17 Flows in Clear Creek during the September through March adult steelhead migration period under
18 A8_LLT would generally be similar to or greater than flows under NAA except in critical years during
19 December (5% lower), wet years during February (7% lower), and below normal years and critical
20 years during March (6% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results*
21 *utilized in the Fish Analysis*).

22 *Kelt*

23 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
24 under A8_LLT would generally be similar to flows under NAA except in below normal years and
25 critical years during March (6% and 8% lower, respectively) (Appendix 11C, *CALSIM II Model Results*
26 *utilized in the Fish Analysis*).

27 Overall in Clear Creek, these results indicate that effects of Alternative 8 on flows would not affect
28 juvenile, adult, or kelt steelhead migration based on a prevalence of negligible effects on flow with
29 infrequent, small increases (to 12%) or decreases (to -8%) in flow that would not have biologically
30 meaningful effects on migration conditions.

31 **Feather River**

32 *Juveniles*

33 Flows in the Feather River at the confluence with the Sacramento River were examined during the
34 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
35 *utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows under NAA
36 during October through December (up to 28% lower) and greater than flows under NAA during
37 January through May (up to 130% greater).

1 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
2 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
5 NAA and Alternative 8 in any month or water year type throughout the period.

6 *Adults*

7 Flows in the Feather River at the confluence with the Sacramento River were examined during the
8 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
9 *Model Results utilized in the Fish Analysis*). Flows under A8_LLT would generally be lower than flows
10 under NAA during September through December (up to 57% lower) and greater than flows under
11 NAA during January through March (up to 95% greater).

12 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
13 were evaluated during the September through March steelhead adult upstream migration period
14 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
15 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
16 temperature between NAA and Alternative 8 in any month or water year type throughout the
17 period, except for a 5% increase under Alternative 8 for above normal years in September.

18 *Kelt*

19 Flows in the Feather River at the confluence with the Sacramento River were examined during the
20 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
21 *Results utilized in the Fish Analysis*). Flows under A8_LLT would be greater than flows under NAA
22 during March and April (up to 130% greater).

23 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
24 were evaluated during the March through April steelhead kelt downstream migration period
25 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
26 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
27 temperature between NAA and Alternative 8 in any month or water year type throughout the
28 period. Overall in the Feather River, these results indicate that effects of Alternative 8 on flows
29 would affect juvenile and adult migration conditions through persistent, substantial reductions in
30 flow in the months prior to (starting in June, to -84%), and during the first few months of (to -50%
31 for juveniles and to -72% for adults), their respective migration conditions. Effects of Alternative 8
32 on flow would not affect kelt steelhead migration based on a prevalence increases in flow (to 566%)
33 in all water years. Effects of Alternative 8 on water temperatures would increase exceedances of
34 suitable water temperatures in the summer and early fall that would affect migration conditions for
35 juveniles and adults.

36 ***American River***

37 *Juveniles*

38 Flows in the American River at the confluence with the Sacramento River were evaluated during the
39 October through May juvenile steelhead migration period. Flows under A8_LLT would be lower than
40 under NAA during October (although 33% higher in above normal years) and November (up to 33%
41 lower in critical years), similar to or lower than flows under NAA during December and March (up to
42 14% lower in critical years), greater than flows under NAA during May and mixed in January and

1 February with some water years higher and some lower(20% higher in critical years) (Appendix
2 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

3 Mean monthly water temperatures in the American River at the confluence with the Sacramento
4 River were evaluated during the October through May juvenile steelhead migration period
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
6 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
7 temperature between NAA and Alternative 8 in any month or water year type throughout the
8 period.

9 *Adults*

10 Flows in the American River at the confluence with the Sacramento River were evaluated during the
11 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
12 *Model Results utilized in the Fish Analysis*). Flows under A8_LLTT would be lower than under NAA
13 during September (up to 33% lower in above normal years), October (although 33% higher in above
14 normal years) and November (up to 33% lower in critical years), similar to or lower than flows
15 under NAA during December and March (up to 14% lower in critical years), and mixed in January
16 and February with some water years higher and some lower.

17 Mean monthly water temperatures in the American River at the confluence with the Sacramento
18 River were evaluated during the September through March steelhead adult upstream migration
19 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
20 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
21 temperature between NAA and Alternative 8 in any month or water year type throughout the
22 period.

23 *Kelt*

24 Flows in the American River at the confluence with the Sacramento River were evaluated for the
25 March and April kelt migration period. Flows under A8_LLTT would generally be similar to or lower
26 during March ((up to 14% lower in critical years) and generally greater than flows under NAA
27 during April (up to 44% higher in critical years) (Appendix 11C, *CALSIM II Model Results utilized in*
28 *the Fish Analysis*).

29 Mean monthly water temperatures in the American River at the confluence with the Sacramento
30 River were evaluated during the March through April steelhead kelt downstream migration period
31 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
32 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
33 temperature between NAA and Alternative 8 in any month or water year type throughout the
34 period.

35 Overall in the American River, the effects of Alternative 8 on flows would have variable effects that
36 would include flow reductions in some months/water year types (to -18% in some drier water years
37 for some months), but not to the extent that would have biologically meaningful negative effects on
38 juvenile, adult, or kelt migration conditions.

1 **Stanislaus River**

2 *Juveniles*

3 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 8 are not
4 different from flows under NAA for any month except for higher flows in below normal, dry and
5 critical water years during June and lower flows in below normal water years in December.
6 Therefore, there would be no effect of Alternative 8 on juvenile, adult, or kelt migration in the
7 Stanislaus River.

8 Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San
9 Joaquin River for Alternative 8 are not different from flows under NAA for any month. Therefore,
10 there would be no effect of Alternative 8 on juvenile, adult, or kelt migration in the Stanislaus River.

11 **San Joaquin River**

12 Flows in the San Joaquin River at Vernalis for Alternative 8 are not different from flows under NAA
13 for any month. Therefore, there would be no effect of Alternative 8 on juvenile, adult, or kelt
14 migration in the San Joaquin River.

15 Water temperature modeling was not conducted in the San Joaquin River.

16 **Mokelumne River**

17 Flows in the Mokelumne River at the Delta for Alternative 8 are not different from flows under NAA
18 for any month. Therefore, there would be no effect of Alternative 8 on juvenile, adult, or kelt
19 migration in the Mokelumne River.

20 Water temperature modeling was not conducted in the Mokelumne River.

21 **Through-Delta**

22 **Sacramento River**

23 *Juveniles*

24 The juvenile steelhead outmigration period through the Delta occurs October through May, with the
25 peak during February and March. Juvenile steelhead would be exposed to increased risk of
26 predation near the NDD intakes, but they are not expected to be negatively affected by predation at
27 the three NDD intakes because of their size and strong swimming ability. Therefore the effect on
28 juvenile steelhead outmigration success through the Delta under Alternative 8 would not be
29 substantial.

30 *Adults*

31 The upstream adult steelhead migration occurs from September-March, peaking during December-
32 February. The steelhead kelt downstream migration occurs from January-April. Straying rates of
33 adult hatchery-origin Chinook salmon that were released upstream of the Delta are low (Marston et
34 al. 2012), suggesting that Plan Area flows in relation to straying have low importance under existing
35 conditions for adult Sacramento River region steelhead.

36 The proportion of Sacramento River water in the Delta under Alternative 8 would be similar to NAA
37 (5% or less difference) throughout the adult steelhead migration (Table 11-8-47). Sacramento

1 River-origin water would still predominate Delta flows, providing sufficient olfactory cues for
2 migration. Alternative 8 would not have a negative effect on steelhead adult and kelt migration
3 through the Delta.

4 ***San Joaquin River***

5 *Juveniles*

6 The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of
7 climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows.
8 There would be no project-related flow changes associated with the alternatives. Flows associated
9 with Alternative 8 would have no effect on steelhead migration success through the Delta.

10 *Adults*

11 Little information apparently currently exists as to the importance of Plan Area flows on the straying
12 of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon
13 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of
14 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including
15 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region
16 steelhead adults as well. The proportion of San Joaquin River water in the Delta in September
17 through December would increase from less than 1% under NAA to 1.4% to 8.2% under Alternative
18 8 (Table 11-8-47). The increase in the proportion of San Joaquin River flows in Delta outflows would
19 be mainly due to the reduction in Sacramento River flows in the Delta. Therefore the effect on the
20 adult steelhead and kelt migration would not be negative and may provide a minor benefit to the
21 species.

22 ***NEPA Effects:*** The effects of Alternative 8 on steelhead migration vary by location. Upstream of the
23 Delta, collectively, the results indicate that the impact would be adverse because it would
24 substantially reduce migration habitat conditions and substantially interfere with the movement of
25 fish. Effects of Alternative 8 on mean monthly flows would include persistent flow reductions that
26 would affect juvenile and adult migration conditions in the Sacramento River (reductions to -28% in
27 drier years), and the Feather River (with persistent and substantial flow reductions, to -84% during
28 portions of the juvenile and adult migration periods). Effects of Alternative 8 on flows in the
29 American River would be variable but would not be substantial enough to be considered adverse.

30 Near-field effects of Alternative 8 NDD on Sacramento River steelhead related to impingement and
31 predation associated with three new intake structures could result in negative effects on juvenile
32 migrating steelhead, although there is high uncertainty regarding the overall effects. It is expected
33 that the level of near-field impacts would be directly correlated to the number of new intake
34 structures in the river and thus the level of impacts associated with 3 new intakes would be
35 considerably lower than those expected from having 5 new intakes in the river. Estimates within the
36 effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~
37 12% mortality above current baseline levels). CM15 would be implemented with the intent of
38 providing localized and temporary reductions in predation pressure at the NDD. Additionally,
39 several pre-construction surveys to better understand how to minimize losses associated with the
40 three new intake structures will be implemented as part of the final NDD screen design effort.
41 Alternative 8 also includes an Adaptive Management Program and Real-Time Operational Decision-
42 Making Process to evaluate and make limited adjustments intended to provide adequate migration
43 conditions for steelhead. However, at this time, due to the absence of comparable facilities anywhere

1 in the lower Sacramento River/Delta, the degree of mortality expected from near-field effects at the
2 NDD remains highly uncertain.

3 Two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with
4 the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of
5 the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 8
6 predict improvements in smolt condition and survival associated with increased access to the Yolo
7 Bypass, reduced interior Delta entry, and reduced south Delta entrainment. The overall magnitude
8 of each of these factors and how they might interact and/or offset each other in affecting salmonid
9 survival through the plan area is uncertain, and remains an area of active investigation for the BDCP.

10 The DPM is a flow-based model being developed for BDCP which attempts to combine the effects of
11 all of these elements of BDCP operations and conservation measures to predict smolt migration
12 survival throughout the entire Plan Area. The current draft of this model predicts that smolt
13 migration survival under Alternative 8 would be similar to those estimated for NAA. Further
14 refinement and testing of the DPM, along with several ongoing and planned studies related to
15 salmonid survival at and downstream of, the NDD are expected to be completed in the foreseeable
16 future. These efforts are expected to improve our understanding of the relationships and
17 interactions among the various factors affecting salmonid survival, and reduce the uncertainty
18 around the potential effects of BDCP implementation on migration conditions for steelhead.
19 However, until these efforts are completed and their results are fully analyzed, the overall
20 cumulative effect of Alternative 8 on steelhead migration remains uncertain.

21 Because upstream effects would be adverse, it is concluded that the overall effect of Alternative 8 on
22 steelhead conditions would be adverse.

23 This effect is a result of the specific reservoir operations and resulting flows associated with this
24 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
25 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change
26 the alternative, thereby making it a different alternative than that which has been modeled and
27 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
28 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-96a through AQUA-
29 96c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
30 level.

31 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of steelhead
32 migration habitat relative to Existing Conditions at upstream locations but not through the Delta for
33 the Sacramento and San Joaquin River origin fish.

34 **Upstream of the Delta**

35 ***Sacramento River***

36 *Juveniles*

37 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
38 May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
39 *Analysis*). Flows under A8_LLТ would be lower than flows under Existing Conditions during October
40 and November (up to 23% lower), generally similar during December (except for 6% lower in
41 critical water years), and generally greater than flows under Existing Conditions during February
42 through April (up to 29% higher).

1 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
2 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*
3 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
4 There would be no differences (<5%) in mean monthly water temperature between Existing
5 Conditions and Alternative 8 in all months but October, in which the temperature under Alternative
6 8 would be 5% greater than that under Existing Conditions.

7 *Adults*

8 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
9 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*
10 *the Fish Analysis*). Flows under A8_LLTP would be mixed in September (higher flows in wet and above
11 normal years but lower flows in below normal, dry and critical water years), lower than flows under
12 Existing Conditions during October and November (up to 23% lower), generally similar during
13 December (except for 6% lower in critical water years), and generally greater than flows under
14 Existing Conditions during February through May (up to 29% higher).

15 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
16 during the September through March steelhead adult upstream migration period (Appendix 11D,
17 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
18 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
19 Existing Conditions and Alternative 8 in all months except September and October, during which the
20 temperature under Alternative 8 would be 6% and 5% greater, respectively, than that under
21 Existing Conditions.

22 *Kelts*

23 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
24 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
25 *Fish Analysis*). Flows under A8_LLTP would generally be greater than flows under Existing Conditions
26 during March and April (up to 29% higher).

27 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
28 during the March through April steelhead kelt downstream migration period (Appendix 11D,
29 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
30 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
31 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

32 Overall in the Sacramento River, these results indicate that Alternative 8 would affect migration
33 conditions for juvenile and adult steelhead in the early portion of their respective migration periods,
34 particularly in drier water years (based on persistent, small to moderate flow reductions to -30%
35 during September, October, and December), and would not affect kelt steelhead migration
36 conditions.

37 **Clear Creek**

38 Water temperatures were not modeled in Clear Creek.

39 Flows in Clear Creek during the October through May juvenile steelhead migration period under
40 A8_LLTP would be similar to or greater than flows under Existing Conditions (up to 54% greater)
41 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 **Adults**

2 Flows in Clear Creek during the September through March adult steelhead migration period under
3 A8_LLTT would generally be similar to flows under Existing Conditions (up to 54% greater) except in
4 critical years during September (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
5 *Fish Analysis*).

6 **Kelt**

7 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
8 under A8_LLTT would be similar to flows under Existing Conditions except that they would be 29%
9 higher in wet years during March (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
10 *Analysis*).

11 Overall in Clear Creek, the effects of Alternative 8 on flows would not affect juvenile, adult, or kelt
12 steelhead migration based on primarily negligible effects (<5%) or increases in mean monthly flow
13 (to 52%).

14 **Feather River**

15 **Juveniles**

16 Flows in the Feather River at the confluence with the Sacramento River were examined during the
17 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
18 *utilized in the Fish Analysis*). Flows under A8_LLTT would be lower than flows under Existing
19 Conditions during October, November, and December (up to 37% lower), and greater flows than
20 Existing Conditions during January through May (up to 121% higher).

21 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
22 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
25 Existing Conditions and Alternative 8 in all months except October and January, in which months
26 temperatures under Alternative 8 would be 5% greater than temperatures under Existing
27 Conditions.

28 **Adults**

29 Flows in the Feather River at the confluence with the Sacramento River were examined during the
30 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
31 *Model Results utilized in the Fish Analysis*). Flows under A8_LLTT would be lower than flows under
32 Existing Conditions during September, October, November, and December (up to 37% lower), and
33 greater flows than Existing Conditions during January through March (up to 90% higher).

34 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
35 were evaluated during the September through March steelhead adult upstream migration period
36 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
37 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
38 temperature between Existing Conditions and Alternative 8 in all months except September,
39 October, and January, in all three of which months temperatures under Alternative 8 would be 5%
40 greater than temperatures under Existing Conditions.

1 **Kelt**

2 Flows in the Feather River at the confluence with the Sacramento River were examined during the
3 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
4 *Results utilized in the Fish Analysis*). Flows under A8_LLTP would be higher than Existing Conditions
5 during March and April (up to 121% higher).

6 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
7 were evaluated during the March through April steelhead kelt downstream migration period
8 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
9 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
10 temperature between Existing Conditions and Alternative 8 in any month or water year type
11 throughout the period.

12 Overall in the Feather River, the of Alternative 8 on flows would affect juvenile and adult migration
13 conditions in all water years during the first several months of their respective migration periods
14 based on persistent, moderate to substantial reductions in mean monthly flow (up to -37%). There
15 would be substantial increases in flow that would have beneficial effects during January through
16 May (up to 121%) that would partially offset some of the substantial flow reductions that would
17 occur starting in June and that would persist into the juvenile and adult migration periods.

18 **American River**

19 **Juveniles**

20 Flows in the American River at the confluence with the Sacramento River were evaluated during the
21 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
22 *utilized in the Fish Analysis*). Flows under A8_LLTP would generally be lower during November and
23 December (up to 33% lower). Flows during February, April and May would generally be higher (up
24 to 80%) although individual water years would be lower (up to 36% lower), and flows in October,
25 January and March would be mixed with two or three water years higher and two or three water
26 years lower in each month.

27 Mean monthly water temperatures in the American River at the confluence with the Sacramento
28 River were evaluated during the October through May juvenile steelhead migration period
29 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
30 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5% to
31 10% higher than those under Existing Conditions in all months during the period except December,
32 April, and May, in which there would be no difference in water temperatures between Existing
33 Conditions and Alternative 8.

34 **Adults**

35 Flows in the American River at the confluence with the Sacramento River were evaluated during the
36 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
37 *Model Results utilized in the Fish Analysis*). Flows under A8_LLTP would generally be lower during
38 September, November and December (up to 62% lower). Flows during February would generally be
39 higher (up to 28%) although critical water years would be lower (26% lower), and flows in October,
40 January and March would be mixed with two or three water years higher and two or three water
41 years lower in each month.

1 Mean monthly water temperatures in the American River at the confluence with the Sacramento
2 River were evaluated during the September through March steelhead adult upstream migration
3 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
4 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would
5 be 5% to 10% higher than those under Existing Conditions in all months during the period except
6 December, in which there would be no difference in water temperatures between Existing
7 Conditions and Alternative 8.

8 *Kelt*

9 Flows in the American River at the confluence with the Sacramento River were evaluated for the
10 March and April kelt migration period. Flows during March would be mixed with higher flows than
11 Existing Conditions in wet and below normal water years (14% lower for each) and lower flows in
12 dry and critical years (7% and 17% lower, respectively) while April flows would generally be higher
13 than Existing Conditions (e.g., 53% in critical years) except that they would be 11% lower in above
14 normal water years.

15 Mean monthly water temperatures in the American River at the confluence with the Sacramento
16 River were evaluated during the March through April steelhead kelt downstream migration period
17 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
18 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would be 5%
19 higher than those under Existing Conditions in March but temperatures would be similar between
20 Existing Conditions and Alternative 8 during April.

21 Overall in the American River, the effects of Alternative 8 on flows would affect juvenile and adult
22 migration conditions (based on moderate to substantial flow reductions in drier water years for
23 September through March, to -62%) and would not affect kelt steelhead migration (based on
24 variable results but limited occurrence of relatively small flow reductions, to -17%, in drier water
25 years).

26 ***Stanislaus River***

27 *Juveniles*

28 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
29 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II*
30 *Model Results utilized in the Fish Analysis*). Mean monthly flows under A8_LLT would be 6% to 16%
31 lower than flows under Existing Conditions depending on month.

32 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
33 River were evaluated during the October through May steelhead juvenile downstream migration
34 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
35 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would
36 be 6% higher than those under Existing Conditions in all months during the period except October,
37 in which temperature would be similar between Existing Conditions and Alternative 8.

38 *Adults*

39 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
40 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*

1 *Model Results utilized in the Fish Analysis*). Mean monthly flows under A8_LLT would be 6% to 16%
2 lower than flows under Existing Conditions depending on month.

3 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
4 River were evaluated during the September through March steelhead adult upstream migration
5 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
6 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would
7 be 6% higher than those under Existing Conditions in all months during the period except October,
8 in which temperature would be similar between Existing Conditions and Alternative 8.

9 *Kelt*

10 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
11 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
12 *Results utilized in the Fish Analysis*). Mean monthly flows under A8_LLT would be 8% and 12% lower
13 than flows under Existing Conditions during March and April, respectively.

14 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
15 River were evaluated during the March and April steelhead kelt downstream migration period
16 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
17 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 8 would
18 be 6% higher than those under Existing Conditions during March and April.

19 ***San Joaquin River***

20 Flows in the San Joaquin River for Alternative 8 are generally below those under Existing Conditions
21 for juveniles, adults or kelts (e.g., 13% lower in below dry years during March and 15% lower in dry
22 years during April) although flow conditions are similar during November and December.

23 Water temperature modeling was not conducted in the San Joaquin River.

24 ***Mokelumne River***

25 Flows in the Mokelumne River for Alternative 8 are generally substantially below those under
26 Existing Conditions for juveniles, adults or kelts (e.g., 17% lower in below normal years during May)
27 during September, October, November, April and May (up to 29% lower) but generally higher
28 during December (e.g., 6% higher in below normal years), January and February, and similar to
29 Existing Conditions in March except for 8% lower flows in dry years

30 Water temperature modeling was not conducted in the Mokelumne River.

31 **Through-Delta**

32 Juvenile steelhead are not expected to be negatively affected by predation at the three NDD intakes
33 because of their size and strong swimming ability. DPM results for Alternative 1A, Impact AQUA-96,
34 for Chinook salmon predict juvenile salmonid outmigration survival through the Delta would not be
35 reduced by more than 0.5%. Assuming similar effects on steelhead, Alternative 8 would have a
36 minimal effect on steelhead migration success through the Delta. Therefore the impact on juvenile
37 steelhead migration through the Delta at the Sacramento River would not be substantial.

38 The proportion of Sacramento River water in the Delta under Alternative 8 would to be similar to
39 Existing Conditions (<10% difference) during the majority of the adult upstream and kelt

1 downstream migrations. There would be a slight reduction in the proportion of Sacramento River
2 flows in March and April (11–12% less) relative to Existing Conditions, but still sufficient to provide
3 strong olfactory cues from Sacramento source water (Table 11-8-47).

4 For the San Joaquin River steelhead, the impact of Alternative 8 impact on steelhead adult and kelt
5 migration through the Delta would not be substantial.

6 **Summary of CEQA Conclusion**

7 The results of the Impact AQUA-96 analysis indicate significant impacts of Alternative 8 upstream of
8 the Delta compared to Existing Conditions, less than significant impacts on through-Delta conditions
9 for Sacramento River origin fish, and less than significant impacts on through-Delta conditions for
10 San Joaquin River origin fish compared to Existing Conditions.

11 Through the Delta, Alternative 8 would result in some effects on flow conditions during steelhead
12 migration periods (juvenile, adult and kelt), although these effects would not be substantial in either
13 the Sacramento or San Joaquin River. Similarly, olfactory effects are not expected to be substantial in
14 both locations. Consequently, the through the Delta impacts of Alternative 8 in the both the
15 Sacramento River and the San Joaquin River would be less than significant and no mitigation is
16 required. Through-Delta survival of juvenile steelhead under Alternative 8 may be similar or
17 improved relative to NAA based on DPM results for juvenile Chinook salmon from the Sacramento
18 basin (Impact AQUA-60). The effect of Alternative 8 would be less than significant on through-Delta
19 steelhead adult and kelt migrations.

20 Upstream of the Delta, the results indicate that the impact would be significant because it would
21 substantially reduce steelhead migration conditions and substantially interfere with the movement
22 of fish. Flows under Alternative 8 would negatively affect juvenile and adult migration conditions in
23 the Sacramento, Feather, American, and Stanislaus Rivers. Alternative 8 would also increase
24 exposure of steelhead to water temperatures in the Feather, American, and Stanislaus Rivers
25 Afterbay that would affect juvenile, adult, and kelt migration behavior and survival.

26 This impact is a result of the specific reservoir operations and resulting flows associated with this
27 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
28 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
29 change the alternative, thereby making it a different alternative than that which has been modeled
30 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
31 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
32 severity of impact though not necessarily to a less-than-significant level.

33 **Mitigation Measure AQUA-96a: Following Initial Operations of CM1, Conduct Additional** 34 **Evaluation and Modeling of Impacts to Steelhead to Determine Feasibility of Mitigation to** 35 **Reduce Impacts to Migration Conditions**

36 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
37 significant and unavoidable adverse effects on migration, this conclusion was based on the best
38 available scientific information at the time and may prove to have been overstated. Upon the
39 commencement of operations of CM1 and continuing through the life of the permit, the BDCP
40 proponents will monitor effects on migration in order to determine whether such effects would
41 be as extensive as concluded at the time of preparation of this document and to determine any
42 potentially feasible means of reducing the severity of such effects. This mitigation measure

1 requires a series of actions to accomplish these purposes, consistent with the operational
2 framework for Alternative 8.

3 The development and implementation of any mitigation actions shall be focused on those
4 incremental effects attributable to implementation of Alternative 8 operations only.
5 Development of mitigation actions for the incremental impact on migration attributable to
6 climate change/sea level rise are not required because these changed conditions would occur
7 with or without implementation of Alternative 8.

8 **Mitigation Measure AQUA-96b: Conduct Additional Evaluation and Modeling of Impacts**
9 **on Steelhead Migration Conditions Following Initial Operations of CM1**

10 Following commencement of initial operations of CM1 and continuing through the life of the
11 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
12 modified operations could reduce impacts to migration under Alternative 8. The analysis
13 required under this measure may be conducted as a part of the Adaptive Management and
14 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

15 **Mitigation Measure AQUA-96c: Consult with NMFS, USFWS, and CDFW to Identify and**
16 **Implement Potentially Feasible Means to Minimize Effects on Steelhead Migration**
17 **Conditions Consistent with CM1**

18 In order to determine the feasibility of reducing the effects of CM1 operations on steelhead
19 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
20 Wildlife to identify and implement any feasible operational means to minimize effects on
21 migration. Any such action will be developed in conjunction with the ongoing monitoring and
22 evaluation of habitat conditions required by Mitigation Measure AQUA-96a.

23 If feasible means are identified to reduce impacts on migration consistent with the overall
24 operational framework of Alternative 8 without causing new significant adverse impacts on
25 other covered species, such means shall be implemented. If sufficient operational flexibility to
26 reduce effects on steelhead habitat is not feasible under Alternative 8 operations, achieving
27 further impact reduction pursuant to this mitigation measure would not be feasible under this
28 Alternative, and the impact on steelhead would remain significant and unavoidable.

29 **Restoration Measures (CM2, CM4–CM7, and CM10)**

30 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
31 differences in restoration-related fish effects are anticipated anywhere in the affected environment
32 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
33 restoration measures described for steelhead under Alternative 1A (Impact AQUA-97 through
34 Impact AQUA-99) also appropriately characterize effects under Alternative 8.

35 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

36 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

37 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

38 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

1 **NEPA Effects:** Detailed discussions regarding the potential effects of these three impact mechanisms
2 on steelhead are the same for Alternative 8, as those described under Alternative 1A. The effects
3 would not be adverse, and generally beneficial. Specifically for AQUA-98, the effects of contaminants
4 on steelhead with respect to selenium, copper, ammonia and pesticides would not be adverse. The
5 effects of methylmercury on steelhead are uncertain.

6 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or
7 less than significant, and no mitigation is required.

8 **Other Conservation Measures (CM12–CM19 and CM21)**

9 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
10 differences in other conservation-related fish effects are anticipated anywhere in the affected
11 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
12 effects of other conservation measures described for steelhead under Alternative 1A (Impact AQUA-
13 100 through Impact AQUA-108) also appropriately characterize effects under Alternative 8.

14 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

15 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

16 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

17 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

18 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

19 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

20 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

21 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

22 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

23 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**
24 **(CM21)**

25 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
26 adverse effect, or beneficial effects on steelhead for NEPA purposes, for the reasons identified for
27 Alternative 1A.

28 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
29 less than significant, or beneficial on steelhead, for the reasons identified for Alternative 1A, and no
30 mitigation is required.

1 Sacramento Splittail

2 Construction and Maintenance of CM1

3 Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento 4 Splittail

5 **NEPA Effects:** The potential effects of construction of the water conveyance facilities on Sacramento
6 splittail would be similar to those described for Alternative 1A (Impact AQUA-109) except that
7 Alternative 8 would include three intakes compared to five intakes under Alternative 1A, so the
8 effects would be proportionally less under this alternative. This would convert about 7,450 lineal
9 feet of existing shoreline habitat into intake facility structures and would require about 17.1 acres of
10 dredge and channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of
11 shoreline and would require 27.3 acres of dredging. As concluded for Alternative 1A, Impact AQUA-
12 109, environmental commitments and mitigation measures would be available to avoid and
13 minimize potential effects, and the effect would not be adverse for Sacramento splittail.

14 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-109, the impact of the construction
15 of water conveyance facilities on Sacramento splittail would be less than significant except for
16 construction noise associated with pile driving. Potential pile driving impacts would be less than
17 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
18 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
19 less than significant.

20 Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects 21 of Pile Driving and Other Construction-Related Underwater Noise

22 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

23 Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving 24 and Other Construction-Related Underwater Noise

25 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

26 Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento 27 Splittail

28 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
29 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-110, except
30 that only three intakes would need to be maintained under Alternative 8 rather than five under
31 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-110, the effect would not be adverse
32 for Sacramento splittail.

33 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-110, the impact of the maintenance
34 of water conveyance facilities on Sacramento splittail would be less than significant and no
35 mitigation would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

3 ***Water Exports from SWP/CVP South Delta Facilities***

4 Total entrainment of juvenile splittail at the south Delta facilities (estimated from Yolo Bypass
5 inundation method) under Alternative 8 would be similar to NAA, averaged across all water year,
6 but increased 216–410% in above normal and below normal water year types. This very substantial
7 increase in entrainment is related to the expected increase in overall juvenile splittail abundance
8 resulting from additional floodplain habitat occurring in wetter years. However, the per capita
9 juvenile splittail entrainment when averaged across water year types would be reduced 88% under
10 NAA. Adult per capita entrainment would be reduced 80% compared to NAA. The reduction in per
11 capita salvage of splittail at the SWP/CVP south Delta facilities would be because of reductions in
12 south Delta exports once the proposed north Delta facilities become operational.

13 **Table 11-8-58. Juvenile Sacramento Splittail Entrainment Index^a (Yolo Bypass Days of Inundation
14 Method) at the SWP and CVP Salvage Facilities and Differences between Model Scenarios for
15 Alternative 8**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	135,862 (14%)	-50,797 (-4%)
Above Normal	71,586 (156%)	80,191 (216%)
Below Normal	11,788 (345%)	12,221 (410%)
Dry	4,428 (154%)	4,773 (188%)
Critical	-185 (-12%)	265 (25%)
All Years	56,512 (18%)	-1,198 (0%)

Shading indicates entrainment increased 10% or more.

^a Average May–July salvage number, based on normalized data, estimated from Yolo Bypass Inundation Method.

16

17 **Table 11-8-59. Juvenile Sacramento Splittail Entrainment Index^a (per Capita Method) at the SWP
18 and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 8**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-1,777,756 (-89%)	-1,456,434 (-87%)
Above Normal	-13,647 (-98%)	-112,815 (-98%)
Below Normal	-9,664 (-97%)	-9,346 (-97%)
Dry	-1,773 (-88%)	-1,283 (-85%)
Critical	-1,151 (-86%)	-896 (-83%)
All Years	-493,649 (-90%)	-392,102 (-88%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost, based on normalized data, estimated from delta inflow.

19

1 **Table 11-8-60. Adult Sacramento Splittail Entrainment Index^a (Salvage Density Method) at the**
 2 **SWP and CVP Salvage Facilities and Differences between Model Scenarios for Alternative 8**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
Wet	-2,649 (-67%)	-2,784 (-68%)
Above Normal	-3,837 (-80%)	-3,852 (-80%)
Below Normal	-2,834 (-84%)	-2,570 (-82%)
Dry	-2,388 (-98%)	-2,223 (-97%)
Critical	-3,325 (-99%)	-3,103 (-99%)
All Years	-2,797 (-80%)	-2,720 (-80%)

Shading indicates entrainment increased 10% or more.

^a Estimated annual number of fish lost, based on normalized data. Average (December–March).

3

4 ***Water Exports from SWP/CVP North Delta Intake Facilities***

5 The impact would be similar in type to Alternative 1A, Impact AQUA-111 (with five intakes), but the
 6 degree would be less because Alternative 8 would have only three intakes, therefore, under
 7 Alternative 8 there would be about a 60% reduction in impingement and predation risk relative to
 8 Alternative 1A, Impact AQUA-111. The conclusion is the same as for Alternative 1A, Impact AQUA-
 9 111.

10 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

11 The effect of implementing dual conveyance for the NBA with a screened alternative Sacramento
 12 River intake would be the same as described under Alternative 1A (Impact AQUA-111).

13 ***Predation Associated with Entrainment***

14 Splittail predation loss at the south Delta facilities is assumed to be proportional to entrainment
 15 loss. Per capita juvenile splittail entrainment would be reduced under Alternative 8 at the south
 16 Delta by 88% compared to NAA; predation losses would be reduced at a similar proportion.

17 Predation at the north Delta would be increased due to the installation of the proposed water export
 18 facilities on the Sacramento River, as described for Alternative 1A (Impact AQUA-111). Potential
 19 predation at the north Delta would be partially offset by reduced predation loss at the SWP/CVP
 20 south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions
 21 (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that predation was
 22 not a factor currently limiting splittail abundance. **NEPA Effects:** In conclusion, the effect from
 23 entrainment and predation loss under Alternative 8 would not be adverse, because while predation
 24 loss of splittail would be increased, per capita entrainment risk would be reduced substantially
 25 compared to the NAA.

26 **CEQA Conclusion:** Under Alternative 8, per capita entrainment of juvenile and adult splittail at the
 27 south Delta would be reduced by 90% and 80%, respectively, compared to Existing Conditions.
 28 Entrainment of splittail would be reduced at the NBA. The impact and conclusion for predation
 29 associated with entrainment would be the same as described above. Entrainment and hence pre-
 30 screen predation loss at the south Delta would be reduced by 18% compared to Existing Conditions,
 31 which would partially offset potential predation losses at the proposed three north Delta diversion

1 intakes. Although predation losses at the north Delta would exceed reductions in predation at the
2 south Delta, in any case, millions of juvenile splittail can be entrained at the south Delta in a given
3 year, but the population is still able to persist. Overall, the impact would be less than significant,
4 because the predation levels under Alternative 8 would not inhibit persistence of the splittail
5 population in the Delta.

6 In conclusion, the impact from entrainment and predation loss would be less than significant,
7 because the increase in predation losses at the north Delta under Alternative 8 would be offset by
8 the substantial reduction in south Delta per capita entrainment losses and the increased production
9 of juvenile splittail from *CM2 Yolo Bypass Fisheries Enhancement*. No mitigation would be required.

10 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 11 **Sacramento Splittail**

12 In general, Alternative 8 would have beneficial effects on splittail spawning habitat relative to the
13 NAA by increasing the quantity and quality of spawning habitat in the Yolo Bypass. There would be
14 beneficial effects on spawning conditions in channel margin and side-channel habitats from
15 moderate to substantial increases in mean monthly flow during most of the spawning period in the
16 Sacramento River and the Feather River. There would be a moderate increase in exposure to critical
17 water temperatures in the Feather River, but this negative effect would be offset by the
18 improvements in spawning habitat based on increases in flow in the Sacramento and Feather rivers
19 and by increases in spawning habitat in the Yolo Bypass.

20 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream
21 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning
22 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not
23 inundated, spawning in side channels and channel margins would be much more critical.

24 ***Floodplain Habitat***

25 Effects of Alternative 8 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased
26 flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the
27 Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects
28 in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m
29 threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored
30 because flow velocity was generally very low throughout the modeled area for most conditions, with
31 generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a
32 reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

33 The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo
34 Bypass inundation events compared to NAA for drier water year types and generally decrease the
35 frequency and duration of Yolo Bypass inundation events for wetter water year types; the changes
36 are attributable to the influence of the Fremont Weir notch at lower flows. For the drier type years
37 (below normal, dry, and critical), Alternative 8 generally results in an increase in frequency of
38 inundation events greater than 30 days compared to the NAA. For below normal years, Alternative 8
39 would result in the occurrence of four inundation events ≥ 70 days, compared to zero such events for
40 the NAA. For dry years, Alternative 8 would result in the occurrence of one inundation event 50–69
41 days, compared to zero such events for the NAA. For critical years, Alternative 8 would result in the
42 occurrence of one inundation event lasting more than 30 days, compared to no such events for the
43 NAA. The overall project-related effects consist of an increase in occurrence of longer-duration

1 inundation events during drier years that would be beneficial for splittail spawning by creating
 2 better spawning habitat conditions. Decreases in the number of longer-duration inundation events
 3 in wetter years would affect spawning conditions to some degree, increasing the importance of
 4 channel margin and side-channel habitats during these time-frames compared to the NAA.

5 **Table 11-8-61. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**
 6 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**
 7 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
30-49 Days		
Wet	-4	-2
Above Normal	-1	-1
Below Normal	5	5
Dry	7	7
Critical	1	1
50-69 Days		
Wet	-5	-5
Above Normal	0	0
Below Normal	-1	-1
Dry	1	1
Critical	0	0
≥70 Days		
Wet	7	-2
Above Normal	3	1
Below Normal	4	4
Dry	0	0
Critical	0	0

8

9 There would be increases in area of suitable splittail habitat in Yolo Bypass under Alternative 8
 10 ranging from 2 to 944 acres relative to NAA (Table 11-8-62). Areas under Alternative 8 would be
 11 53%, 82%, and 443% for wet, above normal, and below normal water years, respectively. There
 12 would be increases in area under A8_LLТ for dry and critical years relative to NAA, but they would
 13 be small to minor (113 and 2 acres, respectively). These results indicate that increases in inundated
 14 acreage in each water year type would result in increased habitat and have a beneficial effect on
 15 splittail spawning.

1 **Table 11-8-62. Increase in Splittail Weighted Habitat Area (Acres and Percent) in Yolo Bypass from**
 2 **Existing Biological Conditions to Alternative 8 by Water Year Type from 15 2-D and Daily CALSIM II**
 3 **Modeling Runs**

Water Year Type	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
Wet	1,038 (67%)	900 (53%)
Above Normal	953 (83%)	944 (82%)
Below Normal	558 (425%)	562 (443%)
Dry	113 (NA)	113 (NA)
Critical	2 (NA)	2 (NA)

NA = percent differences could not be computed because no splittail weighted habitat occurred in the bypass for NAA and Existing Conditions in those years (dividing by 0).

4
 5 A potential adverse effect of Alternative 8 that is not included in the modeling is reduced inundation
 6 of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The Fremont Weir
 7 notch with gates opened would increase the amount Sacramento River flow diverted from the river
 8 into the bypass when the river's flow is greater than about 14,600 cfs (Munévar pers. comm.). As
 9 much as about 6,000 cfs more flow would be diverted from the river with the opened notch than
 10 without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir. A decrease
 11 of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont Weir,
 12 could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although
 13 understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In
 14 any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of
 15 inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the
 16 river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass
 17 inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to
 18 reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects
 19 on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the
 20 Yolo Bypass.

21 ***Channel Margin and Side-Channel Habitat***

22 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel
 23 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,
 24 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are
 25 affected by changes in flow because greater flows cause more flooding, thereby increasing
 26 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially
 27 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are
 28 expected to be most important to the splittail population because in years of high-flows, when most
 29 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively
 30 little production.

31 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions
 32 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the
 33 Sacramento River for the time-frame February through June. These are the most important months
 34 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from
 35 the side-channel habitats during May and June if conditions become unfavorable.

1 Differences between model scenarios for monthly average flows during February through June by
2 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather
3 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 For the Sacramento River at Wilkins Slough flows during February and March would be similar to or
5 with small increased flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
6 *Analysis*). During April through June there would be increases in flow (to 39%). Therefore the effect
7 on spawning habitat for Sacramento splittail would be beneficial. These results indicate that there
8 would be some increases in flow (up to 39%) that would have beneficial effects on splittail rearing
9 conditions in the Sacramento River.

10 For the Feather River at the confluence flows during February through May would be greater than
11 under NAA (up to 130%) for all water year types (Appendix 11C, *CALSIM II Model Results utilized in*
12 *the Fish Analysis*). During June there would be flow reductions (up to 39% lower) although these
13 would be late in the spawning period. There would be an overall beneficial effect on Sacramento
14 splittail spawning.

15 Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather
16 River at the confluence with the Sacramento River, respectively were used to investigate the
17 potential effects of Alternative 8 on the suitability of water temperatures for splittail spawning and
18 egg incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and
19 egg incubation.

20 There would be no biologically meaningful difference (>5% absolute scale) between NAA and
21 Alternative 8 in the frequency of water temperatures in the Sacramento and Feather Rivers being
22 within the suitable 45°F to 75°F regardless of water year type.

1 **Table 11-8-63. Difference (Percent Difference) in Percent of Days or Months^a during February to**
 2 **June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at**
 3 **Hamilton City and Feather River at the Confluence with the Sacramento River^b**

	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
Sacramento River at Hamilton City		
<i>Temperatures below 45°F</i>		
Wet	-4 (-86%)	0 (0%)
Above Normal	-4 (-86%)	0 (0%)
Below Normal	-4 (-79%)	0 (0%)
Dry	-2 (-68%)	0 (0%)
Critical	-7 (-25%)	2 (11%)
All	-7 (-19%)	0 (0%)
<i>Temperatures above 75°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
Feather River at Sacramento River Confluence		
<i>Temperatures below 45°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<i>Temperatures above 75°F</i>		
Wet	6 (NA)	1 (19%)
Above Normal	11 (NA)	2 (22%)
Below Normal	13 (NA)	2 (18%)
Dry	15 (338%)	1 (6%)
Critical	15 (900%)	2 (13%)
All	11 (891%)	1 (9%)

NA = could not be calculated because the denominator was 0.

^a Days were used in the Sacramento River and months were used in the Feather River.

^b Based on the modeling period of 1922 to 2003.

4
 5 Overall, Alternative 8 would have negligible or beneficial effects on upstream spawning and rearing
 6 conditions in the upper Sacramento and Feather rivers.

1 **Stranding Potential**

2 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,
3 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and
4 historical data to evaluate possible stranding effects, the following provides a narrative summary of
5 potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture,
6 which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the
7 bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial
8 ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al.
9 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding
10 by allowing water to inundate certain areas of the bypass to maximize biological benefits, while
11 keeping water away from other areas to reduce stranding in isolated ponds. Actions under
12 Alternative 8 to increase the frequency of Yolo Bypass inundation would increase the frequency of
13 potential stranding events. For splittail, an increase in inundation frequency would also increase the
14 production of Sacramento splittail in the bypass. While total stranding losses may be greater under
15 Alternative 8 than under NAA, the total number of splittail would be expected to be greater under
16 Alternative 8.

17 In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement
18 in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands
19 desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may
20 decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the
21 potential improvements in habitat capacity outweighed the potential stranding problems that may
22 exist in some years.

23 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
24 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
25 as a result of egg mortality. The effects of Alternative 8 on splittail spawning habitat are largely
26 beneficial. There would be substantial benefits due to increased inundation acreages and an
27 increase in longer duration inundation events in the Yolo Bypass that would increase suitable
28 spawning conditions. Benefits due to increased inundation in the Yolo Bypass would outweigh
29 relatively small, project-related increases in exceedance of preferred water temperatures in the
30 Feather River. This is because the Yolo Bypass is a more important splittail spawning habitat than
31 the Feather River channel margin habitat, as evidenced by the large amount of spawning activity in
32 the Bypass when inundated. Effects of Alternative 8 on mean monthly flows would consist primarily
33 of negligible effects (<5%), increases in flow (to 39% in the Sacramento River and to 130% in the
34 Feather River) that would have beneficial effects on spawning conditions, with small, infrequent
35 reductions in flow (to -16%) in the Sacramento River and more persistent and substantial flow
36 reductions (to -39%) in the Feather River that would occur at the end of the spawning period and
37 therefore would not have biologically meaningful effects on spawning conditions. There would be
38 negligible effects on water temperatures in the Sacramento and Feather Rivers, relative to NAA.

39 **CEQA Conclusion:** In general, Alternative 8 would have beneficial impacts on splittail spawning
40 habitat relative to Existing Conditions by increasing the quantity of spawning habitat in the Yolo
41 Bypass through increased acreage subjected to periodic inundation. There would be negligible
42 effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and
43 the Feather River, with beneficial effects due to moderate to substantial increases in mean monthly
44 flow for some months and water year types during the spawning period. There would be negative
45 effects on water temperatures in the Feather River relative to Existing Conditions, but the benefits

1 due to increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased
2 water temperatures in the Feather River because the Yolo Bypass is a more important spawning
3 habitat to splittail than channel margin habitat in the Feather River as evidenced by the large
4 amount of spawning activity when inundated.

5 ***Floodplain Habitat***

6 The proposed changes to the Fremont Weir under Alternative 8 would have variable effects on the
7 frequency and duration of Yolo Bypass inundation events compared to Existing Conditions
8 depending on inundation duration and water year type (Figure 11-8-4, Table 11-8-61). There would
9 be no effect or small changes in occurrence of inundation events of all durations analyzed for all
10 water years with the exception of an increase of five and seven occurrences of 30 to 49-day
11 inundation events in below normal and dry years, respectively, and a decrease of nine inundation
12 events of 30 to 69-day inundation events in wet years, compared to Existing Conditions. However,
13 there would also be an increase of between three and seven inundation events of ≥ 70 days, for wet,
14 above normal and below normal water year types, compared to Existing Conditions. Decreases in
15 the number of longer-duration inundation events in wetter years would affect spawning conditions
16 to some degree, increasing the importance of channel margin and side-channel habitats during these
17 time-frames compared to Existing Conditions.

18 Comparisons of splittail weighted habitat area for Alternative 8 to Existing Conditions (Table 11-8-
19 62) indicate that Alternative 8 would result in increased acreage of suitable spawning habitat
20 compared to Existing Conditions in all water year types, with increases of between 2 and 1,038 acres
21 of suitable spawning habitat depending on water year type. Increased areas for wet, above normal,
22 and below normal water years are predicted to be 67%, 83%, and 425%, respectively, for
23 Alternative 8. Comparisons for dry and critical water years indicate project-related increases of 113
24 and 2 acres of suitable spawning habitat, respectively, compared to 0 acres for Existing Conditions.
25 Conclusions are that Alternative 8 would have beneficial impacts on splittail habitat through
26 increasing spawning habitats by up to 425%.

27 ***Channel Margin and Side-Channel Habitat***

28 Modeled flows were evaluated in the Sacramento River at Wilkins Slough for the February through
29 June splittail spawning and early life stage rearing period (Appendix 11C, *CALSIM II Model Results*
30 *utilized in the Fish Analysis*). Results indicate that Alternative 8 would have primarily negligible
31 effects (<5%) on channel margin and side channel habitats through increased flows during February
32 and March, and generally beneficial effects in April, May, and June from small to moderate increases
33 in flow (to 39%). Therefore, the impact on spawning habitat for Sacramento splittail on the upper
34 Sacramento River would be less than significant.

35 Flows in the Feather River at the confluence with the Sacramento River were evaluated during
36 February through June. Flows would be higher than Existing Conditions during February through
37 May in all water years but lower than Existing Conditions during June in all water years (Appendix
38 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These results show that Alternative 8 flow
39 would not have biologically meaningful effects on splittail rearing conditions in the Feather River.

40 There would generally be no biologically meaningful difference (>5% absolute scale) between
41 Existing Conditions and Alternative 8 in the frequency of water temperatures in the Sacramento and
42 Feather Rivers being within the suitable 45°F to 75°F, except in critical years (7% lower) for the

1 45°F threshold in the Sacramento River and all water years (6% to 15% greater) for the 75°F
2 threshold in the Feather River.

3 ***Stranding Potential***

4 As described in the NEPA effects section above, rapid reductions in flow can dewater channel
5 margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a
6 lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects
7 have been evaluated with a narrative summary. Effects for Alternative 8 would be as described for
8 Alternative 1, which concludes that Yolo Bypass improvements would be designed, in part, to
9 further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to
10 maximize biological benefits, while keeping water away from other areas to reduce stranding in
11 isolated ponds.

12 Collectively, these results indicate that the effect would be less than significant because it would not
13 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result
14 of egg mortality; no mitigation would be necessary. The impacts of Alternative 8 on splittail
15 spawning habitat are largely beneficial. There would be substantial benefits due to increased
16 inundation acreages and an increase in longer duration inundation events in the Yolo Bypass that
17 would increase suitable spawning conditions. Benefits due to increased inundation in the Yolo
18 Bypass would outweigh relatively small, project-related increases in exceedance of preferred water
19 temperatures in the Feather River. This is because the Yolo Bypass is a more important splittail
20 spawning habitat than the Feather River channel margin habitat, as evidenced by the large amount
21 of spawning activity in the Bypass when inundated. Impacts of Alternative 8 on mean monthly flows
22 would consist primarily of negligible effects (<5%), increases in flow (to 39% in the Sacramento
23 River and to 121% in the Feather River) that would have beneficial impacts on spawning conditions,
24 with small, infrequent reductions in flow (to -6%) in the Sacramento River and more persistent and
25 substantial flow reductions (to -47%) in the Feather River that would occur at the end of the
26 spawning period and therefore would not have biologically meaningful effects on spawning
27 conditions. There would be negligible effects on water temperatures in the Sacramento and Feather
28 Rivers, relative to Existing Conditions.

29 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

30 In general, Alternative 8 would have beneficial effects on splittail rearing habitat relative to the NAA
31 by increasing the quantity and quality of rearing habitat in the Yolo Bypass. There would be
32 beneficial effects on rearing conditions in channel margin and side-channel habitats from moderate
33 to substantial increases in mean monthly flow during most of the rearing period in the Sacramento
34 River and the Feather River. There would be a moderate increase in exposure to critical water
35 temperatures in the Feather River, but this negative effect would be offset by the improvements in
36 rearing habitat based on increases in flow in the Sacramento and Feather rivers and by increases in
37 rearing habitat in the Yolo Bypass.

38 Floodplains are important rearing habitats for juvenile splittail during periods of high flows when
39 areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated,
40 splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion
41 applies to rearing as well as spawning habitat for splittail.

1 **NEPA Effects:** Based on the analyses above, the effect of Alternative 8 on splittail rearing habitat
2 would not be adverse because it would not substantially reduce rearing habitat or substantially
3 reduce the number of fish as a result of mortality.

4 **CEQA Conclusion:** In general, Alternative 8 would have beneficial impacts on splittail rearing habitat
5 relative to Existing Conditions, by increasing the quantity of rearing habitat in the Yolo Bypass
6 through increased acreage subjected to periodic inundation. There would be negligible effects on
7 channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the
8 Feather River, with beneficial effect due to moderate to substantial increases in mean monthly flow
9 for some months and water year types during the rearing period. There would be negative effects on
10 water temperatures in the Feather River relative to Existing Conditions, but the benefits due to
11 increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water
12 temperatures in the Feather River because the Yolo Bypass is a more important rearing habitat to
13 splittail than channel margin habitat in the Feather River, as evidenced by the large amount of
14 rearing activity when inundated.

15 As described above, floodplains are important rearing habitats for juvenile splittail during periods of
16 high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are
17 not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous
18 impact discussion applies to rearing as well as spawning habitat for splittail. Based on the analyses
19 above, the effect of Alternative 8 on splittail rearing habitat would be less than significant because it
20 would not substantially reduce rearing habitat or substantially reduce the number of fish as a result
21 of mortality and no mitigation would be necessary.

22 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento** 23 **Splittail**

24 **Upstream of the Delta**

25 In general, effects of Alternative 8 would not affect splittail migration conditions in the Sacramento
26 River or the Feather River relative to the NAA, based on negligible or beneficial effects on mean
27 monthly flow during the migration period. There would be a negative effect based on a small
28 increase in exposure to critical water temperatures in the Feather River but this would be offset by
29 the more substantial beneficial effects from increases in mean monthly flow for much of the
30 migration period.

31 The effects of Alternative 8 on splittail migration conditions would be the same as described for
32 channel margin and side-channel habitats in the Sacramento River and Feather River for Impact
33 AQUA-112 above. There would be benefits to channel margin and side-channel habitat in both
34 locations from increases in mean monthly flow; the negative effect of a small increase in exposure to
35 critical high water temperatures compared to the NAA would not alter the conclusion of beneficial
36 effects.

37 Therefore, the effect of Alternative 8 would not be adverse because it would not substantially reduce
38 or degrade migration habitat or substantially reduce the number of fish as a result of mortality.

39 **Through-Delta**

40 Alternative 8 would reduce OMR reverse flows during the period of juvenile splittail migration
41 through the Delta. OMR flows under Alternative 8 would be greater than NAA conditions across all

1 water year types during the splittail migration. Therefore the effect on survival during the splittail
2 migration would be beneficial because of the substantial improvement in OMR flow conditions.

3 **NEPA Effects:** The effect of Alternative 8 on upstream conditions would not substantially reduce or
4 degrade migration habitat or substantially affect survival. In addition, Alternative 8 would reduce
5 OMR reverse flows during the through-Delta juvenile splittail migration period, across all water type
6 years, resulting in a beneficial effect. Therefore, the overall effect of Alternative 8 would not be
7 adverse.

8 **CEQA Conclusion:**

9 **Upstream of the Delta**

10 In general, effects of Alternative 8 would have beneficial effects on splittail migration conditions
11 relative to Existing Conditions based on moderate to substantial increases in mean monthly flow in
12 the Sacramento River and the Feather River. There would be a negative effect based on a small
13 increase in exposure to critical water temperatures in the Feather River but this would be offset by
14 the more substantial beneficial effects from increases in mean monthly flow for much of the
15 migration period.

16 Effects of Alternative 8 on splittail migration conditions are the same as described for channel
17 margin and side-channel habitats in Impact AQUA-112. As concluded above, the impact would be
18 less than significant because it would not substantially reduce suitable migration habitat or
19 substantially reduce the number of fish as a result of mortality and no mitigation would be
20 necessary. Effects of Alternative 8 on flow would not have negative effects on the availability of
21 channel margin and main-channel habitat, and would have a beneficial effect through increases in
22 mean monthly flow for some months and water year types during the migration period. Benefits to
23 flow conditions would outweigh negative effects of increased exposures to critical water
24 temperatures in the Feather River.

25 **Through-Delta**

26 Average OMR flows would be greater under Alternative 8 than the Existing Conditions during the
27 juvenile splittail migration through the Delta. Therefore the impact on splittail migration survival
28 would be beneficial because of the substantial improvement in OMR flow conditions.

29 **Summary of CEQA Conclusion**

30 In general, Alternative 8 would have beneficial effects on upstream conditions for splittail
31 migrations, relative to Existing Conditions, based on moderate to substantial increases in mean
32 monthly flow in the Sacramento River and the Feather River. In addition the average OMR flows
33 would be greater under Alternative 8, which would improve juvenile migration survival. Overall, the
34 impact would be less than significant, and likely beneficial, as it would not substantially reduce
35 suitable migration habitat or substantially reduce survival. No mitigation would be necessary.

36 **Restoration Measures (CM2, CM4–CM7, and CM10)**

37 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
38 differences in restoration-related fish effects are anticipated anywhere in the affected environment
39 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of

1 restoration measures described for Sacramento splittail under Alternative 1A (Impact AQUA-115
2 through Impact AQUA-117) also appropriately characterize effects under Alternative 8.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

4 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

5 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**
6 **Sacramento Splittail**

7 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

8 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
9 Sacramento splittail, and most would be at least slightly beneficial. Specifically for AQUA-116, the
10 effects of contaminants on Sacramento splittail with respect to selenium, copper, ammonia and
11 pesticides would not be adverse. The effects of methylmercury on Sacramento splittail are
12 uncertain.

13 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial,
14 or less than significant, and no mitigation is required.

15 **Other Conservation Measures (CM12–CM19 and CM21)**

16 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
17 differences in other conservation-related fish effects are anticipated anywhere in the affected
18 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
19 effects of other conservation measures described for Sacramento splittail under Alternative 1A
20 (Impact AQUA-118 through Impact AQUA-126) also appropriately characterize effects under
21 Alternative 8.

22 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

23 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

24 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**
25 **Splittail (CM13)**

26 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**
27 **(CM14)**

28 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**
29 **(CM15)**

30 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

31 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

32 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

33 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

1 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**
2 **Splittail (CM21)**

3 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
4 Sacramento splittail, and most would be at least slightly beneficial.

5 **CEQA Conclusion:** All nine of the impact mechanisms listed above would be at least slightly
6 beneficial, or less than significant, and no mitigation is required.

7 **Green Sturgeon**

8 **Construction and Maintenance of CM1**

9 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

10 The potential effects of construction of the water conveyance facilities on green sturgeon would be
11 similar to those described for Alternative 1A (Impact AQUA-127) except that Alternative 8 would
12 include three intakes compared to five intakes under Alternative 1A, so the effects would be
13 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
14 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
15 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
16 would require 27.3 acres of dredging.

17 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-127, environmental commitments and
18 mitigation measures would be available to avoid and minimize potential effects, and the effect would
19 not be adverse for green sturgeon.

20 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-127, the impact of the construction
21 of water conveyance facilities on green sturgeon would be less than significant except for
22 construction noise associated with pile driving. Potential pile driving impacts would be less than
23 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
24 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
25 less than significant.

26 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
27 **of Pile Driving and Other Construction-Related Underwater Noise**

28 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

29 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
30 **and Other Construction-Related Underwater Noise**

31 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

32 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

33 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
34 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-128, except
35 that only three intakes would need to be maintained under Alternative 8 rather than five under
36 Alternative 1A. As concluded Alternative 1A, Impact AQUA-128, the effect would not be adverse for
37 green sturgeon.

CEQA Conclusion: As described in Alternative 1A, Impact AQUA-128 for green sturgeon, the impact of the maintenance of water conveyance facilities on green sturgeon would be less than significant and no mitigation would be required.

Water Operations of CM1

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Water Exports

The potential entrainment effects under Alternative 8 would be the same as those under Alternative 1A, Impact AQUA-129. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the potential to avoid or reduce entrainment; there would be no adverse effect.

Alternative 8 would substantially reduce entrainment of juvenile green sturgeon at the south Delta export facilities by about 82% (~120 fish) relative to NAA (Table 11-8-64). Relative entrainment reductions would be greater in below normal, dry and critical years (99% reduction, ~41 fish) than in wet and above normal years (76% reduction, ~79 fish) compared to NAA. Therefore, the effect on entrainment would be generally beneficial to the species.

Predation Associated with Entrainment

Juvenile green sturgeon predation loss at the south Delta facilities is assumed to be proportional to entrainment loss. The total reduction of juvenile green sturgeon entrainment, and hence predation loss, would change minimally between Alternative 8 and NAA (120 fish). The impact and conclusion for predation risk associated with NPB structures and the north Delta intakes would be the same as described for Alternative 1A, Impact AQUA-129.

NEPA Effects: The overall effect of water operations on entrainment and entrainment-associated predation of green sturgeon would not be adverse.

CEQA Conclusion: Annual entrainment losses of juvenile green sturgeon across all years would be reduced by 84% under Alternative 8 (A8_LLT)(26 fish) relative to Existing Conditions (166 fish)(Table 11-8-64). Overall, impacts to green sturgeon would be beneficial and no mitigation would be required.

Table 11-8-64. Juvenile Green Sturgeon Annual Entrainment Index^a at the SWP and CVP Salvage Facilities for Alternative 8

Water Year ^b	Entrainment Index			Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS	NAA	A8_LLT	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet and Above Normal	116	104	25	-91 (-78%)	-79 (-76%)
Below Normal, Dry, and Critical	50	42	1	-49 (-99%)	-41 (-99%)
All Years	166	146	26	-140 (-84%)	-120 (-82%)

^a Estimated annual number of fish lost.

^b Sacramento Valley water year-types.

1 The impact and conclusion for predation associated with entrainment would be the same as
2 described above. Since few juvenile green sturgeon are entrained at the south Delta, reductions in
3 entrainment (84% reduction compared to Existing Conditions, representing 140 fish) under
4 Alternative 8 would have little effect on entrainment related predation loss. Overall, the impact
5 would be less than significant, because there would be little change in predation loss under
6 Alternative 8.

7 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
8 **Green Sturgeon**

9 In general, Alternative 8 would not affect spawning and egg incubation habitat for green sturgeon
10 relative to the NAA.

11 **Sacramento River**

12 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
13 Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows
14 can reduce the instream area available for spawning and egg incubation. Flows under A8_LLT would
15 nearly always be similar to or greater than flows under NAA, except in dry years during June (9%
16 lower at both locations) and in all years during July (up to 13% lower at both locations) although
17 flows can be lower or higher in individual months of individual years (*Appendix 11C, CALSIM II*
18 *Model Results utilized in the Fish Analysis*). These results indicate that there would be very few
19 reductions in flows in the Sacramento River under Alternative 8 during the spawning and egg
20 incubation period for green sturgeon.

21 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
22 the March through July green sturgeon spawning and egg incubation period (*Appendix 11D,*
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
25 NAA and Alternative 8 in any month or water year type throughout the period.

26 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was
27 determined for each month (May through September) and year of the 82-year modeling period
28 (Table 11-8-10). The combination of number of days and degrees above the 63°F threshold were
29 further assigned a “level of concern”, as defined in Table 11-8-11. Differences between baselines and
30 Alternative 8 in the highest level of concern across all months and all 82 modeled years are
31 presented in Table 11-8-65. There would be substantial increases the number of days with “orange”
32 and “yellow” “levels of concern” between NAA and Alternative 8.

33 **Table 11-8-65. Differences between Baseline and Alternative 8 Scenarios in the Number of Years**
34 **in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern,**
35 **Sacramento River at Bend Bridge, May through September**

Level of Concern	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Red	10 (250%)	1 (7%)
Orange	3 (300%)	3 (75%)
Yellow	6 (300%)	3 (38%)
None	-19 (-25%)	-7 (-13%)

36

1 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type
 2 during May through September (Table 11-8-66). Total degree-days under Alternative 8 would be up
 3 to 67% lower under Alternative 8 than under NAA during May and June, up to 13% higher under
 4 Alternative 8 during August and September, and no different (<5%) in the July.

5 **Table 11-8-66. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days**
 6 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the**
 7 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	48 (369%)	-15 (-20%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	49 (377%)	-14 (-18%)
June	Wet	6 (NA)	-12 (-67%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	6 (NA)	-12 (-67%)
July	Wet	643 (8,038%)	22 (3%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	2 (NA)	-7 (-78%)
	Critical	0 (NA)	0 (NA)
	All	645 (8,063%)	15 (2%)
August	Wet	1,608 (800%)	156 (9%)
	Above Normal	4 (NA)	-2 (-33%)
	Below Normal	23 (NA)	-23 (-50%)
	Dry	51 (NA)	2 (4%)
	Critical	47 (NA)	-30 (-39%)
	All	1,733 (862%)	104 (6%)
September	Wet	1,798 (603%)	178 (9%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	12 (NA)	12 (NA)
	Dry	177 (NA)	64 (57%)
	Critical	41 (NA)	15 (58%)
	All	2,027 (680%)	268 (13%)

NA = could not be calculated because the denominator was 0.

8

9 ***Feather River***

10 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
 11 the Sacramento River during the February through June green sturgeon spawning and egg
 12 incubation period. Flows under A8_LLT would be greater than flows under NAA in all years at both

1 locations. Flows under A8_LLT would be similar to or greater than flows under NAA at both
2 locations from March through May. Flows under A8_LLT during June would generally be lower at
3 both locations (up to 39% lower depending on water year type). (Appendix 11C, *CALSIM II Model*
4 *Results utilized in the Fish Analysis*).

5 Mean monthly water temperatures in the Feather River at Gridley were examined during the
6 February through June green sturgeon spawning and egg incubation period (Appendix 11D,
7 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
8 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
9 NAA and Alternative 8 in any month or water year type throughout the period.

10 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
11 was evaluated during May through September (Table 11-8-67). For this impact, only the months of
12 May and June were examined because spawning and egg incubation does not generally extend
13 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In
14 both May and June, the percent of months exceeding the threshold under Alternative 8 would be
15 similar to or lower (up to 31% lower on an absolute scale) than the percent under NAA.

16 **Table 11-8-67. Differences between Baseline and Alternative 8 Scenarios in Percent of Months**
17 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
18 **River at Gridley Exceed the 64°F Threshold, May through September**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A8_LLT					
May	9 (27%)	11 (60%)	9 (88%)	10 (267%)	7 (300%)
June	5 (5%)	7 (8%)	12 (16%)	21 (33%)	35 (72%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	31 (45%)
August	0 (0%)	0 (0%)	9 (9%)	20 (25%)	38 (62%)
September	27 (39%)	38 (70%)	57 (200%)	62 (833%)	49 (2,000%)
NAA vs. A8_LLT					
May	-31 (-43%)	-27 (-48%)	-14 (-42%)	-5 (-27%)	-2 (-20%)
June	-1 (-1%)	-1 (-1%)	-4 (-4%)	-7 (-8%)	-5 (-6%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (3%)
August	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (4%)
September	28 (42%)	33 (56%)	36 (73%)	26 (60%)	23 (83%)

19
20 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
21 May through September (Table 11-8-68). Only May and June were examined for spawning and egg
22 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-
23 months exceeding the threshold under Alternative 8 would be 26% lower than that under NAA
24 during May and 8% higher than that under NAA in June.

1 **Table 11-8-68. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 64°F in**
 3 **the Feather River at Gridley, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
May	Wet	8 (133%)	-16 (-53%)
	Above Normal	3 (27%)	-11 (-44%)
	Below Normal	7 (88%)	-17 (-53%)
	Dry	25 (179%)	-4 (-9%)
	Critical	25 (147%)	5 (14%)
	All	68 (121%)	-43 (-26%)
June	Wet	66 (88%)	-1 (-1%)
	Above Normal	40 (78%)	11 (14%)
	Below Normal	48 (74%)	16 (16%)
	Dry	70 (74%)	17 (12%)
	Critical	43 (77%)	4 (4%)
	All	266 (78%)	46 (8%)
July	Wet	136 (80%)	120 (65%)
	Above Normal	75 (142%)	58 (83%)
	Below Normal	107 (157%)	75 (75%)
	Dry	133 (155%)	89 (68%)
	Critical	84 (106%)	30 (23%)
	All	534 (117%)	371 (60%)
August	Wet	107 (60%)	90 (46%)
	Above Normal	64 (142%)	42 (63%)
	Below Normal	87 (124%)	55 (54%)
	Dry	125 (184%)	47 (32%)
	Critical	61 (72%)	11 (8%)
	All	443 (99%)	244 (38%)
September	Wet	61 (156%)	88 (733%)
	Above Normal	37 (231%)	46 (657%)
	Below Normal	53 (189%)	13 (19%)
	Dry	73 (261%)	21 (26%)
	Critical	58 (290%)	4 (5%)
	All	282 (215%)	172 (71%)

4

5 ***San Joaquin River***

6 Flows in the San Joaquin River at Vernalis under Alternative 8 would be similar to those under NAA
 7 throughout the March through June period (Appendix 11C, *CALSIM II Model Results utilized in the*
 8 *Fish Analysis*).

9 No water temperature modeling was conducted in the San Joaquin River.

10 ***NEPA Effects:*** Collectively, these results indicate that this effect would not be adverse because it
 11 does not have the potential to substantially reduce the amount of suitable habitat. There would be

1 very few reductions in flows or increases in water temperature exceedances in the Sacramento,
2 Feather, and San Joaquin Rivers under Alternative 8 during the spawning and egg incubation period.

3 **CEQA Conclusion:** In general, Alternative 8 would not affect spawning and egg incubation habitat for
4 green sturgeon relative to Existing Conditions.

5 **Sacramento River**

6 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
7 Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under
8 A8_LLT would generally be similar to or greater than those under Existing Conditions, except in wet
9 years during May at Keswick and Red Bluff (10% and 8% lower, respectively) and during June in
10 most years at Keswick and Red Bluff (up to 12% and 11%, respectively) although flows can be lower
11 or higher in individual months of individual years (Appendix 11C, *CALSIM II Model Results utilized in*
12 *the Fish Analysis*). These results indicate that there would be few reductions in flows in the
13 Sacramento River under Alternative 8 relative to Existing Conditions.

14 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
15 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
18 Existing Conditions and Alternative 8 in any month or water year type throughout the period.

19 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was
20 determined for each month (May through September) and year of the 82-year modeling period
21 (Table 11-8-65). The combination of number of days and degrees above the 63°F threshold were
22 further assigned a “level of concern”, as defined in Table 11-8-11. Differences between baselines and
23 Alternative 8 in the highest level of concern across all months and all 82 modeled years are
24 presented in Table 11-8-12. The number of “red” years would be 250% higher under Alternative 8
25 relative to Existing Conditions.

26 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type
27 during May through September (Table 11-8-66). Water temperatures under Alternative 8 would
28 exceed the threshold 49 degree-days (377%) more than those under Existing Conditions during May
29 and 6 degree-days (no relative change calculation possible due to division by 0) more than those
30 under Existing Conditions during June.

31 **Feather River**

32 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
33 the Sacramento River during the February through June green sturgeon spawning and egg
34 incubation period. At both locations, flows under A8_LLT would be greater in all years during
35 February than under Existing Conditions, would be similar to or greater than flows under Existing
36 Conditions during March through May, and would be lower than flows under Existing Conditions
37 during June (9% to 47% lower depending on water year type) (Appendix 11C, *CALSIM II Model*
38 *Results utilized in the Fish Analysis*).

39 Mean monthly water temperatures in the Feather River at Gridley were examined during the
40 February through June green sturgeon spawning and egg incubation period (Appendix 11D,
41 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
42 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between

1 Existing Conditions and Alternative 8 in any month or water year type throughout the period, except
2 during February, in which mean monthly temperature under Alternative 8 would be 5% higher than
3 that under Existing Conditions.

4 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
5 was evaluated during May through September (Table 11-8-67). For this impact, only the months of
6 May and June were examined because spawning and egg incubation does not generally extend
7 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131.
8 During the period, the percent of months exceeding the threshold under Alternative 8 would be
9 similar to or higher (up to 35% higher on an absolute scale) than the percent under Existing
10 Conditions.

11 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
12 May through September (Table 11-8-68). Only May and June were examined for spawning and egg
13 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-
14 months exceeding the threshold under Alternative 8 would be 121% and 77% higher than those
15 under Existing Conditions during May and June.

16 ***San Joaquin River***

17 Flows in the San Joaquin River at Vernalis under Alternative 8 would be similar to those under
18 Existing Conditions during wetter water years but up to 15% lower during drier water year types
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 No water temperatures modeling was conducted in the San Joaquin River.

21 **Summary of CEQA Conclusion**

22 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between
23 the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the
24 alternative could substantially reduce suitable spawning and egg incubation habitat, contrary to the
25 NEPA conclusion set forth above. Flows under Alternative 8 in the Feather River would be up to
26 47% lower than Existing Conditions and water temperatures in the Sacramento and Feather Rivers
27 would be elevated under Alternative 8 relative to Existing Conditions.

28 These results are primarily caused by four factors: differences in sea level rise, differences in climate
29 change, future water demands, and implementation of the alternative. The analysis described above
30 comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the
31 alternative from those of sea level rise, climate change and future water demands using the model
32 simulation results presented in this chapter. However, the increment of change attributable to the
33 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
34 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
35 implementation period, which does include future sea level rise, climate change, and water
36 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
37 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
38 effect of the alternative from those of sea level rise, climate change, and water demands. The
39 additional comparison of CALSIM flow outputs between Existing Conditions in the late long-term
40 implementation period and Alternative 8 indicates that flows in the locations and during the months
41 analyzed above would generally be similar between Existing Conditions during the LLT and
42 Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8

1 found above would generally be due to climate change, sea level rise, and future demand, and not
2 the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea
3 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
4 result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is
5 found to be less than significant and no mitigation is required.

6 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

7 In general, Alternative 8 would not affect the quantity and quality of green sturgeon larval and
8 juvenile rearing habitat relative to the NAA.

9 ***Sacramento River***

10 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
11 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*
12 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There
13 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8
14 in any month or water year type throughout the period.

15 ***Feather River***

16 Mean monthly water temperatures in the Feather River at Gridley were examined during the April
17 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
18 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
19 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8 in any
20 month or water year type throughout the period, except for higher temperatures under Alternative
21 8 in all water year types except critical during July, and above normal and below normal years in
22 August.

23 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
24 was evaluated during May through September (Table 11-8-67). The percent of months exceeding
25 the threshold under Alternative 8 would be similar to the percent under NAA during June through
26 August, lower (up to 31% lower on an absolute scale) than the percent under NAA in May, and
27 higher (up to 36% higher on an absolute scale) in September.

28 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
29 May through September (Table 11-8-68). Total degree-months exceeding the threshold under
30 Alternative 8 would be 26% lower than those under NAA during May, and would be up to 71%
31 higher those under NAA during June through September. These results indicate that there would be
32 both beneficial and negative temperature-related effects to green sturgeon rearing in the Feather
33 River.

34 ***San Joaquin River***

35 Water temperature modeling was not conducted in the San Joaquin River.

36 ***NEPA Effects:*** Collectively, these results indicate that the effect would not be adverse because it does
37 not have the potential to substantially reduce the amount of suitable habitat. There would be no
38 effect of Alternative 8 on temperatures in the Sacramento River. There would be both increases and
39 decreases in temperatures in the Feather River, which combined do not rise to the level of adverse.

1 **CEQA Conclusion:** In general, Alternative 8 would not affect the quantity and quality of green
2 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

3 **Sacramento River**

4 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
5 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*
6 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean
7 monthly water temperature under Alternative 8 would be similar to those under Existing Conditions
8 during May through July, but 5% to 9% lower than those under Existing Conditions during August
9 through October.

10 **Feather River**

11 Mean monthly water temperatures in the Feather River at Gridley were examined during the April
12 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
13 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
14 be no differences (<5%) in mean monthly water temperature between Existing Conditions and
15 Alternative 8 in any month of the rearing period.

16 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
17 was evaluated during May through September (Table 11-8-67). The percent of months exceeding
18 the threshold under Alternative 8 would be similar to or greater (up to 36% higher on an absolute
19 scale) than the percent under Existing Conditions in all months during the period.

20 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
21 May through September (Table 11-8-68). Total degree-months exceeding the threshold under
22 Alternative 8 would be 41% to 170% greater than those under Existing Conditions depending on
23 month.

24 **San Joaquin River**

25 Water temperature modeling was not conducted in the San Joaquin River.

26 **Summary of CEQA Conclusion**

27 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between
28 the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the
29 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set
30 forth above. Water temperatures would be higher in the Sacramento and Feather Rivers under
31 Alternative 8. Higher temperatures for rearing larval and juvenile green sturgeon could increase
32 stress, mortality, and susceptibility to disease.

33 These results are primarily caused by four factors: differences in sea level rise, differences in climate
34 change, future water demands, and implementation of the alternative. The analysis described above
35 comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the
36 alternative from those of sea level rise, climate change and future water demands using the model
37 simulation results presented in this chapter. However, the increment of change attributable to the
38 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
39 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
40 implementation period, which does include future sea level rise, climate change, and water

1 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
2 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
3 effect of the alternative from those of sea level rise, climate change, and water demands.

4 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
5 term implementation period and Alternative 8 indicates that flows in the locations and during the
6 months analyzed above would generally be similar between Existing Conditions during the LLT and
7 Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8
8 found above would generally be due to climate change, sea level rise, and future demand, and not
9 the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea
10 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
11 result in a significant impact on green sturgeon rearing habitat. This impact is found to be less than
12 significant and no mitigation is required.

13 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

14 In general, Alternative 8 would reduce green sturgeon migration conditions relative to the NAA.

15 **Upstream of the Delta**

16 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
17 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
18 the Sacramento River during the April through October larval migration period, the August through
19 March juvenile migration period, and the November through June adult migration period (Appendix
20 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
21 entire year, flows during all months were compared. Reduced flows could slow or inhibit
22 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
23 cues and pass impediments by adults.

24 Sacramento River flows under A8_LLTT would generally be similar to or greater than flows under
25 NAA during December through June (at Keswick and at Wilkins Slough), with some exceptions (up
26 to 18% lower). Sacramento River flows under A8_LLTT during July through November at both
27 locations would generally be lower than flows under NAA by up to 29% lower depending on
28 location, month, and water year type.

29 Feather River flows under A8_LLTT would always be similar to or greater than those under NAA LLT
30 during January through May, and nearly always lower by up to 85% during June through December.

31 Larval transport flows were also examined by utilizing the positive correlation between white
32 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the
33 assumption that the mechanism responsible for the relationship is that Delta outflow provides
34 improved green sturgeon larval transport that results in improved year class strength. Results for
35 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation
36 between Delta outflow and year class strength, green sturgeon year class strength would be greater
37 and lower under Alternative 8 depending on month.

38 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
39 potential to substantially interfere with the movement of fish. Reductions in flows in the Sacramento
40 and Feather rivers during multiple months would affect the migratory abilities of all three life stages
41 by slowing or inhibiting downstream migration of larvae and reducing the ability to sense upstream
42 migration cues and pass impediments by adults. This effect is a result of the specific reservoir

1 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
2 reservoir operations in order to alter the flows) to the extent necessary to reduce this effect to a
3 level that is not adverse would fundamentally change the alternative, thereby making it a different
4 alternative than that which has been modeled and analyzed. As a result, this would be an
5 unavoidable adverse effect because there is no feasible mitigation available. Even so, proposed
6 mitigation (Mitigation Measure AQUA-132a through AQUA-132c) has the potential to reduce the
7 severity of impact, although not necessarily to a not adverse level.

8 **CEQA Conclusion:** In general, Alternative 8 would reduce green sturgeon migration conditions
9 relative to Existing Conditions.

10 **Upstream of the Delta**

11 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
12 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
13 the Sacramento River during the April through October larval migration period, the August through
14 March juvenile migration period, and the November through June adult migration period (Appendix
15 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
16 entire year, flows during all months were compared. Reduced flows could slow or inhibit
17 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
18 cues and pass impediments by adults.

19 Flows in the Sacramento River at Keswick under A8_LLT would generally be similar to or greater
20 than flows under Existing Conditions during January through July, with some exceptions (up to 12%
21 lower), and would generally be lower than flows under Existing Conditions during August through
22 December (up to 33% lower). Flows in the Sacramento River at Wilkins Slough under A8_LLT would
23 nearly always be similar to or greater than flows under Existing Conditions during December
24 through June, except in dry years during December (5% lower) and in wet years during may (6%
25 lower). Flows at Wilkins Slough under A8_LLT would generally be lower than flows under Existing
26 Conditions during July through November (up to 35% lower).

27 Flows in the Feather River at both locations examined under A8_LLT would always be similar to or
28 greater than flows under Existing Conditions during January through May, and nearly always lower
29 during June through December (up to 85% lower).

30 For Delta outflow, the percent of months exceeding flow thresholds under A8_LLT would
31 consistently be lower than those under Existing Conditions for each flow threshold, water year type,
32 and month (8% to 50% lower) (see Table 11-8-74 below). The percentage of months exceeding flow
33 thresholds under A8_LLT would consistently be similar to or greater than those under Existing
34 Conditions, for each flow threshold and water year type during April, and lower than the percentage
35 under Existing Conditions for each flow threshold during May and during the April/May averaged
36 period (8% to 50% lower depending on water year type and period).

37 **Summary of CEQA Conclusion**

38 Collectively, these results indicate that the impact would be significant because it has the potential
39 to substantially interfere with the movement of fish. The reduction in flows in the Sacramento and
40 Feather rivers during multiple months would affect the migratory abilities of all three life stages by
41 slowing or inhibiting downstream migration of larvae and reducing the ability to sense upstream
42 migration cues and pass impediments by adults.

1 This impact is a result of the specific reservoir operations and resulting flows associated with this
2 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
3 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
4 change the alternative, thereby making it a different alternative than that which has been modeled
5 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
6 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
7 severity of impact though not necessarily to a less-than-significant level.

8 **Mitigation Measure AQUA-132a: Following Initial Operations of CM1, Conduct Additional**
9 **Evaluation and Modeling of Impacts to Green Sturgeon to Determine Feasibility of**
10 **Mitigation to Reduce Impacts to Migration Conditions**

11 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
12 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on
13 the best available scientific information at the time and may prove to have been overstated.
14 Upon the commencement of operations of CM1 and continuing through the life of the permit, the
15 BDCP proponents will monitor effects on migration habitat in order to determine whether such
16 effects would be as extensive as concluded at the time of preparation of this document and to
17 determine any potentially feasible means of reducing the severity of such effects. This mitigation
18 measure requires a series of actions to accomplish these purposes, consistent with the
19 operational framework for Alternative 8.

20 The development and implementation of any mitigation actions shall be focused on those
21 incremental effects attributable to implementation of Alternative 8 operations only.
22 Development of mitigation actions for the incremental impact on migration habitat attributable
23 to climate change/sea level rise are not required because these changed conditions would occur
24 with or without implementation of Alternative 8.

25 **Mitigation Measure AQUA-132b: Conduct Additional Evaluation and Modeling of Impacts**
26 **on Green Sturgeon Migration Conditions Following Initial Operations of CM1**

27 Following commencement of initial operations of CM1 and continuing through the life of the
28 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
29 modified operations could reduce impacts to migration habitat under Alternative 8. The analysis
30 required under this measure may be conducted as a part of the Adaptive Management and
31 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

32 **Mitigation Measure AQUA-132c: Consult with NMFS, USFWS, and CDFW to Identify and**
33 **Implement Potentially Feasible Means to Minimize Effects on Green Sturgeon Migration**
34 **Conditions Consistent with CM1**

35 In order to determine the feasibility of reducing the effects of CM1 operations on green sturgeon
36 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
37 Wildlife to identify and implement any feasible operational means to minimize effects on
38 migration habitat. Any such action will be developed in conjunction with the ongoing monitoring
39 and evaluation of habitat conditions required by Mitigation Measure AQUA-132a.

40 If feasible means are identified to reduce impacts on migration habitat consistent with the overall
41 operational framework of Alternative 8 without causing new significant adverse impacts on other
42 covered species, such means shall be implemented. If sufficient operational flexibility to reduce

1 effects on green sturgeon habitat is not feasible under Alternative 8 operations, achieving further
2 impact reduction pursuant to this mitigation measure would not be feasible under this Alternative,
3 and the impact on green sturgeon would remain significant and unavoidable.

4 **Restoration Measures (CM2, CM4–CM7, and CM10)**

5 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
6 differences in restoration-related fish effects are anticipated anywhere in the affected environment
7 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
8 restoration measures described for green sturgeon under Alternative 1A (Impact AQUA-133
9 through Impact AQUA-135) also appropriately characterize effects under Alternative 8.

10 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

11 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

12 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green** 13 **Sturgeon**

14 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

15 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
16 green sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-134, the effects
17 of contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be
18 adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

19 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial,
20 or less than significant, and no mitigation is required.

21 **Other Conservation Measures (CM12–CM19 and CM21)**

22 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
23 differences in other conservation-related fish effects are anticipated anywhere in the affected
24 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
25 effects of other conservation measures described for green sturgeon under Alternative 1A (Impact
26 AQUA-136 through Impact AQUA-144) also appropriately characterize effects under Alternative 8.

27 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

28 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

29 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon** 30 **(CM13)**

31 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

32 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon** 33 **(CM15)**

34 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

1 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

2 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

3 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

4 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**
5 **Sturgeon (CM21)**

6 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
7 adverse effect, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified
8 for Alternative 1A.

9 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
10 less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A,
11 and no mitigation is required.

12 **White Sturgeon**

13 **Construction and Maintenance of CM1**

14 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

15 The potential effects of construction of the water conveyance facilities on white sturgeon would be
16 similar to those described for Alternative 1A (Impact AQUA-145) except that Alternative 8 would
17 include three intakes compared to five intakes under Alternative 1A, so the effects would be
18 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
19 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
20 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
21 would require 27.3 acres of dredging.

22 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-145, environmental commitments and
23 mitigation measures would be available to avoid and minimize potential effects, and the effect would
24 not be adverse for white sturgeon.

25 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-145, the impact of the construction
26 of water conveyance facilities on white sturgeon would be less than significant except for
27 construction noise associated with pile driving. Potential pile driving impacts would be less than
28 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
29 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
30 less than significant.

31 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
32 **of Pile Driving and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

34 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
35 **and Other Construction-Related Underwater Noise**

36 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

1 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

2 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
3 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-146 except
4 that only three intakes would need to be maintained under Alternative 8 rather than five under
5 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-146, the effect would not be adverse
6 for white sturgeon.

7 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-146, the impact of the maintenance
8 of water conveyance facilities on white sturgeon would be less than significant and no mitigation
9 would be required.

10 **Water Operations of CM1**

11 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

12 **Water Exports**

13 The potential entrainment effects under Alternative 8 would be the same as those under Alternative
14 1A, Impact AQUA-147. Operating new north Delta intakes, dual conveyance for SWP NBA, NPBs at
15 the entrances to CCF and the DMC, and decommissioning agricultural diversions in ROAs have the
16 potential to avoid or reduce entrainment; there would be no adverse effect.

17 Alternative 8 would substantially reduce overall entrainment of juvenile white sturgeon at the south
18 Delta export facilities, estimated as salvage density, by about 84% across all years relative to NAA
19 (Table 11-8-69). Under Alternative 8, entrainment in wet and above normal water years would be
20 reduced 85%, and reduced 80% in below normal, dry, and critical water year types compared to
21 NAA. This effect would be generally beneficial to the species.

22 **Predation Associated with Entrainment**

23 Juvenile white sturgeon predation loss at the south Delta facilities is assumed to be proportional to
24 entrainment loss. The total reduction of juvenile white sturgeon entrainment, and hence predation
25 loss, would change minimally between Alternative 8 and NAA (228 fish). The impact and conclusion
26 for predation risk associated with NPB structures and the north Delta intakes would be the same as
27 described for Alternative 1A, Impact AQUA-147.

28 **NEPA Effects:** The overall effect on entrainment and entrainment-related predation under
29 Alternative 8 would not be adverse.

30 **CEQA Conclusion:** Operational activities associated with water exports from SWP/CVP south Delta
31 facilities would result in an overall 86% reduction in entrainment for juvenile white sturgeon
32 compared to Existing Conditions. Overall, impacts from Alternative 8 on white sturgeon would be
33 beneficial and no mitigation would be required.

1 **Table 11-8-69. Juvenile White Sturgeon Entrainment Index^a at the SWP and CVP Salvage Facilities**
 2 **for Sacramento Valley Water Year-Types and Differences (Absolute and Percentage) between**
 3 **Model Scenarios**

Water Year ^b	Absolute Difference (Percent Difference)	
	NAA vs. A8_LLТ	EXISTING CONDITIONS vs. A8_LLТ
Wet and Above Normal	-227 (-85%)	-203 (-84%)
Below Normal, Dry, and Critical	-30 (-80%)	-26 (-77%)
All Years	-256 (-84%)	-228 (-83%)

^a Estimated annual number of fish lost.
^b Sacramento Valley water year-types.

4
 5 The impact and conclusion for predation associated with entrainment would be the same as
 6 described above. Since few juvenile white sturgeon are entrained at the south Delta, reductions in
 7 entrainment (86% reduction compared to Existing Conditions, representing 283 fish) under
 8 Alternative 8 would have little effect in affecting entrainment related predation loss. Overall, the
 9 impact would be less than significant, because there would be little change in predation loss under
 10 Alternative 8.

11 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
 12 **White Sturgeon**

13 In general, Alternative 8 would not affect spawning and egg incubation habitat for white sturgeon
 14 relative to the NAA.

15 ***Sacramento River***

16 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
 17 May spawning and egg incubation period for white sturgeon. Flows at Wilkins Slough under A8_LLТ
 18 would nearly always be similar to or greater than those under NAA, except in critical years during
 19 April (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at
 20 Verona under A8_LLТ from February to May would always be similar to or greater than flows under
 21 NAA.

22 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
 23 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*
 24 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
 25 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8 in any
 26 month or water year type throughout the period.

27 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by
 28 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year
 29 of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees
 30 above each threshold were further assigned a “level of concern”, as defined in Table 11-8-11.
 31 Differences between baselines and Alternative 8 in the highest level of concern across all months
 32 and all 82 modeled years are presented in Table 11-8-70. For the 61°F threshold, there would be 4
 33 fewer (8% fewer) “red” years under Alternative 8 than under NAA. For the 68°F threshold, there
 34 would be negligible differences in the number of years under each level of concern between NAA
 35 and Alternative 8.

1 **Table 11-8-70. Differences between Baselines and Alternative 8 Scenarios in the Number of Years**
 2 **in Which Water Temperature Exceedances above the 61°F and 68°F Thresholds Are within Each**
 3 **Level of Concern, Sacramento River at Hamilton City, March through June**

Level of Concern	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
61°F threshold		
Red	45 (563%)	-4 (-8%)
Orange	-3 (-20%)	0 (0%)
Yellow	-19 (-61%)	2 (17%)
None	-23 (-82%)	2 (40%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	2 (NA)	-1 (-50%)
None	-2 (-2%)	1 (1%)

NA = could not be calculated because the denominator was 0.

4
 5 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at
 6 Hamilton City during March through June (Table 11-8-71, Table 11-8-72). During March through
 7 May, total degree-days exceeding the 61°F threshold under Alternative 8 would be up to 56% lower
 8 than those under NAA, while there would be no difference (<5%) during June. (Table 11-8-71). Total
 9 degree-days exceeding the 68°F threshold would not differ between NAA and Alternative 8 during
 10 March, April, and June, but would be 21% lower under Alternative 8 than under NAA during May
 11 (Table 11-8-72).

1 **Table 11-8-71. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days**
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the**
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	-2 (-50%)
	Dry	4 (NA)	-7 (-64%)
	Critical	1 (NA)	0 (0%)
	All	7 (NA)	-9 (-56%)
April	Wet	54 (450%)	-12 (-15%)
	Above Normal	15 (150%)	-53 (-68%)
	Below Normal	32 (533%)	-30 (-44%)
	Dry	83 (163%)	-61 (-31%)
	Critical	18 (1,800%)	4 (27%)
	All	202 (253%)	-152 (-35%)
May	Wet	848 (255%)	-267 (-18%)
	Above Normal	124 (57%)	-227 (-40%)
	Below Normal	337 (183%)	-112 (-18%)
	Dry	570 (282%)	137 (22%)
	Critical	302 (150%)	-48 (-9%)
	All	2,181 (191%)	-517 (-13%)
June	Wet	494 (86%)	-464 (-30%)
	Above Normal	279 (91%)	-87 (-13%)
	Below Normal	688 (326%)	186 (26%)
	Dry	1,220 (364%)	518 (50%)
	Critical	421 (113%)	-125 (-14%)
	All	3,102 (172%)	28 (1%)

NA = could not be calculated because the denominator was 0.

4

1 **Table 11-8-72. Differences between Baseline and Alternative 8 Scenarios in Total Degree-Days**
 2 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the**
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
April	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
May	Wet	31 (443%)	-5 (-12%)
	Above Normal	0 (NA)	-20 (-100%)
	Below Normal	0 (NA)	0 (NA)
	Dry	14 (NA)	12 (600%)
	Critical	0 (NA)	-1 (-100%)
	All	45 (643%)	-14 (-21%)
June	Wet	7 (NA)	-1 (-13%)
	Above Normal	7 (700%)	3 (60%)
	Below Normal	6 (NA)	4 (200%)
	Dry	17 (NA)	17 (NA)
	Critical	5 (NA)	-22 (-81%)
	All	42 (4,200%)	1 (2%)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
 7 River were examined during the February to May spawning and egg incubation period for white
 8 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at both
 9 locations under A8_LLT would always be similar to or greater than those under NAA. These results
 10 indicate that there would be no reductions in flows in the Feather River during the white sturgeon
 11 spawning and egg incubation period under Alternative 8.

12 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the
 13 confluence with the Sacramento River were examined during the February through May white
 14 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ
 15 between NAA and Alternative 8 at either location throughout the period.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis under Alternative 8 during February through May would
3 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*).

5 Water temperature modeling was not conducted for the San Joaquin River.

6 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
7 not have the potential to substantially reduce the amount of suitable habitat. Flows under
8 Alternative 8 are generally similar to flows under the NAA. In addition, exceedances above key water
9 temperature thresholds for spawning adults and egg incubation under Alternative 8 would generally
10 be similar to or lower than exceedances under the NAA.

11 **CEQA Conclusion:** In general, Alternative 8 would not affect spawning and egg incubation habitat for
12 white sturgeon relative to Existing Conditions.

13 **Sacramento River**

14 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
15 May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results*
16 *utilized in the Fish Analysis*). Flows under A8_LLTT would nearly always be similar to or greater than
17 those under Existing Conditions at both locations, except in wet years during May at Wilkins Slough
18 (6% lower). These results indicate that there would be nearly no reduction in flows in the
19 Sacramento River under Alternative 8 relative to Existing Conditions.

20 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
21 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*
22 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
23 be no differences (<5%) in mean monthly water temperature between Existing Conditions and
24 Alternative 8 in any month or water year type throughout the period.

25 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by
26 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year
27 of the 82-year modeling period (Table 11-8-10). The combination of number of days and degrees
28 above each threshold were further assigned a “level of concern”, as defined in Table 11-8-11.
29 Differences between baselines and Alternative 8 in the highest level of concern across all months
30 and all 82 modeled years are presented in Table 11-8-70. For the 61°F threshold, there would be 45
31 more (563% increase) “red” years under Alternative 8 than under Existing Conditions. For the 68°F
32 threshold, there would be negligible differences in the number of years under each level of concern
33 between Existing Conditions and Alternative 8.

34 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at
35 Hamilton City during March through June (Table 11-8-71, Table 11-8-72). Total degree-days
36 exceeding the 61°F threshold under Alternative 8 would range from 202 more degree-days (253%
37 increase) to 3,102 more degree-days (172% increase) during April through June, with a much
38 smaller difference (7 degree days - percent change unable to be calculated due to division by 0) in
39 March. Total degree-days exceeding the 68°F threshold would not differ between Existing
40 Conditions and Alternative 8 during March and April. During May and June, total degree-days would
41 be 45 (643%) and 42 (4,200%) degree-days higher under Alternative 8.

1 **Feather River**

2 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
3 River were examined during the February to May spawning and egg incubation period for white
4 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at both
5 locations from February to May under A8_LLТ would always be greater than those under Existing
6 Conditions. These results indicate that there would be no reductions in flows in the Feather River
7 under Alternative 8 relative to Existing Conditions.

8 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the
9 confluence with the Sacramento River were examined during the February through May white
10 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality
11 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water
12 temperatures would not differ between Existing Conditions and Alternative 8 at either location
13 throughout the period, except below Thermalito Afterbay during February, in which the mean
14 temperature under Alternative 8 would be 5% higher than the temperature under Existing
15 Conditions.

16 **San Joaquin River**

17 Flows in the San Joaquin River at Vernalis under Alternative 8 during February through May would
18 not be different from flows under Existing Conditions in wetter water year types, but would be up to
19 16% lower during drier water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish
20 Analysis*).

21 **Summary of CEQA Conclusion**

22 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between
23 the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the
24 alternative could substantially reduce suitable spawning and egg incubation habitat and cause
25 mortality due to elevated water temperatures, contrary to the NEPA conclusion set forth above.
26 Flows under Alternative 8 are generally similar to flows under Existing Conditions in the
27 Sacramento and Feather Rivers, although flows in drier years in the San Joaquin River during
28 February through May would be 5% to 15% lower in all months. In addition, exceedances above
29 NMFS temperature thresholds for spawning adults and egg incubation in the Sacramento River
30 would be greater under Alternative 8 than those under Existing Conditions.

31 These results are primarily caused by four factors: differences in sea level rise, differences in climate
32 change, future water demands, and implementation of the alternative. The analysis described above
33 comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the
34 alternative from those of sea level rise, climate change and future water demands using the model
35 simulation results presented in this chapter. However, the increment of change attributable to the
36 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
37 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLТ
38 implementation period, which does include future sea level rise, climate change, and water
39 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
40 the LLТ, both of which include sea level rise, climate change, and future water demands, isolates the
41 effect of the alternative from those of sea level rise, climate change, and water demands.

42 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
43 term implementation period and Alternative 8 indicates that flows in the locations and during the

1 months analyzed above would generally be similar between Existing Conditions during the LLT and
2 Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8
3 found above would generally be due to climate change, sea level rise, and future demand, and not
4 the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea
5 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
6 result in a significant impact on white sturgeon spawning and egg incubation habitat. This impact is
7 found to be less than significant and no mitigation is required.

8 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

9 In general, Alternative 8 would not affect the quantity and quality of white sturgeon larval and
10 juvenile rearing habitat relative to the NAA.

11 Water temperature was used to determine the potential effects of Alternative 8 on white sturgeon
12 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
13 their habitat is more likely to be limited by changes in water temperature than flow rates.

14 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
15 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
16 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
17 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 8 in any
18 month or water year type throughout the period. Mean monthly water temperatures in the Feather
19 River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing period
20 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
21 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
22 temperature between NAA and Alternative 8 in any month or water year type throughout the
23 period, except for above normal years in April, all water year types except critical in July, all water
24 year types except dry and critical in August, and wet and above normal years in September.

25 Water temperatures were not modeled in the San Joaquin River.

26 **NEPA Effects:** These results indicate that the effect would not be adverse because it does not have
27 the potential to substantially reduce the amount of suitable habitat. Water temperatures in the
28 Sacramento and Feather Rivers under Alternative 8 would not differ from those under the NEPA
29 point of comparison.

30 **CEQA Conclusion:** In general, Alternative 8 would not affect the quantity and quality of white
31 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

32 Water temperature was used to determine the potential effects of Alternative 8 on white sturgeon
33 larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore,
34 their habitat is more likely to be limited by changes in water temperature than flow rates.

35 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
36 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
37 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean
38 monthly water temperatures would be similar between Existing Conditions and Alternative 8 during
39 November through June, but would be 5% to 7% higher under Alternative 8 relative to Existing
40 Conditions during July through October.

1 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the
2 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality*
3 *Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water
4 temperatures would be similar between Existing Conditions and Alternative 8 during March through
5 May, but 5% to 10% higher under Alternative 8 during June through February.

6 Water temperatures were not modeled in the San Joaquin River.

7 **Summary of CEQA Conclusion**

8 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between
9 the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the
10 alternative could substantially reduce suitable spawning and egg incubation habitat and cause
11 mortality due to elevated water temperatures, contrary to the NEPA conclusion set forth above.
12 Water temperatures would be elevated during large portions of the year-round white sturgeon
13 rearing period in the Sacramento and Feather Rivers under Alternative 8 relative to Existing
14 Conditions.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate
16 change, future water demands, and implementation of the alternative. The analysis described above
17 comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the
18 alternative from those of sea level rise, climate change and future water demands using the model
19 simulation results presented in this chapter. However, the increment of change attributable to the
20 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
21 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
22 implementation period, which does include future sea level rise, climate change, and water
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
27 term implementation period and Alternative 8 indicates that flows in the locations and during the
28 months analyzed above would generally be similar between Existing Conditions during the LLT and
29 Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8
30 found above would generally be due to climate change, sea level rise, and future demand, and not
31 the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea
32 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
33 result in a significant impact on white sturgeon rearing habitat. This impact is found to be less than
34 significant and no mitigation is required.

35 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

36 In general, Alternative 8 would reduce white sturgeon migration conditions relative to the NAA.

37 Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins
38 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number
39 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)
40 (Table 11-8-73). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A8_LLT would
41 generally be similar to or greater than those under NAA, except in above normal years (5% lower).
42 The number of months per year above 31,000 cfs at Verona under A8_LLT would generally be

1 similar to or greater than those under NAA. Overall, there is no consistent negative effect of
2 Alternative 8.

3 **Table 11-8-73. Difference and Percent Difference in Number of Months between February and**
4 **May in Which Flow Rates Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough**
5 **and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wilkins Slough, 17,700 cfs^a		
Wet	0 (-2%)	0 (0%)
Above Normal	0.1 (6%)	-0.1 (-5%)
Below Normal	0 (0%)	0.1 (33%)
Dry	0.1 (33%)	0.1 (33%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs^b		
Wet	-0.1 (-2%)	0.1 (1%)
Above Normal	-0.2 (-3%)	0.2 (3%)
Below Normal	0.5 (10%)	0.8 (16%)
Dry	0.2 (5%)	-0.1 (-1%)
Critical	0.1 (2%)	0 (0%)
Verona, 31,000 cfs^a		
Wet	-0.2 (-9%)	0.1 (5%)
Above Normal	0.3 (15%)	0.4 (28%)
Below Normal	0.1 (29%)	0.2 (50%)
Dry	0 (0%)	0.1 (25%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Months analyzed: February through May.

^b Months analyzed: November through May.

6

7 Larval transport flows were also examined by utilizing the positive correlation between year class
8 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the
9 mechanism responsible for the relationship is that Delta outflow provides improved larval transport
10 that results in improved year class strength. The percentage of months exceeding flow thresholds
11 under A8_LLT would consistently be similar to or greater than those under NAA for each flow
12 threshold and water year type during April, and generally lower than those under NAA for each flow
13 threshold during May and during the April/May averaged period (up to 50% lower depending on
14 water year type and period) (Table 11-8-74). These results indicate that, using the positive
15 correlation between Delta outflow and year class strength, year class strength would be greater and
16 lower under Alternative 8 depending on month.

1 **Table 11-8-74. Difference and Percent Difference in Percentage of Months in Which Average Delta**
 2 **Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second in April and May**
 3 **of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
April			
15,000 cfs	Wet	0 (0%)	0 (0%)
	Above Normal	8 (9%)	8 (9%)
20,000 cfs	Wet	4 (5%)	4 (5%)
	Above Normal	17 (22%)	25 (38%)
25,000 cfs	Wet	0 (0%)	4 (5%)
	Above Normal	0 (0%)	8 (17%)
May			
15,000 cfs	Wet	-8 (-9%)	0 (0%)
	Above Normal	-17 (-20%)	8 (14%)
20,000 cfs	Wet	-35 (-41%)	-12 (-19%)
	Above Normal	-17 (-40%)	-8 (-25%)
25,000 cfs	Wet	-27 (-39%)	-15 (-27%)
	Above Normal	-17 (-50%)	-8 (-33%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-25 (-25%)	-17 (-18%)
20,000 cfs	Wet	-19 (-22%)	-15 (-18%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	-25 (-50%)	-25 (-50%)

4
 5 For juveniles, migration flows at Verona would nearly always be up to 50% lower under A8_LLT
 6 relative to NAA during July through December (Appendix 11C, *CALSIM II Model Results utilized in the*
 7 *Fish Analysis*). Flows under A8_LLT during January through June would generally be similar to or
 8 greater than flows under NAA with few exceptions (up to 18% lower).

9 For adults, the average number of months per year during the November through May adult
 10 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was
 11 determined (Table 11-8-73). The average number of months exceeding 5,300 cfs under A8_LLT
 12 would always be similar to greater than the number of months under NAA.

13 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
 14 potential to substantially reduce the amount of suitable habitat and substantially interfere with the
 15 movement of fish. Juvenile migration flows in the Sacramento River at Verona would be up to 50%
 16 lower in six of 12 months. These reduced flows would have a substantial effect on the ability to
 17 migrate downstream, delaying or slowing rates of successful migration downstream and increasing
 18 the risk of mortality. This effect is a result of the specific reservoir operations and resulting flows
 19 associated with this alternative. Applying mitigation (e.g., changing reservoir operations in order to
 20 alter the flows) to the extent necessary to reduce this effect to a level that is not adverse would
 21 fundamentally change the alternative, thereby making it a different alternative than that which has

1 been modeled and analyzed. As a result, this would be an unavoidable adverse effect because there
2 is no feasible mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-150a
3 through AQUA-150c) has the potential to reduce the severity of impact, although not necessarily to a
4 not adverse level.

5 **CEQA Conclusion:** In general, Alternative 8 would reduce white sturgeon migration conditions
6 relative to Existing Conditions.

7 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough
8 under A8_LLT would be similar to or greater those under Existing Conditions, in all water year typed
9 (Table 11-8-73). The number of months per year above 31,000 cfs at Verona under A8_LLT would
10 be generally similar to or greater than the number under Existing Conditions, except in wet years
11 (9% lower).

12 For Delta outflow, the percent of months exceeding flow thresholds under A8_LLT would
13 consistently be lower than those under Existing Conditions for each flow threshold, water year type,
14 and month (8% to 50% lower) (Table 11-8-74). The percentage of months exceeding flow
15 thresholds under A8_LLT would consistently be similar to or greater than those under Existing
16 Conditions, for each flow threshold and water year type during April, and lower than the percentage
17 under Existing Conditions for each flow threshold during May and during the April/May averaged
18 period (8% to 50% lower depending on water year type and period).

19 For juveniles, year-round migration flows at Verona would be up to 50% lower under A8_LLT
20 relative to Existing Conditions in nearly all water year types during June through December
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLT during
22 other months are similar to or greater than flows under Existing Conditions regardless of water year
23 type.

24 For adult migration, the average number of months exceeding 5,300 cfs under A8_LLT would
25 generally be similar to or greater than the number of months under Existing Conditions regardless
26 of water year type (Table 11-8-73).

27 **Summary of CEQA Conclusion**

28 These results indicate that this would be a significant impact because it has the potential to
29 substantially reduce the amount of suitable habitat. Juvenile migration flows in the Sacramento
30 River at Verona would be up to 50% lower in seven of 12 months. These reduced flows would have a
31 substantial effect on the ability to migrate downstream, delaying or slowing rates of successful
32 migration downstream and increasing the risk of mortality. This impact is a result of the specific
33 reservoir operations and resulting flows associated with this alternative. Applying mitigation (e.g.,
34 changing reservoir operations in order to alter the flows) to the extent necessary to reduce this
35 impact to a less-than-significant level would fundamentally change the alternative, thereby making
36 it a different alternative than that which has been modeled and analyzed. As a result, this impact is
37 significant and unavoidable because there is no feasible mitigation available. Even so, proposed
38 below is mitigation that has the potential to reduce the severity of impact though not necessarily to a
39 less-than-significant level.

1 **Mitigation Measure AQUA-150a: Following Initial Operations of CM1, Conduct Additional**
2 **Evaluation and Modeling of Impacts to White Sturgeon to Determine Feasibility of**
3 **Mitigation to Reduce Impacts to Migration Conditions**

4 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
5 significant and unavoidable adverse effects on migration, this conclusion was based on the best
6 available scientific information at the time and may prove to have been overstated. Upon the
7 commencement of operations of CM1 and continuing through the life of the permit, the BDCP
8 proponents will monitor effects on migration in order to determine whether such effects would
9 be as extensive as concluded at the time of preparation of this document and to determine any
10 potentially feasible means of reducing the severity of such effects. This mitigation measure
11 requires a series of actions to accomplish these purposes, consistent with the operational
12 framework for Alternative 8.

13 The development and implementation of any mitigation actions shall be focused on those
14 incremental effects attributable to implementation of Alternative 8 operations only.
15 Development of mitigation actions for the incremental impact on migration attributable to
16 climate change/sea level rise are not required because these changed conditions would occur
17 with or without implementation of Alternative 8.

18 **Mitigation Measure AQUA-150b: Conduct Additional Evaluation and Modeling of Impacts**
19 **on White Sturgeon Migration Conditions Following Initial Operations of CM1**

20 Following commencement of initial operations of CM1 and continuing through the life of the
21 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
22 modified operations could reduce impacts to migration under Alternative 8. The analysis
23 required under this measure may be conducted as a part of the Adaptive Management and
24 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

25 **Mitigation Measure AQUA150c: Consult with NMFS, USFWS, and CDFW to Identify and**
26 **Implement Potentially Feasible Means to Minimize Effects on White Sturgeon Migration**
27 **Conditions Consistent with CM1**

28 In order to determine the feasibility of reducing the effects of CM1 operations on white sturgeon
29 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
30 Wildlife to identify and implement any feasible operational means to minimize effects on
31 migration. Any such action will be developed in conjunction with the ongoing monitoring and
32 evaluation of habitat conditions required by Mitigation Measure AQUA-150a.

33 If feasible means are identified to reduce impacts on migration consistent with the overall
34 operational framework of Alternative 8 without causing new significant adverse impacts on
35 other covered species, such means shall be implemented. If sufficient operational flexibility to
36 reduce effects on white sturgeon habitat is not feasible under Alternative 8 operations,
37 achieving further impact reduction pursuant to this mitigation measure would not be feasible
38 under this Alternative, and the impact white sturgeon would remain significant and
39 unavoidable.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
3 differences in restoration-related fish effects are anticipated anywhere in the affected environment
4 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
5 restoration measures described for white sturgeon under Alternative 1A (Impact AQUA-151
6 through Impact AQUA-153) also appropriately characterize effects under Alternative 8.

7 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

8 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

9 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White**
10 **Sturgeon**

11 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

12 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
13 white sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-152, the effects
14 of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be
15 adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

16 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or
17 less than significant, and no mitigation is required.

18 **Other Conservation Measures (CM12–CM19 and CM21)**

19 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
20 differences in other conservation-related fish effects are anticipated anywhere in the affected
21 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
22 effects of other conservation measures described for white sturgeon under Alternative 1A (Impact
23 AQUA-154 through Impact AQUA-162) also appropriately characterize effects under Alternative 8.

24 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

25 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

26 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**
27 **(CM13)**

28 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

29 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**
30 **(CM15)**

31 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

32 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

33 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

1 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

2 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**
3 **Sturgeon (CM21)**

4 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
5 adverse effect, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified
6 for Alternative 1A.

7 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
8 less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A,
9 and no mitigation is required.

10 **Pacific Lamprey**

11 **Construction and Maintenance of CM1**

12 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

13 The potential effects of construction of the water conveyance facilities on Pacific lamprey would be
14 similar to those described for Alternative 1A (Impact AQUA-163) except that Alternative 8 would
15 include three intakes compared to five intakes under Alternative 1A, so the effects would be
16 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
17 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
18 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
19 would require 27.3 acres of dredging.

20 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and
21 mitigation measures would be available to avoid and minimize potential effects, and the effect would
22 not be adverse for Pacific lamprey.

23 *CEQA Conclusion:* As described in Alternative 1A, Impact AQUA-163, the impact of the construction
24 of water conveyance facilities on Pacific lamprey would be less than significant except for
25 construction noise associated with pile driving. Potential pile driving impacts would be less than
26 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
27 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
28 less than significant.

29 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
30 **of Pile Driving and Other Construction-Related Underwater Noise**

31 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

32 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
33 **and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

35 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

36 *NEPA Effects:* The potential effects of the maintenance of water conveyance facilities under
37 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-164, except

1 that only three intakes would need to be maintained under Alternative 8 rather than five under
2 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-164, the effect would not be adverse
3 for Pacific lamprey.

4 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-164, the impact of the maintenance
5 of water conveyance facilities on Pacific lamprey would be less than significant and no mitigation
6 would be required.

7 **Water Operations of CM1**

8 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

9 **Water Exports**

10 The potential entrainment impacts of Alternative 8 on Pacific lamprey would be the same as
11 described above for Alternative 1A for operating new SWP/CVP North Delta intakes (Impact AQUA-
12 165), non-physical barriers at the entrances to CCF and the DMC (Impact AQUA-165), and
13 decommissioning agricultural diversions in ROAs (Impact AQUA-165). These actions would avoid or
14 reduce potential entrainment on Pacific lamprey and the effect would not be adverse.

15 The analysis of Pacific lamprey and river lamprey entrainment at the SWP/CVP south Delta facilities
16 is combined because the salvage facilities do not distinguish between the two lamprey species.
17 Under Alternative 8, average annual entrainment of lamprey at the south Delta export facilities
18 would be substantially reduced by about 82% (~2,700 fish) (Table 11-8-75) across all year types
19 compared to NAA. Therefore, Alternative 8 would not have adverse effects on lamprey.

20 **Predation Associated with Entrainment**

21 Lamprey predation loss at the south Delta facilities is assumed to be proportional to entrainment
22 loss. Lamprey entrainment to the south Delta would be reduced by 81% compared to NAA and
23 predation losses would be reduced at a similar proportion. The impact and conclusion for predation
24 risk associated with NPB structures would be the same as described for Alternative 1A.

25 Predation at the north Delta would be increased due to the installation of the proposed water export
26 facilities on the Sacramento River. The effect on lamprey from predation loss at the north Delta is
27 unknown because of the lack of knowledge about their distribution and population abundances in
28 the Delta.

29 **NEPA Effects:** The overall effect of Alternative 8 on entrainment and entrainment-related predation
30 on lamprey would not be adverse.

31 **CEQA Conclusion:** Annual entrainment losses of Pacific lamprey would be decreased under
32 Alternative 8 by 82% relative to Existing Conditions (Table 11-8-75). Impacts of water operations
33 on entrainment of Pacific lamprey would be less than significant, and would provide a benefit to
34 Pacific lamprey from the reduction in entrainment loss at water export facilities. No mitigation
35 would be required.

1 **Table 11-8-75. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for**
2 **Alternative 8**

Water Year	Absolute Difference (Percent Difference)	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
All Years	-2,774 (-82%)	-2,668 (-81%)

^a Number of fish lost, based on non-normalized data, for all months.

3

4 The impact and conclusion for predation associated with entrainment would be the same as
5 described above because the additional predation losses associated with the proposed north Delta
6 intakes would be offset by the reduction in predation loss at the south Delta. The relative impact of
7 predation loss on the lamprey population is unknown since there is little available knowledge on
8 their distribution and abundance in the Delta. The impact would be less than significant. No
9 mitigation would be required.

10 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
11 **Pacific Lamprey**

12 In general, Alternative 8 would reduce the quantity and quality of Pacific lamprey spawning habitat
13 relative to the NAA due to a substantial increase exposure to critical water temperatures in the
14 Feather River. There would be negligible effects of Alternative 8 on flow and therefore redd
15 dewatering risk in all locations analyzed.

16 Flow-related impacts to Pacific lamprey spawning habitat were evaluated by estimating effects of
17 flow alterations on redd dewatering risk and effects on water temperature for the Sacramento River
18 at Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at
19 Thermalito Afterbay, American River at Nimbus Dam and at the confluence with the Sacramento
20 River, and Stanislaus River at the confluence with the San Joaquin River. Pacific lamprey spawn in
21 these rivers between January and August. Rapid reductions in flow can dewater redds leading to
22 mortality. Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing
23 a month-over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Water
24 temperature results from the SRWQM and the Reclamation Temperature Model were used to assess
25 the exceedances of water temperatures under all model scenarios in the upper Sacramento, Trinity,
26 Feather, and American Rivers.

27 Comparisons for Alternative 8 relative to NAA indicates negligible effects (<5%) for all locations
28 analyzed, indicating that project-related effects of Alternative 8 on flow would not affect the number
29 of Pacific lamprey redd cohorts predicted to experience a month-over-month change in flow of
30 greater than 50% in the Sacramento, Trinity, Feather and American Rivers. (Table 11-8-76).

1
2

Table 11-8-76. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd Cohorts^a

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A8_LLТ	NAA vs. A8_LLТ
Sacramento River at Keswick	Difference	21	-1
	Percent Difference	38%	-1%
Sacramento River at Red Bluff	Difference	18	0
	Percent Difference	33%	0%
Trinity River downstream of Lewiston	Difference	-38	4
	Percent Difference	-25%	4%
Feather River at Thermalito Afterbay	Difference	39	2
	Percent Difference	46%	2%
American River at Nimbus Dam	Difference	45	5
	Percent Difference	47%	4%
American River at Sacramento River confluence	Difference	1	1
	Percent Difference	1%	1%
Stanislaus River at San Joaquin River confluence	Difference	0	-2
	Percent Difference	0%	-3%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 8 than under Existing Conditions or NAA.

3

4 Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C
5 (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the
6 number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least
7 one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis
8 predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C
9 (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual
10 day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River,
11 corresponding to 82 years of eggs being laid every day each year from January 1 through August 31,
12 and 648 cohorts for the other rivers using monthly data over the same period. The incubation
13 periods used in this analysis are conservative and represent the extreme long end of the egg
14 incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited
15 because the extreme temperatures are masked; however, no better analytical tools are currently
16 available for this analysis. Exact spawning locations of Pacific lamprey are not well defined.
17 Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

18 In most locations, egg cohort exposure to 22°C (71.6°F) would be similar between NAA and
19 Alternative 8 or would be higher under Alternative 8, with the largest increases in the Sacramento
20 River at Hamilton (185 more cohorts, 17% increase) and in the Feather River below Thermalito
21 Afterbay (156 more cohorts, 170% increase) (Table 11-8-77). However, the number of cohorts
22 exposed to 22°C (71.6°F) under Alternative 8 would be 29% lower in the Trinity River at North
23 Fork.

1 **Table 11-8-77. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg**
 2 **Cohort Temperature Exposure^a**

Location	EXISTING CONDITIONS vs.	
	A8_LLТ	NAA vs. A8_LLТ
Sacramento River at Keswick	57 (NA)	6 (12%)
Sacramento River at Hamilton City	1,253 (NA)	185 (17%)
Trinity River at Lewiston	8 (NA)	3 (60%)
Trinity River at North Fork	12 (NA)	-5 (-29%)
Feather River at Fish Barrier Dam	1 (NA)	0 (0%)
Feather River below Thermalito Afterbay	224 (933%)	156 (170%)
American River at Nimbus	80 (727%)	6 (7%)
American River at Sacramento River Confluence	181 (323%)	21 (10%)
Stanislaus River at Knights Ferry	5 (NA)	3 (150%)
Stanislaus River at Riverbank	84 (4,200%)	-3 (-3%)

NA = could not be calculated because the denominator was 0.

^a Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F during January to August on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in Alternative 8 than in EXISTING CONDITIONS or NAA.

3
 4 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
 5 potential to substantially reduce suitable spawning habitat and substantially reduce the number of
 6 fish as a result of egg mortality. This is based on a substantial increase in egg cohorts exposed to
 7 elevated water temperatures in the Sacramento, Feather and American Rivers. Effects of Alternative
 8 8 on flow would not affect redd dewatering risk in any of the locations analyzed. This effect is a
 9 result of the specific reservoir operations and resulting flows associated with this alternative.
 10 Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent
 11 necessary to reduce this effect to a level that is not adverse would fundamentally change the
 12 alternative, thereby making it a different alternative than that which has been modeled and
 13 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
 14 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-166a through AQUA-
 15 166c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
 16 level.

17 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of Pacific lamprey
 18 spawning habitat relative to Existing Conditions due to substantial increases in Pacific lamprey redd
 19 dewatering risk in the Feather River and the American River, and substantial increases in exposure
 20 to critical water temperatures during the incubation period in the Feather River. Rapid reductions in
 21 flow can dewater redds leading to mortality. Effects of Alternative 8 on month-over-month flow
 22 reduction compared to Existing Conditions, consist of negligible effects (<5% difference) in the
 23 American River at the confluence and the Stanislaus River, a substantial decrease in egg cohorts
 24 exposed to flow reductions (-25%) in the Trinity River, and increases in exposures in the
 25 Sacramento River, Feather River, and American River at Nimbus Dam (Table 11-8-76). Changes
 26 would be most substantial for the American River (increased risk of dewatering exposure to 45
 27 cohorts or 47% at Nimbus Dam). For the Sacramento River, there would be increased exposure to

1 flow reductions for 21 cohorts or 38% at Keswick, and to 18 cohorts or 33% at Red Bluff. For the
2 Feather River, there would be increased exposure to 39 cohorts or 46%.

3 The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 8 would be greater by up to
4 933% than that under Existing Conditions in at least one location in every river examined (Table 11-
5 8-77).

6 Collectively, these results indicate that the impact would be significant because it has the potential
7 to substantially reduce suitable spawning habitat and substantially reduce the number of fish as a
8 result of egg mortality. Effects of Alternative 8 on flow would result in substantial increases in
9 Pacific lamprey redd dewatering risk in the Feather River (46%) and the American River (47%).
10 More egg cohorts are predicted to be exposed to elevated temperatures in at least one location in
11 every river examined.

12 This impact is a result of the specific reservoir operations and resulting flows associated with this
13 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
14 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
15 change the alternative, thereby making it a different alternative than that which has been modeled
16 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
17 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the severity
18 of impact though not necessarily to a less-than-significant level.

19 **Mitigation Measure AQUA-166a: Following Initial Operations of CM1, Conduct Additional**
20 **Evaluation and Modeling of Impacts to Pacific Lamprey to Determine Feasibility of**
21 **Mitigation to Reduce Impacts to Spawning Habitat**

22 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
23 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on
24 the best available scientific information at the time and may prove to have been overstated.
25 Upon the commencement of operations of CM1 and continuing through the life of the permit, the
26 BDCP proponents will monitor effects on spawning habitat in order to determine whether such
27 effects would be as extensive as concluded at the time of preparation of this document and to
28 determine any potentially feasible means of reducing the severity of such effects. This mitigation
29 measure requires a series of actions to accomplish these purposes, consistent with the
30 operational framework for Alternative 8.

31 The development and implementation of any mitigation actions shall be focused on those
32 incremental effects attributable to implementation of Alternative 8 operations only.
33 Development of mitigation actions for the incremental impact on spawning habitat attributable
34 to climate change/sea level rise are not required because these changed conditions would occur
35 with or without implementation of Alternative 8.

36 **Mitigation Measure AQUA-166b: Conduct Additional Evaluation and Modeling of Impacts**
37 **on Pacific Lamprey Spawning Habitat Following Initial Operations of CM1**

38 Following commencement of initial operations of CM1 and continuing through the life of the
39 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
40 modified operations could reduce impacts to spawning habitat under Alternative 8. The analysis
41 required under this measure may be conducted as a part of the Adaptive Management and
42 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

1 **Mitigation Measure AQUA-166c: Consult with NMFS, USFWS, and CDFW to Identify and**
2 **Implement Potentially Feasible Means to Minimize Effects on Pacific Lamprey Spawning**
3 **Habitat Consistent with CM1**

4 In order to determine the feasibility of reducing the effects of CM1 operations on Pacific lamprey
5 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
6 Wildlife to identify and implement any feasible operational means to minimize effects on
7 spawning habitat. Any such action will be developed in conjunction with the ongoing monitoring
8 and evaluation of habitat conditions required by Mitigation Measure AQUA-166a.

9 If feasible means are identified to reduce impacts on spawning habitat consistent with the
10 overall operational framework of Alternative 8 without causing new significant adverse impacts
11 on other covered species, such means shall be implemented. If sufficient operational flexibility
12 to reduce effects on Pacific lamprey habitat is not feasible under Alternative 8 operations,
13 achieving further impact reduction pursuant to this mitigation measure would not be feasible
14 under this Alternative, and the impact on Pacific lamprey would remain significant and
15 unavoidable.

16 **Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey**

17 In general, Alternative 8 would reduce rearing habitat conditions for Pacific lamprey relative to the
18 NAA.

19 Flow-related impacts to Pacific lamprey rearing habitat were evaluated by estimating effects of flow
20 alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the
21 Trinity River, Feather River, the American River at Nimbus Dam and at the confluence with the
22 Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River. Lower
23 flows can reduce the instream area available for rearing and rapid reductions in flow can strand
24 ammocoetes leading to mortality. The analysis of ammocoete stranding was conducted by analyzing
25 a range of month-over-month flow reductions from CALSIM II outputs, using the range of 50%–90%
26 in 5% increments. A cohort was considered stranded if at least one month-over-month flow
27 reduction was greater than the flow reduction at any time during the period.

28 Effects of Alternative 8 on Pacific lamprey ammocoete stranding were analyzed by calculating
29 month-over-month flow reductions for the Sacramento River at Keswick for January through August
30 (Table 11-8-78). Results for Alternative 8 compared to NAA indicate either no effect (0%) or
31 negligible effects (<5%) on cohort exposures to all flow reductions. These results indicate that
32 effects of Alternative 8 on flow would not affect Pacific lamprey ammocoete stranding in the
33 Sacramento River at Keswick.

1 **Table 11-8-78. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
 3 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	3	3
-70%	3	3
-75%	-5	-3
-80%	4	-3
-85%	47	0
-90%	NA	NA

NA = all values were 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

4
 5 Results of comparisons for the Sacramento River at Red Bluff (Table 11-8-79) for Alternative 8
 6 compared to NAA indicate no change (0%) or negligible effects ($\leq 5\%$) in all but one flow reduction
 7 category, 80% flow reductions with a moderate decrease (-16%) under Alternative 8, which would
 8 have a beneficial effect on spawning success. These results indicate that effects of Alternative 8 on
 9 flow would not affect Pacific lamprey ammocoete cohort stranding in the Sacramento River at Red
 10 Bluff.

11 **Table 11-8-79. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
 13 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	4	0
-60%	3	2
-65%	6	5
-70%	9	-3
-75%	7	-3
-80%	-6	-16
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

14
 15 Isolating the effects of the project from the effects of climate change (A8_LLT compared to NAA)
 16 indicates no effect (0%) or negligible effects ($\leq 5\%$) attributable to the project for all flow reduction

1 categories. These results indicate that effects of Alternative 8 on flow would not affect Pacific
2 lamprey ammocoete stranding in the Trinity River (Table 11-8-80).

3 **Table 11-8-80. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
4 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	24	0
-80%	31	3
-85%	24	5
-90%	33	-2

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

5
6 Comparisons of Alternative 8 to NAA for the Feather River no effect (0%) or reductions in the
7 percentage of cohorts exposed to all flow reduction categories (to -100% or a reduction from 128 to
8 0 cohorts) which would have beneficial effects on spawning success (Table 11-8-81). These results
9 indicate that effects of Alternative 8 on flow would not have negative effects on Pacific lamprey
10 ammocoete stranding in the Feather River.

11 **Table 11-8-81. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
12 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
13 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-7	-7
-70%	-10	-10
-75%	-13	-13
-80%	-48	-47
-85%	-91	-93
-90%	-100	-100

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

14
15 Comparisons for the American River at Nimbus Dam (Table 11-8-82) and at the confluence with the
16 Sacramento River (Table 11-8-83) indicate negligible effects (<5%) and moderate
17 increases in exposure (15% to 35%), attributable to the project. Increases at Nimbus Dam range

1 from 15% (increase from 284 to 327 cohorts) to 20% (increase from 483 to 580 cohorts); increases
 2 at the confluence range from 28% (392 to 500 cohorts) to 35% (429 to 578 cohorts). These results
 3 indicate that there would be substantial dewatering risk under NAA; project-related effects would
 4 contribute increases dewatering risk but would not be considered to have biologically meaningful
 5 negative effects on Pacific lamprey ammocoete rearing success in the American River.

6 **Table 11-8-82. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 7 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 8 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
-50%	0	0
-55%	0	0
-60%	1	0
-65%	2	0
-70%	40	1
-75%	130	20
-80%	346	18
-85%	483	15
-90%	200	0

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

9

10 **Table 11-8-83. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 11 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 12 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
-50%	0	0
-55%	0	0
-60%	1	0
-65%	1	0
-70%	8	0
-75%	42	4
-80%	299	35
-85%	346	28
-90%	323	1

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

13

14 Comparisons of Alternative 8 to NAA for the Stanislaus River (Table 11-8-84) indicates no effect
 15 (0%) or negligible effects to the lower flow reduction categories and 100% reduction (from 56
 16 cohorts to 0) in the 80%, 85%, and 90% flow reduction categories which would have beneficial
 17 effects on spawning success. These results indicate that project-related effects of Alternative 8 on

1 flow would not have negative effects on Pacific lamprey ammocoete stranding in the Stanislaus
2 River.

3 **Table 11-8-84. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
4 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the**
5 **Confluence with the San Joaquin River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
-50%	0	0
-55%	0	0
-60%	0	0
-65%	-8	0
-70%	5	1
-75%	52	1
-80%	-100	-100
-85%	-100	-100
-90%	-100	-100

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

6
7 To evaluate water temperature-related effects of Alternative 8 on Pacific lamprey ammocoetes, we
8 examined the predicted number of ammocoete “cohorts” that experience water temperatures
9 greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature
10 data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers
11 over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each
12 individual day or month starts a new “cohort” such that there are 18,244 cohorts for the Sacramento
13 River, corresponding to 82 years of ammocoetes being “born” every day each year from January 1
14 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

15 There would be differences in the number of ammocoete cohorts exposed to temperatures greater
16 than 71.6°F in most of the rivers (Table 11-8-85). There would be 3,155 more cohorts (28%
17 decrease) under Alternative 8 in the Sacramento River at Hamilton City, 23 more cohorts (20%
18 increase) exposed under Alternative 8 in the Trinity River at Lewiston, but 112 fewer cohorts (37%
19 decrease) exposed in the Trinity River at North Fork. In addition, there would be 72 more cohorts
20 (14% increase) exposed under Alternative 8 in the Feather River below Thermalito Afterbay, and 57
21 more cohorts (102% increase) exposed in the Stanislaus River at Knights Ferry. Overall, the
22 increases and decreases are expected to balance out within rivers such that there would be no
23 overall effect on Pacific lamprey ammocoetes.

1 **Table 11-8-85. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Temperatures Greater than 71.6°F in at Least One Day or Month**

Location	EXISTING CONDITIONS	
	vs. A8_LL1	NAA vs. A8_LL1
Sacramento River at Keswick ^b	1,711 (NA)	6 (0.4%)
Sacramento River at Hamilton City ^b	14,410 (NA)	3,155 (28%)
Trinity River at Lewiston	136 (NA)	23 (20%)
Trinity River at North Fork	193 (NA)	-112 (-37%)
Feather River at Fish Barrier Dam	56 (NA)	0 (0%)
Feather River below Thermalito Afterbay	211 (55%)	72 (14%)
American River at Nimbus	383 (197%)	16 (3%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	113 (NA)	57 (102%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Positive values indicate a higher value in Alternative 8 than in EXISTING CONDITIONS or NAA.

^b Based on daily data; all other locations use monthly data; 1922–2003.

3

4 **NEPA Effects:** Collectively these results indicate that the effect would be adverse because it would
 5 substantially reduce rearing habitat or substantially reduce the number of fish as a result of
 6 ammocoete mortality. There would be similar or decreased stranding risk in all river except the
 7 American River, in which stranding risk would increase at both sites by up to 25%. Further,
 8 exposure to elevated temperatures would increase in at least one location in all rivers except the
 9 American River.

10 **CEQA Conclusion:** In general, Alternative 8 would reduce rearing habitat conditions for Pacific
 11 lamprey relative to the Existing Conditions. As described for operations-related effects of
 12 Alternative 8 on spawning habitat for Pacific lamprey above, it was determined that the effects of
 13 Alternative 8 on water temperatures for the Sacramento River, Trinity River, American River, and
 14 Stanislaus River were the same as described for Alternative 1A, Impact AQUA-167, which are that
 15 there would not be adverse effects on ammocoete cohort rearing based on water temperatures for
 16 these locations.

17 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can
 18 strand ammocoetes leading to mortality. Comparisons of Alternative 8 to Existing Conditions for the
 19 Sacramento River at Keswick indicate negligible changes ($\leq 5\%$) in ammocoete cohort exposure to
 20 flow reductions for all flow reduction categories with the exception of an increase (47%) in cohorts
 21 exposed to 85% flow reductions (Table 11-8-78). Comparisons for the Sacramento River at Red
 22 Bluff indicate negligible effects (<5%) or small increases (to 9%) for all flow reduction categories,
 23 with the exception of a small decrease in exposure (-6%) for 80% flow reduction events and an
 24 increase in exposure (56 to 112 cohorts or a 100% increase) for 85% flow reduction events. Based
 25 on the fact that increases in exposure would only be substantial for a single flow reduction category
 26 at both locations, Alternative 8 would not be expected to have biologically meaningful negative
 27 effects on spawning success in the Sacramento River.

28 Comparisons of Alternative 8 to Existing Conditions for the Trinity River indicate no effect (0%
 29 difference) for flow reductions from 50% to 70%, and increases ranging from 24% to 33% for the

1 larger flow reduction categories (Table 11-8-79). Despite the prevalence of increased exposure risk
2 to the higher flow reduction events, the percentage of cohorts exposed to stranding risk is relatively
3 small compared to the total number of cohorts exposed to dewatering risk under Existing
4 Conditions (for example, an increase from 413 to 542 cohorts) and therefore effects of Alternative 8
5 are not expected to have biologically meaningful effects on spawning success in the Trinity River.

6 In the Feather River, Alternative 8 would have no effect (0%) or decreased occurrence of
7 ammocoete cohorts exposed to flow reductions for all flow reduction categories, ranging from -7%
8 to -100%, which would have beneficial effects on spawning success (Table 11-8-81). These results
9 indicate that the effects of Alternative 8 on flow would not have negative effects on Pacific lamprey
10 ammocoete cohort stranding in the Feather River.

11 Comparisons for the American River at Nimbus Dam (Table 11-8-82) and at the confluence with the
12 Sacramento River (Table 11-8-83) predict negligible effects (<5%) for the lower flow reduction
13 categories, and increased occurrence of flow reductions between 65% or 70% and 90% for
14 Alternative 8 compared to Existing Conditions; predicted increases ranged from 40% to 483% for
15 Nimbus Dam and from 42 to 346% for the confluence. These percentage increases are based on
16 increases on the order of 56 to 327 cohorts and 112 to 500 cohorts exposed to flow reductions at
17 Nimbus Dam, and 56 to 237 and 112 to 500 cohorts exposed to flow reductions at the confluence.
18 These persistent and substantial increases in exposures to larger flow reduction events would have
19 biologically meaningful effects on Pacific lamprey ammocoete cohort stranding and therefore
20 spawning success in the American River.

21 Comparisons for the Stanislaus River indicate that Alternative 8 would have no effect (0%) or
22 decreased occurrence of ammocoete cohorts exposed to flow reductions for flow reduction
23 categories from 50% to 70%, an increase (52%) in exposure to 75% flow reduction events, and
24 substantial decreases (from 56 cohorts to 0) in exposure to 80% through 90% flow reduction events
25 which would have beneficial effects on spawning success (Table 11-8-84). Substantial reductions to
26 the higher flow reduction events would offset the increase (52%) to 75% flow reduction events in
27 terms of biological effects on rearing success. These results indicate that the effects of Alternative 8
28 on flow would not have negative effects on Pacific lamprey ammocoete cohort stranding in the
29 Stanislaus River.

30 The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under
31 Alternative 8 would be higher than those under Existing Conditions in all the river locations (Table
32 11-8-85).

33 **Summary of CEQA Conclusion**

34 Collectively, the results of the Impact AQUA-167 CEQA analysis indicate that the difference between
35 the CEQA baseline and Alternative 8 is significant because, the alternative could substantially reduce
36 rearing habitat and substantially reduce the number of fish as a result of ammocoete mortality.
37 Effects of Alternative 8 on flow relative to Existing Conditions would have biologically meaningful,
38 negative effects in the Trinity and American Rivers through substantial increases in the number of
39 ammocoete cohorts exposed to a broad range of flow reductions. There would be no biologically
40 meaningful effects on Pacific lamprey ammocoete stranding in the Sacramento or Feather Rivers.
41 Exposure to elevated water temperatures would substantially increase under Alternative 8 relative
42 to Existing Conditions in every location evaluated.

1 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

2 In general, effects of Alternative 8 on Pacific lamprey migration conditions would be negligible
3 relative to the NAA.

4 ***Macrophthalmia***

5 After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macrophthalmia once
6 they reach the Delta. Migration generally is associated with large flow pulses in winter months
7 (December through March) (USFWS unpublished data) meaning alterations in flow have the
8 potential to affect downstream migration conditions. The effects of Alternative 8 on seasonal
9 migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow output. Flow
10 rates along the migration pathways of Pacific lamprey during the likely migration period (December
11 through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River
12 at the confluence with the Sacramento River, the American River at the confluence with the
13 Sacramento River, and the Stanislaus River at the confluence with the San Joaquin River.

14 ***Sacramento River***

15 The difference in mean monthly flow rate for the Sacramento River at Rio Vista for Alternative 8
16 compared to NAA for December to May indicates variable results, with decreases in mean monthly
17 flow to -17% during December for all but wet water years (<5%), and negligible effects (<5%) or
18 small increases (to 13%) or decreases (to -14%) in flow for the remainder of the migration period,
19 with the exception of larger increases during April and May (to 34%) that would have beneficial
20 effects on migration conditions. These results indicate that the effects of Alternative 8 on flow would
21 not have biologically meaningful negative effects on macrophthalmia migration conditions in the
22 Sacramento River at Rio Vista.

23 For the Sacramento River at Red Bluff, the difference in mean monthly flow rate for Alternative 8
24 compared to NAA for December through May indicates primarily negligible effects (<5%) on flow
25 attributable to the project throughout the migration period, with relatively infrequent increases in
26 flow (to 20%) and more persistent and substantial increases (to 36%) during April and May that
27 would be beneficial for migration. There would be infrequent, small decreases in flow during
28 December in above normal years (-9%), and during January in dry (-7%) and critical years (-11%).
29 These decreases would be isolated and small in magnitude and would not have biologically
30 meaningful effects on migration conditions. These results indicate that the project-related effects on
31 flow in the Sacramento River at Red Bluff would not have biologically meaningful negative effects on
32 migration conditions.

33 ***Feather River***

34 Comparisons for the Feather River at the confluence with the Sacramento River for December to
35 May indicate similar results with a few occurrences of negligible effects (<5%) but otherwise
36 primarily decreases in flow (to -28%) during December and increases in flow (to 130%) during
37 January through May. The fairly persistent, project-related decreases in flow during December
38 would have negative effects at the start of the migration period, but would be offset by persistent,
39 substantial increases for the remainder of the migration period, which would have beneficial effects.
40 These results indicate that Alternative 8 would not have biologically meaningful negative effects on
41 migration conditions in the Feather River.

1 *American River*

2 Comparisons for the American River at the confluence with the Sacramento River for Alternative 8
3 compared to NAA for all December through May indicate project-related effects consist of negligible
4 effects (<5%) or small increases (to 9%) and decreases (to -14%) in mean monthly flows that would
5 not have biologically meaningful effects on migration, and more substantial increases in flow during
6 April and May (to 131%), including in drier water years, which would have beneficial effects on
7 migration conditions. These results indicate that the effects of Alternative 8 on flow would not have
8 biologically meaningful negative effects on macrophthalmia migration in the American River.

9 *Stanislaus River*

10 Comparisons for the Stanislaus River at the confluence with the San Joaquin River for Alternative 8
11 compared to NAA for all December through May indicate project-related effects consist of negligible
12 effects (<5%) for each month and water year type throughout the migration period. These results
13 indicate that the project-related effects of Alternative 8 on flow would not have biologically
14 meaningful negative effects on macrophthalmia migration in the Stanislaus River.

15 Overall, for macrophthalmia migration conditions, these results indicate that project-related effects of
16 Alternative 8 on flow consist primarily of negligible effects (<5%) and small to substantial increases
17 in flow (depending on location, to 36% in the Sacramento River, 130% in the Feather River, and
18 131% in the American River) that would have beneficial effects on migration conditions, with
19 infrequent and/or small decreases in flow (to -17%, to -28% in the American River) that would not
20 have biologically meaningful negative effects on migration conditions, for all locations analyzed.

21 **Adult**

22 CALSIM flow data form the basis for the summary of changes in adult lamprey migration flows for
23 the January to June migration period.

24 *Sacramento River*

25 For the Sacramento River at Red Bluff for January to June, analysis of Alternative 8 indicates that
26 project-related effects throughout the migration period would be negligible (<5%), with small to
27 moderate increases in flow (to 36%) for some water years in each month that would have beneficial
28 effects on migration conditions, and infrequent, small reductions in flow, during January in dry (-
29 7%) and critical years (-11%) and during June in dry years (-9%). These decreases in flow would be
30 infrequent and of small magnitude and would not have biologically meaningful negative effects.
31 These results indicate that the effects of Alternative 8 on flow would not have negative effects on
32 adult migration in the Sacramento River.

33 *Feather River*

34 For the Feather River at the confluence with the Sacramento River for January to June, mean
35 monthly flows under Alternative 8 indicates project-related effects consist primarily of negligible
36 effects (<5%) and increases in flow to 130% that would have beneficial effects on migration
37 conditions for January through May, and decreases in flow for most water years during June ranging
38 from -24% to -39%. These decreases during June would occur at the end of the migration period and
39 following a lengthy portion of the migration period that would experience increases in flow under
40 Alternative 8, and would therefore not have negative effects on migration conditions. These results

1 indicate that effects of Alternative 8 on flow would not have biologically meaningful negative effects
2 on adult migration in the Feather River.

3 *American River*

4 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
5 River for January to June indicate predominantly negligible effects (<5%) and small-scale increases
6 (to 9%) or decreases (to -14%) attributable to the project during January through March, more
7 substantial increases (to 131%) during April, May and June, including in drier years, that would
8 have beneficial effects on migration conditions. These results indicate that project-related effects of
9 Alternative 8 on flow would not have biologically meaningful negative effects on adult migration
10 conditions in the American River.

11 *Stanislaus River*

12 Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin
13 River for January to June indicate negligible effects (<5%) attributable to the project for all months
14 and water year types throughout the migration period, with the exception of moderate increases in
15 flow during June in dry (19%) and critical years (16%) that would have beneficial effects on
16 migration conditions. These results indicate that project-related effects of Alternative 8 on flow
17 would not have biologically meaningful negative effects on adult migration conditions in the
18 Stanislaus River.

19 Overall, results for adult migration indicate that project-related effects of Alternative 8 on flow
20 would consist primarily of negligible effects (<5%), small to substantial increases in flow (to 36% in
21 the Sacramento River, 130% in the Feather River, and 131% in the American River) that would have
22 beneficial effects on migration conditions, and infrequent and/or small reductions in flow (to -14%,
23 to -39% late in the migration period in the Feather River), that would not have biologically
24 meaningful negative effects on adult migration.

25 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
26 would not substantially reduce the amount of suitable habitat or substantially interfere with the
27 movement of fish. Effects of Alternative 8 on mean monthly flow during the Pacific lamprey
28 macrophthalmia and adult migration periods consist primarily of negligible effects (<5%), small to
29 substantial increases in flow (to 131%) that would have beneficial effects on migration conditions,
30 with infrequent and/or small decreases in flow (to -39%) that would not have biologically
31 meaningful negative effects on migration conditions, for all locations analyzed.

32 **CEQA Conclusion:** In general, under Alternative 8 water operations, the quantity and quality of
33 Pacific lamprey migration conditions would not be reduced relative to the CEQA baseline.

34 **Macrophthalmia**

35 *Sacramento River*

36 Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista for December to May
37 for Alternative 8 relative to Existing Conditions indicate persistent, moderate reductions in mean
38 monthly flow during December (to -21%), and negligible effects (<5% difference) or small-scale
39 increases (to 13%) and decreases (to -8%) in flow for January through March, with more substantial
40 increases during April and May in drier water years (to 33%) when effects on migration conditions
41 would be beneficial, and decreases in flow during May in wetter years when effects on migration

1 conditions would be less critical. The persistent, moderate decreases in December would occur at
2 the start of the migration period and would not persist to the same magnitude through the rest of
3 the migration period, and would therefore not have biologically meaningful negative effects on
4 migration conditions. These results indicate that effects of Alternative 8 on flow would not have
5 biologically meaningful effects on outmigrating macrophthalmia in the Sacramento River at Rio Vista.

6 Comparisons for the Sacramento River at Red Bluff for December to May for Alternative 8 relative to
7 Existing Conditions indicate primarily negligible effects (<5%) or increases in flow (to 29%) that
8 would have beneficial effects on migration conditions, with limited occurrence of reductions in flow
9 during December in above normal (-8%) and dry years (-6%) that would not have biologically
10 meaningful negative effects. These results indicate that the effects of Alternative 8 on flow would not
11 have biologically meaningful effects on outmigrating macrophthalmia in the Sacramento River at Red
12 Bluff.

13 *Feather River*

14 Comparisons for the Feather River at the confluence for December to May indicate variable effects
15 by month and water year type, with decreases in mean monthly flow during December for all water
16 year types, ranging from -7% to -44%, and increases in flow for the remainder of the migration
17 period in all water years (to 121%) that would have beneficial effects on migration conditions. The
18 persistent, moderate flow reductions during December would occur at the start of the migration
19 period and would be offset by moderate to substantial increases in flow for the rest of the migration
20 period and would therefore not have biologically meaningful negative effects. These results indicate
21 that effects of Alternative 8 on flows would not have biologically meaningful negative effects on
22 macrophthalmia migration in the Feather River.

23 *American River*

24 Comparisons for the American River at the confluence with the Sacramento River for December to
25 May indicate variable effects of Alternative 8 relative to Existing Conditions, with decreases in mean
26 monthly flow during December (to -29%), including in drier water years; variable effects during
27 January, February and March with primarily increases in wetter years (to 29%) and decreases in
28 drier years (to -35%); primarily increases in flow during April (to 53%), including in drier water
29 years; and reductions in wetter years (to -32%) and increases in drier years (to 80%) during May.
30 Effects that would be most critical for migration conditions consist of reductions in flow in drier
31 water years; these would occur in December (to -29%) and January (to -35%) at the start of the
32 migration period, and would persist in critical years during February (-26%) and March (-17%).
33 Negative effects of these reductions would be somewhat offset by substantial increases in flow in
34 drier years during April (to 53%) and May (to 80%), the last two months of the migration period.
35 The persistent, moderate decreases, particularly in drier water years, from January through March
36 would have negative effects on migration conditions that would only be partially offset by later
37 increases.

38 *Stanislaus River*

39 Comparisons for the Stanislaus River at the confluence with the San Joaquin River for December to
40 May indicate primarily decreases in mean monthly flow throughout the migration period (to -36%)
41 with the exception of three isolated occurrences of increases in flow during December in below
42 normal years (7%), January in above normal years (14%), and March in wet years (7%). Effects that
43 would be most critical for migration conditions consist of reductions in flow in drier water years;

1 these would occur in December (to -7%) and January (to -16%) at the start of the migration period,
2 and would persist in drier water years through May (to -27% in below normal years, to -36% in dry
3 years, and to -29% in critical years). The persistent, moderate decreases, particularly in drier water
4 years, from December through May would have negative effects on migration conditions throughout
5 the migration period.

6 Overall for juvenile migration, the effects of Alternative 8 on mean monthly flows consist of variable
7 results for most locations, with increases and decreases in mean monthly flow depending on the
8 month and water year type. Generally results would not be expected to result in biologically
9 meaningful negative effects on migration conditions with the exception of the American River and
10 the Stanislaus River, where persistent, moderate flow reductions would occur in drier water years
11 for most of the migration period (to -35% in the American River, to -36% in the Stanislaus River)
12 and could have negative effects on migration conditions in those locations.

13 **Adult**

14 *Sacramento River*

15 Comparisons of mean monthly flow for the Sacramento River at Red Bluff during the Pacific lamprey
16 adult migration period from January through June indicate that for most months and water year
17 types, flows under Alternative 8 would be similar to (<5% difference) or greater than flows under
18 Existing Conditions, with increases in mean monthly flow to 29% that would have a beneficial effect
19 on migration conditions, with the only exception being a small decrease in flow during May in wet
20 years (-8%) when effects of flow reductions would be less critical for migration conditions.
21 Increases in mean monthly flow, particularly those that would occur in drier water years during
22 January, March, May and June, would have beneficial effects on migration. These results indicate that
23 the effects of Alternative 8 on flow would not affect adult migration conditions in the Sacramento
24 River.

25 *Feather River*

26 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento
27 River for January to June indicate effects of Alternative 8 on flow consist entirely of small (6%) to
28 substantial increases in flow (to 121%) for January through May that would have beneficial effects
29 on migration conditions, and decreases in flow during June (to -47%) in all water years. The
30 decreases in June would occur in the last month of the migration period and would occur after a
31 prolonged period of persistent, substantial increases in flow under Alternative 8 in all water years.
32 Therefore, the overall effects of Alternative 8 would be beneficial, and the flow reductions in June
33 would not have biologically meaningful negative effects on migration conditions.

34 *American River*

35 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
36 River for January to June indicate variable effects of Alternative 8 depending on the month and
37 water year type, with primarily increases in mean monthly flow (to 29%) during January through
38 March in wetter years, and decreases (to -35%) in drier years. There would be primarily increases
39 during April (to 53%) and May (to 80%) in drier years that would have beneficial effects on
40 migration conditions, with negligible effects (<5%), or small (-11%) to moderate (-32%) decreases
41 in wetter years. There would be decreases during June in wet (-36%) and critical (-21%) years, an
42 increase (10%) in dry years, and negligible effects in the remaining years. Effects during dry and

1 critical years when changes in flow would be more important for migration consist of decreases in
2 flow (to -35%) for the first three months of the migration period, followed by substantial increases
3 in flow (to 80%) for two months, followed by a decrease in critical years for the last month of the
4 migration period. Despite the variability of these results, the persistent, moderate decreases in flow
5 for the first three months of the migration period could have negative effects on migration
6 conditions.

7 *Stanislaus River*

8 Comparisons of mean monthly flow for the Stanislaus River at the confluence with the San Joaquin
9 River for January to June indicate primarily decreases in mean monthly flow (to -36%) during
10 January through June with only a few, isolated exceptions consisting of negligible effects (<5%) or
11 small increases in flow (to 14%). The persistent, small to moderate decreases in flow throughout the
12 migration period, including in drier water years, would have negative effects on migration
13 conditions.

14 Overall regarding adult migration, the effects of Alternative 8 on flow consist predominantly of
15 increases in mean monthly flow (to 29% in the Sacramento River, 121% in the Feather River) with
16 the exception of decreases that would occur late in the migration period in the Feather River (to -
17 47%), and therefore not have biologically meaningful negative effects on migration conditions, and
18 decreases in flow for the first half of the migration period (to -35%) in drier water years in the
19 American River, and throughout the migration period in all water years in the Stanislaus River (to -
20 36%), that would have negative effects on migration conditions.

21 **Summary of CEQA Conclusion**

22 Collectively, these results indicate that the effect of Alternative 8 would less than significant because
23 there would be no substantial reduction in migration habitat or potential to substantially interfere
24 with the movement of fish. Flows in each river, except the Stanislaus River, would generally be
25 similar to or higher than those under the CEQA baseline. In the Stanislaus River, mean monthly flows
26 would be 8% to 14% lower during a large portion of both the macrophthemia and adult migration
27 periods. These reductions, due to their small magnitude, are not expected to cause a biologically
28 meaningful effect to the Pacific lamprey population.

29 Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between
30 the CEQA baseline and Alternative 8 could be significant because, under the CEQA baseline, the
31 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
32 the movement of fish contrary to the NEPA conclusion set forth above. Effects of Alternative 8 on
33 flow would have negative effects on juvenile migration conditions in the American River (based on
34 persistent, moderate reductions in flow, to -35%, including in drier water years, during most of the
35 juvenile migration period and the first half of the adult migration period) and in the Stanislaus River
36 (based on persistent, small to moderate reductions in flow, to -36%, in all months and most water
37 year types throughout the migration period), and despite some variability based on month and
38 water year type would not have biologically meaningful negative effects in the Sacramento River or
39 the Feather River.

40 These results are primarily caused by four factors: differences in sea level rise, differences in climate
41 change, future water demands, and implementation of the alternative. The analysis described above
42 comparing Existing Conditions to Alternative 8 does not partition the effect of implementation of the
43 alternative from those of sea level rise, climate change and future water demands using the model

1 simulation results presented in this chapter. However, the increment of change attributable to the
2 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
3 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
4 implementation period, which does include future sea level rise, climate change, and water
5 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
6 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
7 effect of the alternative from those of sea level rise, climate change, and water demands.

8 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
9 term implementation period and Alternative 8 indicates that flows in the locations and during the
10 months analyzed above would generally be similar between Existing Conditions during the LLT and
11 Alternative 8. This indicates that the differences between Existing Conditions and Alternative 8
12 found above would generally be due to climate change, sea level rise, and future demand, and not
13 the alternative. As a result, the CEQA conclusion regarding Alternative 8, if adjusted to exclude sea
14 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
15 result in a significant impact on migration conditions for Pacific lamprey. This impact is found to be
16 less than significant and no mitigation is required.

17 **Restoration Measures (CM2, CM4–CM7, and CM10)**

18 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
19 differences in restoration-related fish effects are anticipated anywhere in the affected environment
20 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
21 restoration measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169
22 through Impact AQUA-171) also appropriately characterize effects under Alternative 8.

23 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

24 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

25 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific 26 Lamprey**

27 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

28 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
29 Pacific lamprey, and most would be at least slightly beneficial.

30 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial, or
31 less than significant, and no mitigation is required.

32 **Other Conservation Measures (CM12–CM19 and CM21)**

33 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
34 differences in other conservation-related fish effects are anticipated anywhere in the affected
35 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
36 effects of other conservation measures described for Pacific lamprey under Alternative 1A (Impact
37 AQUA-172 through Impact AQUA-180) also appropriately characterize effects under Alternative 8.

1 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

2 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

3 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**
4 **(CM13)**

5 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

6 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**
7 **(CM15)**

8 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

9 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

10 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

11 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

12 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**
13 **Lamprey (CM21)**

14 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
15 adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified
16 for Alternative 1A.

17 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
18 less than significant, or beneficial on Pacific lamprey, for the reasons identified for Alternative 1A,
19 and no mitigation is required.

20 **River Lamprey**

21 **Construction and Maintenance of CM1**

22 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

23 The potential effects of construction of the water conveyance facilities on river lamprey would be
24 similar to those described for Alternative 1A (Impact AQUA-181) except that Alternative 8 would
25 include three intakes compared to five intakes under Alternative 1A, so the effects would be
26 proportionally less under this alternative. This would convert about 7,450 lineal feet of existing
27 shoreline habitat into intake facility structures and would require about 17.1 acres of dredge and
28 channel reshaping. In contrast, Alternative 1A would convert 11,900 lineal feet of shoreline and
29 would require 27.3 acres of dredging.

30 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-181, environmental commitments and
31 mitigation measures would be available to avoid and minimize potential effects, and the effect would
32 not be adverse for river lamprey.

33 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-181, the impact of the construction
34 of water conveyance facilities on river lamprey would be less than significant except for

1 construction noise associated with pile driving. Potential pile driving impacts would be less than
2 Alternative 1A because only three intakes would be constructed rather than five. Implementation of
3 Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to
4 less than significant.

5 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
6 **of Pile Driving and Other Construction-Related Underwater Noise**

7 Please refer to Mitigation Measure AQUA-1a under Impact AQUA-1.

8 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
9 **and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1b under Impact AQUA-1.

11 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

12 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
13 Alternative 8 would be the same as those described for Alternative 1A, Impact AQUA-182, except
14 that only three intakes would need to be maintained under Alternative 8 rather than five under
15 Alternative 1A. As concluded in Alternative 1A, Impact AQUA-182, the effect would not be adverse
16 for river lamprey.

17 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-182, the impact of the maintenance
18 of water conveyance facilities on river lamprey would be less than significant and no mitigation
19 would be required.

20 **Water Operations of CM1**

21 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

22 **Water Exports**

23 The potential entrainment impacts of Alternative 8 on river lamprey would be the same as described
24 above for Alternative 1A for operating new SWP/CVP North Delta intakes (Impacts AQUA-183), non-
25 physical barriers at the entrances to CCF and the DMC (Impacts AQUA-183), and decommissioning
26 agricultural diversions in ROAs (Impacts AQUA-183). These actions would avoid or reduce potential
27 entrainment and the effect would not be adverse.

28 The analysis of river lamprey entrainment at the SWP/CVP south Delta facilities is combined with
29 the analysis of Pacific lamprey because the salvage facilities do not distinguish between the two
30 lamprey species. Like Alternative 1A (Impact AQUA-183), Alternative 8 would substantially reduce
31 average annual entrainment of lamprey, estimated by salvage density, by about 81% (Table 11-8-
32 86) averaged across all years compared to the NAA.

33 **NEPA Effects:** The overall effect on entrainment under Alternative 8 would not be adverse.

34 **CEQA Conclusion:** As described above, annual entrainment losses of river lamprey would be
35 reduced under Alternative 8 by approximately 82% compared to Existing Conditions (Table 11-8-
36 86). At the north Delta facilities and the alternate NBA intake, the screened intakes as designed
37 would exclude this species. Decommissioning agricultural diversions would slightly reduce potential

1 entrainment. Impacts of water operations on entrainment of river lamprey would be less than
2 significant, and no mitigation would be required.

3 **Table 11-8-86. Lamprey Annual Entrainment Index at the SWP and CVP Salvage Facilities for**
4 **Alternative 8**

Water Year	Absolute Difference (Percent Difference) ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
All Years	-2,774 (-82%)	-2,668 (-81%)

^a Number of fish lost, based on non-normalized data, for all months.

5

6 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
7 **River Lamprey**

8 In general, Alternative 8 would reduce the quantity and quality of river lamprey spawning habitat
9 relative to the NAA due to moderate to substantial increases in risk of dewatering in the Feather
10 River and the American River, and due to substantial increases in exposure to critical water
11 temperatures in the Feather River below Thermalito Afterbay.

12 Flow-related impacts to river lamprey spawning habitat were evaluated by estimating effects of flow
13 alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames
14 for river lamprey incorporated into the analysis. Rapid reductions in flow can dewater redds leading
15 to mortality. The same locations were analyzed as for Pacific lamprey: the Sacramento River at
16 Keswick and Red Bluff, Trinity River downstream of Lewiston, Feather River at Thermalito Afterbay,
17 American River at Nimbus Dam and at the confluence with the Sacramento River, and the Stanislaus
18 River at the confluence with the San Joaquin River. River lamprey spawn in these rivers between
19 February and June so flow reductions during those months have the potential to dewater redds,
20 which could result in incomplete development of the eggs to ammocoetes (the larval stage).

21 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-
22 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. There would be
23 negligible effects ($\leq 5\%$) in the Sacramento River at Keswick and Red Bluff and in the Trinity River, a
24 moderate increase (33%) in the Feather River, and increases in the American River at Nimbus Dam
25 (23%) and the confluence (20%). There would be a small decrease in exposure (-8%) in the
26 Stanislaus River that would have beneficial effects on spawning success (Table 11-8-87). These
27 results indicate that project-related effects of Alternative 8 on flow would not have biologically
28 meaningful negative effects on redd dewatering risk in the Sacramento River, Trinity River, and
29 Stanislaus River, but would affect spawning conditions in the Feather River and the American River.

1 **Table 11-8-87. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**
2 **Cohorts^a**

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A8_LLТ	NAA vs. A8_LLТ
Sacramento River at Keswick	Difference	3	0
	Percent Difference	9%	0%
Sacramento River at Red Bluff	Difference	0	-2
	Percent Difference	0%	-5%
Trinity River downstream of Lewiston	Difference	-2	0
	Percent Difference	-3%	0%
Feather River Below Thermalito Afterbay	Difference	9	19
	Percent Difference	13%	33%
American River at Nimbus	Difference	24	15
	Percent Difference	44%	23%
American River at Sacramento River confluence	Difference	32	15
	Percent Difference	54%	20%
Stanislaus River at San Joaquin River confluence	Difference	-9	-4
	Percent Difference	-16%	-8%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 8 than under Existing Conditions or NAA.

3
4 River lamprey generally spawn between February and June (Beamish 1980; Moyle 2002). Using
5 Pacific lamprey as a surrogate, eggs are assumed to hatch in 18-49 days depending on water
6 temperature (Brumo 2006) and are, therefore, assumed to be present during roughly the same
7 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey “adults need...
8 temperatures [that] do not exceed 25°C,” although there is no mention of thermal requirements for
9 eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs,
10 significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both
11 temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs.
12 The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM
13 period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from
14 USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods
15 during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data
16 from the Bureau’s temperature model. Each individual day or month starts a new “egg cohort” such
17 that there are 12.320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid
18 every day each year from February 1 through June 30, and 405 cohorts for the other rivers using
19 monthly data over the same period. The incubation periods used in this analysis are conservative
20 and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of
21 the monthly average time step is limited because the extreme temperatures are masked; however,
22 no better analytical tools are currently available for this analysis. Spawning locations of river
23 lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is
24 thought to spawn in each river.

1 For both thresholds, there would be few differences in egg cohort exposure between NAA and
 2 Alternative 8 at all sites (Table 11-8-88). The reduction of 43 cohorts (13% decrease) in the
 3 Sacramento River at Hamilton City for the 71.6°F threshold is negligible to the population
 4 considering the total number of cohorts is 12,320. In the Feather River below Thermalito Afterbay,
 5 there would be 64 more cohorts (168% increase) exposed to the 71.6°F threshold under Alternative
 6 8 relative to NAA and a small differences in cohorts (5 more cohorts, 250% increase) at the 77°F
 7 threshold. Overall, these results indicate that there would be no differences in egg exposure to
 8 elevated temperatures under Alternative 8, except in the Feather River at Thermalito Afterbay.

9 **Table 11-8-88. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg**
 10 **Cohort Temperature Exposure**

Location	EXISTING CONDITIONS	
	vs. A8_LL1	NAA vs. A8_LL1
71.6°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	280 (NA)	-43 (-13%)
Trinity River at Lewiston	0 (NA)	-1 (-100%)
Trinity River at North Fork	4 (NA)	-1 (-20%)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	93 (1,033%)	64 (168%)
American River at Nimbus	24 (480%)	-1 (-3%)
American River at Sacramento River Confluence	65 (232%)	11 (13%)
Stanislaus River at Knights Ferry	1 (NA)	1 (NA)
Stanislaus River at Riverbank	31 (3,100%)	-3 (-9%)
77°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	46 (NA)	10 (28%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	7 (NA)	5 (250%)
American River at Nimbus	10 (NA)	6 (150%)
American River at Sacramento River Confluence	16 (NA)	10 (167%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F and 77°F F during February to June on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in Alternative 8 than in EXISTING CONDITIONS or NAA.

11

12 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
 13 potential to substantially reduce spawning habitat and substantially reduce the number of fish as a
 14 result of egg mortality. Alternative 8 would reduce river lamprey egg survival due to increased risk

1 of dewatering in the Feather River (33%) and the American River (to 23%), and due to increases in
 2 exposure to water temperatures above preferred thresholds in the Feather River below Thermalito
 3 Afterbay. Increased water temperatures would increase stress and reduce survival of lamprey eggs.
 4 This effect is a result of the specific reservoir operations and resulting flows associated with this
 5 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
 6 the extent necessary to reduce this effect to a level that is not adverse would fundamentally change
 7 the alternative, thereby making it a different alternative than that which has been modeled and
 8 analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
 9 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-184a through AQUA-
 10 184c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
 11 level.

12 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of river lamprey
 13 spawning habitat relative to Existing Conditions due to substantial increases in dewatering risk in
 14 the American River and substantial increases in exposure to critical water temperatures in the
 15 Feather River. Rapid reductions in flow can dewater redds leading to mortality. Effects of
 16 Alternative 8 on flow reductions during the river lamprey spawning period from February to June
 17 consist of negligible effects ($\leq 5\%$) in the Sacramento River at Red Bluff and the Trinity River, small
 18 increases in redd cohort dewatering risk in the Sacramento River at Keswick (9%) and the Feather
 19 River (13%), and more substantial increases in the American River at Nimbus Dam (44%) and at the
 20 confluence with the Sacramento River (54%) (Table 11-8-87) that would affect spawning success.
 21 There would be a moderate decrease in exposure to flow reductions (-16%) in the Stanislaus River
 22 that would have beneficial effects on spawning success.

23 In the Sacramento River at Hamilton City, there would be 280 more cohorts (could not calculate
 24 relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 8 relative
 25 to Existing Conditions, although this represents a very small proportion of the total number of
 26 cohorts evaluated (12,320 cohorts)(Table 11-8-88) and, therefore, would not be biologically
 27 meaningful. There would be no differences between Existing Conditions and Alternative 8 at either
 28 location in the Trinity River. In the Feather River below Thermalito Afterbay, there would be 93
 29 more cohorts (1,033% higher) exposed to the 71.6°F threshold under Alternative 8 relative to
 30 Existing Conditions, although there would be no difference at the Fish Barrier Dam. At the two
 31 locations in the American River, there would be 24 to 65 more cohorts (480% and 232% higher)
 32 exposed to the 71.6°F threshold under Alternative 8 relative to Existing Conditions. In the Stanislaus
 33 River at Riverbank, there would be 31 more cohorts (3,100% higher) exposed to the 71.6°F
 34 threshold under Alternative 8 relative to Existing Conditions, although there would be no difference
 35 at the Knights Ferry. There would be no differences between Existing Conditions and Alternative 8
 36 at any location examined in exposure of egg cohorts to the 77°F threshold, except for increases of 46
 37 cohorts in the Sacramento River at Hamilton City, 10 cohorts in the American River at Nimbus, and
 38 16 cohorts in the American River at the confluence with the Sacramento River.

39 Collectively, these results indicate that the impact would be significant because it has the potential
 40 to substantially reduce spawning habitat and substantially reduce the number of fish as a result of
 41 egg mortality. Alternative 8 would increase risk of redd dewatering in the American River and
 42 would affect egg survival due to increases in water temperature in at least one location within each
 43 river examined. 7). Increased water temperatures would increase stress and reduce survival of
 44 lamprey eggs.

1 This impact is a result of the specific reservoir operations and resulting flows associated with this
2 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
3 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
4 change the alternative, thereby making it a different alternative than that which has been modeled
5 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
6 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
7 severity of impact though not necessarily to a less-than-significant level.

8 **Mitigation Measure AQUA-184a: Following Initial Operations of CM1, Conduct Additional**
9 **Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of**
10 **Mitigation to Reduce Impacts to Spawning Habitat**

11 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
12 significant and unavoidable adverse effects on spawning habitat, this conclusion was based on
13 the best available scientific information at the time and may prove to have been overstated.
14 Upon the commencement of operations of CM1 and continuing through the life of the permit, the
15 BDCP proponents will monitor effects on spawning habitat in order to determine whether such
16 effects would be as extensive as concluded at the time of preparation of this document and to
17 determine any potentially feasible means of reducing the severity of such effects. This mitigation
18 measure requires a series of actions to accomplish these purposes, consistent with the
19 operational framework for Alternative 8.

20 The development and implementation of any mitigation actions shall be focused on those
21 incremental effects attributable to implementation of Alternative 8 operations only.
22 Development of mitigation actions for the incremental impact on spawning habitat attributable
23 to climate change/sea level rise are not required because these changed conditions would occur
24 with or without implementation of Alternative 8.

25 **Mitigation Measure AQUA-184b: Conduct Additional Evaluation and Modeling of Impacts**
26 **on River Lamprey Spawning Habitat Following Initial Operations of CM1**

27 Following commencement of initial operations of CM1 and continuing through the life of the
28 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
29 modified operations could reduce impacts to spawning habitat under Alternative 8. The analysis
30 required under this measure may be conducted as a part of the Adaptive Management and
31 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

32 **Mitigation Measure AQUA-184c: Consult with NMFS, USFWS, and CDFW to Identify and**
33 **Implement Potentially Feasible Means to Minimize Effects on River Lamprey Spawning**
34 **Habitat Consistent with CM1**

35 In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey
36 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
37 Wildlife to identify and implement any feasible operational means to minimize effects on
38 spawning habitat. Any such action will be developed in conjunction with the ongoing monitoring
39 and evaluation of habitat conditions required by Mitigation Measure AQUA-184a.

40 If feasible means are identified to reduce impacts on spawning habitat consistent with the
41 overall operational framework of Alternative 8 without causing new significant adverse impacts
42 on other covered species, such means shall be implemented. If sufficient operational flexibility

1 to reduce effects on river lamprey habitat is not feasible under Alternative 8 operations,
2 achieving further impact reduction pursuant to this mitigation measure would not be feasible
3 under this Alternative, and the impact on river lamprey would remain significant and
4 unavoidable.

5 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

6 In general, Alternative 8 would reduce the quantity and quality of river lamprey rearing habitat
7 relative to the NAA.

8 Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow
9 alterations on ammocoete exposure, or stranding risk, as described for Pacific lamprey. Effects of
10 Alternative 8 on flow were evaluated in the Sacramento River at Keswick and Red Bluff, the Trinity
11 River, Feather River, the American River at Nimbus Dam and at the confluence with the Sacramento
12 River, and the Stanislaus River at the confluence with the San Joaquin River. Lower flows can reduce
13 the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading
14 to mortality. As for Pacific lamprey, the analysis of river lamprey ammocoete stranding was
15 conducted by analyzing a range of month-over-month flow reductions from CALSIM II outputs, using
16 the range of 50%–90% in 5% increments. A cohort of ammocoetes was assumed to be born every
17 month during their spawning period (February through June) and spend 5 years rearing upstream.
18 Therefore, a cohort was considered stranded if at least one month-over-month flow reduction was
19 greater than the flow reduction at any time during the period.

20 Comparisons of Alternative 8 to NAA for the Sacramento River at Keswick (Table 11-8-89) predicted
21 no effect (0%) or negligible effects ($\leq 5\%$) attributable to the project in all flow reduction categories,
22 which means that Alternative 8 would not affect spawning conditions at this location.

23 **Table 11-8-89. Percent Difference between Model Scenarios in the Number of River Lamprey**
24 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
25 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
-50%	0	0
-55%	2	0
-60%	6	3
-65%	6	3
-70%	3	3
-75%	-9	-3
-80%	6	-5
-85%	44	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

26

1 Comparisons for the Sacramento River at Red Bluff indicate negligible effects (<5%), a single small
2 increase (7%) to 65% flow reductions that would not have biologically meaningful negative effects,
3 and small to moderate decreases (to -16%) to larger flow reduction events that would have
4 beneficial effects on spawning success (Table 11-8-90). These results indicate that project-related
5 effects of Alternative 8 would be largely beneficial by reducing risk of ammocoete exposure and
6 mortality for this location.

7 **Table 11-8-90. Percent Difference between Model Scenarios in the Number of River Lamprey**
8 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
9 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	6	2
-60%	7	0
-65%	8	7
-70%	6	-3
-75%	16	-5
-80%	-8	-16
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

10

11 Comparisons for the Trinity River indicate no effect (0%), negligible effects (<5%), and small
12 increases (to 10%) in dewatering exposure to 80% and 85% flow reduction events attributable to
13 the project (Table 11-8-91). These small increases would not be expected to have biologically
14 meaningful negative effects on spawning success.

15 **Table 11-8-91. Percent Difference between Model Scenarios in the Number of River Lamprey**
16 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	36	3
-80%	51	9
-85%	44	10
-90%	52	0

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

17

1 Comparisons in the Feather River indicate no effect (0%) or negligible effects (<5%) to the lower
 2 flow reduction categories (50% through 60% flow reductions) and decreases in ammocoete cohort
 3 exposure (from -11% to -100%, or from 69 to 0 cohorts exposed) to all higher flow reduction
 4 categories (Table 11-8-92). Therefore project-related effects of Alternative 8 on flow would have
 5 beneficial effects on spawning conditions at this location.

6 **Table 11-8-92. Percent Difference between Model Scenarios in the Number of River Lamprey**
 7 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
 8 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LL1	NAA vs. A8_LL1
-50%	0	0
-55%	0	0
-60%	-1	-1
-65%	-11	-11
-70%	-17	-17
-75%	-27	-27
-80%	-57	-54
-85%	-90	-92
-90%	-100	-100

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

9
 10 Comparisons for the American River at Nimbus Dam (Table 11-8-93) and at the confluence with the
 11 Sacramento River (Table 11-8-94) indicate no effect (0%) or negligible effects (<5%) attributable to
 12 the project for flow reduction events from 50% to 70%, and more substantial increases in exposure
 13 to higher flow reduction events (to 28% at Nimbus Dam and to 41% at the confluence). Increased
 14 risk of dewatering would be considered small (11%) to moderate (to 28%) for 75% through 85%
 15 flow reductions at Nimbus Dam; increased risk would be considered moderate (29%) to substantial
 16 (41%) for 85% and 80% flow reduction events, respectively, at the confluence. These would
 17 contribute incremental risk to ammocoete dewatering but not to the extent that would be
 18 considered to have biologically meaningful negative effects on spawning success in the American
 19 River.

1 **Table 11-8-93. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 3 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	9	1
-70%	62	2
-75%	190	28
-80%	474	21
-85%	524	11
-90%	200	0

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

4

5 **Table 11-8-94. Relative Difference between Model Scenarios in the Number of River Lamprey**
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 7 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	4	0
-65%	5	0
-70%	24	1
-75%	65	7
-80%	379	41
-85%	454	29
-90%	360	-1

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

8

9 Comparisons in the Stanislaus River indicate no effect (0%), negligible effects (<5%), or small
 10 increases in exposure (to 10%) attributable to the project for all higher flow reduction categories
 11 (Table 11-8-95). Based on the small magnitude of increased exposure to only two flow reduction
 12 categories, project-related effects of Alternative 8 on flow would not have biologically meaningful
 13 negative effects on spawning conditions at this location.

1 **Table 11-8-95. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Stanislaus River at the**
 3 **Confluence with the San Joaquin River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	36	3
-80%	51	9
-85%	44	10
-90%	52	0

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 8.

4
 5 Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of
 6 Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et
 7 al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be
 8 conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day
 9 or month starts a new “cohort” such that there are 18,730 cohorts for the Sacramento River,
 10 corresponding to 82 years of ammocoetes being “born” every day each year from January 1 through
 11 August 31, and 380 cohorts for the other rivers using monthly data over the same period.

12 In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative 8
 13 would be similar to or lower than those under NAA (Table 11-8-96). Biologically meaningful
 14 exceptions include the Sacramento River at Hamilton, Trinity River at Lewiston, Feather River below
 15 Thermalito Afterbay, and Stanislaus River at Knights Ferry for the 71.6°F threshold, and the
 16 Sacramento River at Hamilton City, Feather River below Thermalito Afterbay, and American River at
 17 confluence for the 77°F threshold. In all cases, there would be another location within the river that
 18 would have similar or lower exceedances under Alternative 8.

1 **Table 11-8-96. Differences (Percent Differences) between Model Scenarios in River Lamprey**
 2 **Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F and 77°F**
 3 **in at Least One Month**

Location	EXISTING CONDITIONS vs. A8_LLТ	NAA vs. A8_LLТ
71.6°F Threshold		
Sacramento River at Keswick ^b	1,224 (NA)	6 (0.5%)
Sacramento River at Hamilton City ^b	12,112 (NA)	2,617 (28%)
Trinity River at Lewiston	65 (NA)	15 (30%)
Trinity River at North Fork	110 (NA)	-50 (-31%)
Feather River at Fish Barrier Dam	25 (NA)	0 (0%)
Feather River below Thermalito Afterbay	190 (100%)	60 (19%)
American River at Nimbus	260 (289%)	15 (4%)
American River at Sacramento River Confluence	135 (55%)	0 (0%)
Stanislaus River at Knights Ferry	50 (NA)	25 (100%)
Stanislaus River at Riverbank	335 (1,340%)	0 (0%)
77°F Threshold		
Sacramento River at Keswick ^b	0 (NA)	0 (NA)
Sacramento River at Hamilton City ^b	1,502 (NA)	901 (60%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	130 (NA)	90 (225%)
American River at Nimbus	190 (NA)	-30 (-14%)
American River at Sacramento River Confluence	265 (NA)	35 (15%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Positive values indicate a higher value in Alternative 8 than in EXISTING CONDITIONS or NAA.

^b Based on daily data; all other locations use monthly data; 1922–2003.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
 6 potential to substantially reduce rearing habitat and substantially reduce the number of fish as a
 7 result of ammocoete mortality. Alternative 8 would increase exposure of river lamprey ammocoete
 8 cohorts to elevated water temperatures that would affect ammocoete survival in at least one
 9 location within each river evaluated. Effects of Alternative 8 on redd dewatering risk would vary by
 10 location, with negligible effects (<5%), small-scale increases in dewatering exposure (to 10%),
 11 and/or reductions in exposure (to -16%) that would have beneficial effects by reducing dewatering
 12 risk in the Sacramento River, Trinity River, Feather River, and Stanislaus River. Effects would be
 13 more variable in the American River, with more substantial increases in dewatering exposure to two
 14 to three dewatering events (to 28% at Nimbus Dam, to 41% at the confluence), that would not be
 15 considered to have biologically meaningful negative effects on spawning success in the American
 16 River. This effect is a result of the specific reservoir operations and resulting flows associated with
 17 this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows)

1 to the extent necessary to reduce this effect to a level that is not adverse would fundamentally
2 change the alternative, thereby making it a different alternative than that which has been modeled
3 and analyzed. As a result, this would be an unavoidable adverse effect because there is no feasible
4 mitigation available. Even so, proposed mitigation (Mitigation Measure AQUA-185a through AQUA-
5 185c) has the potential to reduce the severity of impact, although not necessarily to a not adverse
6 level.

7 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of river lamprey
8 rearing habitat relative to Existing Conditions. Comparisons for the Trinity River indicate no effect
9 (0%) for flow reduction categories from 50% to 70%, and increases ranging from 26% to 59% for
10 the higher flow reduction categories (Table 11-8-91). The substantial and persistent increases in
11 dewatering exposure would affect spawning success in the Trinity River.

12 Comparisons for the Feather River indicate no effect or reductions in frequency of occurrence for all
13 flow reduction categories, with reductions of -11% to -90% in ammocoete cohorts exposed to 65%
14 to 90% flow reduction events and a reduction of 100% (decrease from 122 cohorts to 0) to 90%
15 flow reduction events (Table 11-8-92). Reduced ammocoete cohort exposure to flow reductions
16 would have beneficial effects on spawning success.

17 Comparisons for the American River indicate no effect (0%) and small increases (to 9%) to flow
18 reduction events from 50% to 65%, and larger increases in frequency of occurrence to the larger
19 flow reduction categories, with increases of 62% to 524% (from 25 to 156 cohorts) in ammocoete
20 cohorts exposed flow reduction events at Nimbus Dam (Table 11-8-93) and increases of 24% to
21 454% (from 50 to 277 cohorts) for the confluence (Table 11-8-94). These persistent and substantial
22 increases in ammocoete cohort exposure to flow reductions would have negative effects on
23 spawning success in the American River.

24 Comparisons for the Stanislaus River indicate no effect in frequency of occurrence for ammocoete
25 cohort exposures to flow reduction categories from 50% to 70%, and increases in exposure to the
26 higher flow reduction categories ranging from 36% to 52% (Table 11-8-95). Increased ammocoete
27 cohort exposure to these larger flow reductions would have negative effects on spawning success.

28 The number of ammocoete cohorts exposed to 71.6°F under Alternative 8 would be higher than
29 those under Existing Conditions in all locations examined (Table 11-8-96). The number of
30 ammocoete cohorts exposed to 77°F under Alternative 8 would be similar to the number under
31 NAA, at all locations except the Sacramento River at Hamilton City, Feather River below Thermalito
32 Afterbay and at both locations in the American River, all of which would be higher under
33 Alternative 8.

34 **Summary of CEQA Conclusion**

35 Collectively, these results indicate that the impact would be significant because it has the potential
36 to substantially reduce rearing habitat and substantially reduce the number of fish as a result of
37 ammocoete mortality. Effects of Alternative 8 would affect ammocoete cohort stranding through
38 increases in flow reductions in the Trinity River (to 59%), American River (to 524%), and Stanislaus
39 River (to 52%). Effects in the Sacramento River would include moderate increases in exposure to
40 some flow reduction events but not to the extent that would cause biologically meaningful negative
41 effects; effects in the Feather River would be beneficial by reducing dewatering events and therefore
42 stranding potential. Exposure of ammocoetes to elevated water temperatures would increase by up
43 to 1,340% under Alternative 8 relative to the CEQA baseline at all locations evaluated.

1 This impact is a result of the specific reservoir operations and resulting flows associated with this
2 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
3 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
4 change the alternative, thereby making it a different alternative than that which has been modeled
5 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
6 mitigation available. Even so, proposed below is mitigation that has the potential to reduce the
7 severity of impact though not necessarily to a less-than-significant level.

8 **Mitigation Measure AQUA-185a: Following Initial Operations of CM1, Conduct Additional**
9 **Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of**
10 **Mitigation to Reduce Impacts to Rearing Habitat**

11 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
12 significant and unavoidable adverse effects on rearing habitat, this conclusion was based on the
13 best available scientific information at the time and may prove to have been overstated. Upon
14 the commencement of operations of CM1 and continuing through the life of the permit, the
15 BDCP proponents will monitor effects on rearing habitat in order to determine whether such
16 effects would be as extensive as concluded at the time of preparation of this document and to
17 determine any potentially feasible means of reducing the severity of such effects. This mitigation
18 measure requires a series of actions to accomplish these purposes, consistent with the
19 operational framework for Alternative 8.

20 The development and implementation of any mitigation actions shall be focused on those
21 incremental effects attributable to implementation of Alternative 8 operations only.
22 Development of mitigation actions for the incremental impact on rearing habitat attributable to
23 climate change/sea level rise are not required because these changed conditions would occur
24 with or without implementation of Alternative 8.

25 **Mitigation Measure AQUA-185b: Conduct Additional Evaluation and Modeling of Impacts**
26 **River Lamprey Rearing Habitat Following Initial Operations of CM1**

27 Following commencement of initial operations of CM1 and continuing through the life of the
28 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
29 modified operations could reduce impacts to rearing habitat under Alternative 8. The analysis
30 required under this measure may be conducted as a part of the Adaptive Management and
31 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

32 **Mitigation Measure AQUA-185c: Consult with NMFS, USFWS, and CDFW to Identify and**
33 **Implement Potentially Feasible Means to Minimize Effects on River Lamprey Rearing**
34 **Habitat Consistent with CM1**

35 In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey
36 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
37 Wildlife to identify and implement any feasible operational means to minimize effects on rearing
38 habitat. Any such action will be developed in conjunction with the ongoing monitoring and
39 evaluation of habitat conditions required by Mitigation Measure AQUA-185a.

40 If feasible means are identified to reduce impacts on rearing habitat consistent with the overall
41 operational framework of Alternative 8 without causing new significant adverse impacts on
42 other covered species, such means shall be implemented. If sufficient operational flexibility to

1 reduce effects on river lamprey habitat is not feasible under Alternative 8 operations, achieving
2 further impact reduction pursuant to this mitigation measure would not be feasible under this
3 Alternative, and the impact on river lamprey would remain significant and unavoidable.

4 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

5 In general, Alternative 8 would reduce the quantity and quality of river lamprey migration habitat
6 relative to the NAA.

7 ***Macrophthalmia***

8 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once
9 they reach the Delta. River lamprey migration generally occurs September through November
10 (USFWS unpublished data). The effects of water operations on seasonal migration flows for river
11 lamprey macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely
12 migration pathways of river lamprey during the likely migration period (September through
13 November) were examined to predict how Alternative 8 may affect migration flows for outmigrating
14 macrophthalmia.

15 Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with
16 the Sacramento River, the American River at the confluence with the Sacramento River, and the
17 Stanislaus River at the confluence with the San Joaquin River.

18 ***Sacramento River***

19 Comparisons for the Sacramento River at Red Bluff for September through November for Alternative
20 8 relative to NAA few occurrences of negligible effects (<5%) but primarily reductions in flow
21 during September through November, ranging from -8% to -26%, including in drier water years
22 when effects of flow reductions would be more critical for migration conditions. These persistent,
23 small to moderate reductions in flow during the entire migration period and in all water year types
24 would affect macrophthalmia migration conditions in the Sacramento River.

25 ***Feather River***

26 Comparisons for the Feather River at the confluence with the Sacramento River for September
27 through November for Alternative 8 compared to NAA indicate project-related effects consisting of a
28 single occurrence of negligible effects (<5% difference during November in dry years) and moderate
29 to substantial reductions in flow for the remaining months and water year types (to -57%). These
30 persistent, moderate to substantial reductions in flow during the entire migration period and in all
31 water year types would affect macrophthalmia migration conditions in the Feather River.

32 ***American River***

33 Comparisons for the American River at the confluence with the Sacramento River for September
34 through November for Alternative 8 compared to NAA indicate much smaller project-related
35 contribution to decreased flows, including during September in below normal years (to -16%) and
36 critical years (-10%), during October in below normal years (-10%), and during November (to -
37 18%) in all but wet and dry years. Project-related effects in drier water years when effects of flow
38 reductions would be more critical for migration conditions consist of negligible effects (<5%), or
39 small (to -10%) to moderate (-18%) decreases in flow. Persistent reductions in below normal (to -
40 17%) and critical years (-10%, -2%, -18%) would affect migration conditions in drier water years.

1 *Stanislaus River*

2 Comparisons for the Stanislaus River at the confluence with the San Joaquin River for September
3 through November for Alternative 8 compared to NAA indicate negligible effects (<5% difference)
4 for the entire migration period in all water years. These results indicate that project-related effects
5 of Alternative 8 on flow would not affect macrophthalmia migration conditions in the Stanislaus
6 River.

7 Overall for macrophthalmia migration, project-related effects of Alternative 8 on flow consist of
8 moderate to substantial decreases in mean monthly flow during the macrophthalmia migration
9 period that would affect migration conditions in the Sacramento River and Feather River, and less
10 substantial decreases in the American River that would be persistent enough in drier water years to
11 have negative effects on migration conditions at that location as well. There would be no effect in the
12 Stanislaus River.

13 **Adults**

14 Effects of Alternative 8 on flow during the adult migration period, September through November,
15 would be the same as described for the macrophthalmia migration period, September through
16 November, above.

17 **NEPA Effects:** Collectively, these results indicate that the effect would be adverse because it has the
18 potential to substantially reduce the amount of suitable habitat and substantially interfere with the
19 movement of fish. Effects of Alternative 8 on mean monthly flow during September through
20 November consist primarily of moderate to substantial reductions (to -57%), including in drier
21 water years, that would affect migration conditions in the Sacramento River at Red Bluff, the Feather
22 River, and the American River at the confluence with the Sacramento River. There would be no
23 effect in the Stanislaus River. This effect is a result of the specific reservoir operations and resulting
24 flows associated with this alternative. Applying mitigation (e.g., changing reservoir operations in
25 order to alter the flows) to the extent necessary to reduce this effect to a level that is not adverse
26 would fundamentally change the alternative, thereby making it a different alternative than that
27 which has been modeled and analyzed. As a result, this would be an unavoidable adverse effect
28 because there is no feasible mitigation available. Even so, proposed mitigation (Mitigation Measure
29 AQUA-186a through AQUA-186c) has the potential to reduce the severity of impact, although not
30 necessarily to a not adverse level.

31 **CEQA Conclusion:** In general, Alternative 8 would reduce the quantity and quality of river lamprey
32 migration habitat relative to Existing Conditions due to a predominance of small to substantial
33 reductions in mean monthly flow in most months and water year types during the migration period
34 that would affect migration conditions for macrophthalmia and adults in all locations analyzed.

35 **Macrophthalmia**

36 *Sacramento River*

37 Comparisons for the Sacramento River at Red Bluff for September through November for Alternative
38 8 relative to Existing Conditions indicate variable effects during September, with increases in mean
39 monthly flow for wetter water year types (25 to 36%) and decreases for drier water year types (to -
40 30%). Alternative 8 would cause reductions in flow (from -6% to -23%) during October in all water
41 years and would have negligible effects (<5%) or cause small decreases in mean monthly flows for
42 all water year types in November (-6 to -13%). The occurrence of moderate reductions in flow

1 during September and October, followed by smaller reductions in November, particularly during
2 drier years, would affect migration conditions in the Sacramento River.

3 *Feather River*

4 Comparisons for the Feather River at the confluence with the Sacramento River for September
5 through November for Alternative 8 relative to Existing Conditions indicate small (-9%) to
6 substantial (-37%) reductions in mean monthly flow for all months and water year types with only
7 one exception, an increase in flow (30%) during September in wet years. These results indicate the
8 effects of Alternative 8 on flow would affect macrophthalmia migration conditions in the Feather
9 River.

10 *American River*

11 Comparisons for the American River at the confluence with the Sacramento River for September
12 through November indicate small (-6%) to substantial (to -62%) reductions in mean monthly flow
13 during September and November in all water year types, and negligible effects (<5%), or small
14 increases (to 14%) or decreases (to -19%) during October. The predominance of decreased flows
15 for Alternative 8 compared to Existing Conditions would affect migration conditions, with
16 substantial decreases for dry and critical years in September (-43 and -62%, respectively) and
17 November (-33 and -36%, respectively), with an additional decrease during dry years in October (-
18 19%), and a small increase in critical years (11%) that would not be sufficient to offset the decreases
19 in the other months.

20 *Stanislaus River*

21 Comparisons for the Stanislaus River at the confluence with the San Joaquin River for September
22 through November for Alternative 8 relative to Existing Conditions indicate negligible effects (<5%)
23 or small (-6%) to moderate (to -17%) reductions in mean monthly flow for all months and water
24 year types. Effects in drier water years, when effects of flow reductions would be more critical for
25 migration conditions, consist of negligible effects or small decreases (to -8%) that are not expected
26 to have biologically meaningful negative effects on migration conditions.

27 Overall regarding macrophthalmia migration, the effects of Alternative 8 on flows would include
28 persistent, small to substantial flow reductions (to -30% in the Sacramento River, to -37% in the
29 Feather River, to -62% in the American River, and to -17% in the Stanislaus River) for substantial
30 portions of the river lamprey macrophthalmia migration period that would have negative effects on
31 migration conditions in all locations analyzed; effects in the Stanislaus River are not expected to be
32 biologically meaningful based on the small magnitude of the flow reductions.

33 **Adults**

34 Effects of Alternative 8 on flow during the adult migration period, September through November,
35 would be the same as described for the macrophthalmia migration period, September through
36 November, above.

37 Collectively, these results indicate that the impact would be significant because it has the potential
38 to substantially reduce the amount of suitable habitat and substantially interfere with the movement
39 of fish. This is based on a predominance of small to substantial (to -62%) reductions in mean
40 monthly flow in most months and water year types during the migration period that would affect
41 migration conditions for macrophthalmia and adults. This impact is a result of the specific reservoir

1 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
2 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
3 less-than-significant level would fundamentally change the alternative, thereby making it a different
4 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
5 unavoidable because there is no feasible mitigation available. Even so, proposed below is mitigation
6 that has the potential to reduce the severity of impact though not necessarily to a less-than-
7 significant level.

8 **Mitigation Measure AQUA-186a: Following Initial Operations of CM1, Conduct Additional**
9 **Evaluation and Modeling of Impacts to River Lamprey to Determine Feasibility of**
10 **Mitigation to Reduce Impacts to Migration Conditions**

11 Although analysis conducted as part of the EIR/EIS determined that Alternative 8 would have
12 significant and unavoidable adverse effects on migration, this conclusion was based on the best
13 available scientific information at the time and may prove to have been overstated. Upon the
14 commencement of operations of CM1 and continuing through the life of the permit, the BDCP
15 proponents will monitor effects on migration in order to determine whether such effects would
16 be as extensive as concluded at the time of preparation of this document and to determine any
17 potentially feasible means of reducing the severity of such effects. This mitigation measure
18 requires a series of actions to accomplish these purposes, consistent with the operational
19 framework for Alternative 8.

20 The development and implementation of any mitigation actions shall be focused on those
21 incremental effects attributable to implementation of Alternative 8 operations only.
22 Development of mitigation actions for the incremental impact on migration attributable to
23 climate change/sea level rise are not required because these changed conditions would occur
24 with or without implementation of Alternative 8.

25 **Mitigation Measure AQUA-186b: Conduct Additional Evaluation and Modeling of Impacts**
26 **on River Lamprey Migration Conditions Following Initial Operations of CM1**

27 Following commencement of initial operations of CM1 and continuing through the life of the
28 permit, the BDCP proponents will conduct additional evaluations to define the extent to which
29 modified operations could reduce impacts to migration under Alternative 8. The analysis
30 required under this measure may be conducted as a part of the Adaptive Management and
31 Monitoring Program required by the BDCP (Chapter 3 of the BDCP, Section 3.6).

32 **Mitigation Measure AQUA-186c: Consult with NMFS, USFWS, and CDFW to Identify and**
33 **Implement Potentially Feasible Means to Minimize Effects on River Lamprey Migration**
34 **Conditions Consistent with CM1**

35 In order to determine the feasibility of reducing the effects of CM1 operations on river lamprey
36 habitat, the BDCP proponents will consult with NMFS, USFWS and the Department of Fish and
37 Wildlife to identify and implement any feasible operational means to minimize effects on
38 migration. Any such action will be developed in conjunction with the ongoing monitoring and
39 evaluation of habitat conditions required by Mitigation Measure AQUA-186a.

40 If feasible means are identified to reduce impacts on migration consistent with the overall
41 operational framework of Alternative 8 without causing new significant adverse impacts on
42 other covered species, such means shall be implemented. If sufficient operational flexibility to

1 reduce effects on river lamprey habitat is not feasible under Alternative 8 operations, achieving
2 further impact reduction pursuant to this mitigation measure would not be feasible under this
3 Alternative, and the impact river lamprey would remain significant and unavoidable.

4 **Restoration Measures (CM2, CM4–CM7, and CM10)**

5 Alternative 8 has the same Restoration Measures as Alternative 1A. Because no substantial
6 differences in restoration-related fish effects are anticipated anywhere in the affected environment
7 under Alternative 8 compared to those described in detail for Alternative 1A, the fish effects of
8 restoration measures described for river lamprey under Alternative 1A (Impact AQUA-187 through
9 Impact AQUA-189) also appropriately characterize effects under Alternative 8.

10 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

11 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

12 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River** 13 **Lamprey**

14 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

15 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
16 river lamprey, and most would be at least slightly beneficial.

17 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or
18 less than significant, and no mitigation is required.

19 **Other Conservation Measures (CM12–CM19 and CM21)**

20 Alternative 8 has the same other conservation measures as Alternative 1A. Because no substantial
21 differences in other conservation-related fish effects are anticipated anywhere in the affected
22 environment under Alternative 8 compared to those described in detail for Alternative 1A, the fish
23 effects of other conservation measures described for river lamprey under Alternative 1A (Impact
24 AQUA-190 through Impact AQUA-198) also appropriately characterize effects under Alternative 8.

25 The following impacts are those presented under Alternative 1A that are identical for Alternative 8.

26 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

27 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey** 28 **(CM13)**

29 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

30 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

31 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

32 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

33 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

1 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

2 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey**
3 **(CM21)**

4 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
5 adverse effect, or beneficial effects on river lamprey for NEPA purposes, for the reasons identified
6 for Alternative 1A.

7 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
8 less than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A, and
9 no mitigation is required.

10 **Non-Covered Aquatic Species of Primary Management Concern**

11 **Construction and Maintenance of CM1**

12 The effects of construction and maintenance of CM1 under Alternative 8 would be similar for all
13 non-covered species; therefore, the analysis below is combined for all non-covered species instead
14 of analyzed by individual species.

15 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**
16 **Aquatic Species of Primary Management Concern**

17 Refer to Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water
18 conveyance facilities on non-covered species of primary management concern. That discussion
19 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
20 to the aquatic environment and aquatic species. The potential effects of the construction of water
21 conveyance facilities under Alternative 8 would be similar to those described for Alternative 1A (see
22 Alternative 1A, Impact AQUA-1) except that Alternative 8 would include three intakes compared to
23 five intakes under Alternative 1A, so the effects would be proportionally less under this alternative.
24 This would convert about 7,450 lineal feet of existing shoreline habitat into intake facility structures
25 and would require about 17.1 acres of dredge and channel reshaping. In contrast, Alternative 1A
26 would convert 11,900 lineal feet of shoreline and would require 27.3 acres of dredging. Additionally,
27 California bay shrimp would not be affected because they do not occur in the vicinity and
28 Sacramento-San Joaquin roach and hardhead are unlikely to be affected because their primary
29 distributions are upstream.

30 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-1, environmental commitments and
31 mitigation measures would be available to avoid and minimize potential effects, and the effect would
32 not be adverse for non-covered aquatic species of primary management concern.

33 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 1A for delta smelt, the impact
34 of the construction of water conveyance facilities on non-covered species of primary management
35 concern would not be significant except potentially for construction noise associated with pile
36 driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
37 reduce that noise impact to less than significant.

1 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
2 **of Pile Driving and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

4 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
5 **and Other Construction-Related Underwater Noise**

6 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

7 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**
8 **Aquatic Species of Primary Management Concern**

9 Refer to Impact AQUA-2 under delta smelt for a discussion of the effects of maintenance of water
10 conveyance facilities on non-covered species of primary management concern. That discussion
11 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
12 to the aquatic environment and aquatic species. Also, California bay shrimp would not be affected
13 because they do not occur in the vicinity and Sacramento-San Joaquin roach and hardhead are
14 unlikely to be affected because their primary distributions are upstream.

15 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
16 Alternative 8 would be similar to those described in detail for Alternative 1A (see Alternative 1A,
17 Impact AQUA-2) except that only three intakes would be maintained rather than five. Consequently,
18 the effects would not be adverse.

19 **CEQA Conclusion:** As described above, these impacts would be less than significant.

20 **Water Operations of CM1**

21 The effects of water operations of CM1 under Alternative 8 include a detailed analysis of the
22 following species:

- 23 ● Striped Bass
- 24 ● American Shad
- 25 ● Threadfin Shad
- 26 ● Largemouth Bass
- 27 ● Sacramento tule perch
- 28 ● Sacramento-San Joaquin roach – California species of special concern
- 29 ● Hardhead – California species of special concern

30 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**
31 **Species of Primary Management Concern**

32 Also, see Alternative 1A, Impact AQUA-201 for additional background information relevant to non-
33 covered species of primary management concern.

1 **Striped Bass**

2 Striped bass eggs and larvae would be passively transported from upstream spawning grounds
3 towards the proposed north Delta intakes. Although these intakes would be screened to exclude fish
4 larger than 15mm, striped bass eggs or larvae in the vicinity of the screens would have the potential
5 to be entrained.

6 Entrainment losses under Alternative 8 would be expected to be reduced compared to NAA since
7 exports from the south Delta facilities would be reduced.

8 Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile
9 striped bass (Nobriga et al. 2004). Reduction or consolidation of diversions from the ROAs
10 (approximately 4–12% of diversions) would not increase entrainment and may provide a minor
11 benefit.

12 Variations in striped bass survival rates during the first few months of life are moderated by a
13 population bottleneck between YOY striped bass and three-year-old individuals (Kimmerer et al.
14 2000). Therefore it would be expected that reduction in entrainment of juveniles and adults at the
15 south Delta intakes would have a greater population impact than increases in entrainment of striped
16 bass larvae and eggs at the proposed SWP/CVP north Delta intakes and the NBA intake.
17 Furthermore, decommissioning of agricultural diversions may also reduce entrainment of striped
18 bass. Also, restoration activities as part of the conservation measures should increase the amount of
19 habitat for young striped bass (e.g. inshore rearing habitat), and increase their food supply. The
20 expectation is that these habitat changes would result in at least a minor improvement in production
21 of juvenile striped bass.

22 **NEPA Effects:** Overall, the effect on striped bass entrainment would not be adverse.

23 **CEQA Conclusion:** The impact of water operations on entrainment of striped bass would be the
24 same as described immediately above. The changes in entrainment under Alternative 8 would not
25 substantially reduce the striped bass population when other conservation measures are taken into
26 account. The impact would be less than significant and no mitigation would be required.

27 **American Shad**

28 The majority of American shad spawning occurs upstream of the Delta but some spawning is
29 believed to occur in the Delta along the Sacramento River (Stevens 1966). American shad eggs stay
30 suspended in the water column and may gradually drift downstream towards the proposed north
31 Delta intakes. The intakes of the proposed north Delta diversions and the NBA intake would be
32 screened, but small life stages (eggs and larvae) would have the potential to be entrained. Most
33 American shad spawning though occurs well upstream of the Delta.

34 American shad entrainment losses under Alternative 8 would be reduced compared to NAA due to
35 reduced south Delta exports. Reduction or consolidation of agricultural diversions in ROAs would
36 not increase entrainment and may provide a benefit to the species.

37 **NEPA Effects:** Overall, the effect on American shad under Alternative 8 would not be adverse, and
38 would be slightly beneficial.

39 **CEQA Conclusion:** The impact of water operations on entrainment of American shad would be the
40 same as described immediately above. The changes in entrainment under Alternative 8 would not

1 substantially reduce the American shad population. The impact would be less than significant and
2 no mitigation would be required.

3 ***Threadfin Shad***

4 Threadfin shad are widely distributed throughout the Delta, however they are most abundant in the
5 southeastern region of the Delta where areas of dense SAV in shallow water serve as important
6 spawning and rearing habitat (Feyrer et al. 2009). The proposed SWP/CVP north Delta intakes and
7 alternate NBA intake would be located well upstream of this region, which would limit potential
8 entrainment. At the SWP/CVP south Delta facilities threadfin shad entrainment losses would be
9 reduced due to reduced south Delta exports under Alternative 8. Reduction or consolidation of up to
10 12% of Delta agricultural diversions would further reduce the risk of threadfin shad entrainment.

11 ***NEPA Effects:*** Overall, entrainment would be reduced, which would benefit threadfin shad. The
12 effect on threadfin shad would not be adverse.

13 ***CEQA Conclusion:*** The impact of water operations on entrainment of threadfin shad would be the
14 same as described immediately above. Entrainment under Alternative 8 would be reduced providing
15 a modest benefit to threadfin shad population. The impact would be less than significant and no
16 mitigation would be required.

17 ***Largemouth Bass***

18 At the SWP/CVP south Delta facilities, entrainment losses under Alternative 8 would be reduced
19 compared to NAA because water exports would be decreased from the south Delta. Largemouth bass
20 are predominantly distributed in the central and south Delta in areas of dense SAV, and thus would
21 have minimal overlap with propose north Delta intake facilities and alternate NBA intake on the
22 Sacramento River.

23 Agricultural diversions may be sources of entrainment for largemouth bass. Agricultural diversions
24 are typically located nearshore, which is the habitat mainly used by largemouth bass. Reduction or
25 consolidation of these agricultural diversions under the Plan would further reduce entrainment risk
26 of largemouth bass.

27 ***NEPA Effects:*** Overall, the effect from Alternative 8 would not be adverse and would likely provide
28 minor benefits to the species from reduced entrainment loss.

29 ***CEQA Conclusion:*** The impact of water operation on largemouth bass would be as described
30 immediately above. Entrainment under Alternative 8 would be reduced and would be beneficial to
31 the largemouth bass. The impact would be less than significant and no mitigation would be required.

32 ***Sacramento Tule Perch***

33 At the SWP/CVP south Delta facilities, entrainment losses under Alternative 8 would be reduced
34 compared to NAA, because less water would be exported from the south Delta under this
35 Alternative. The proposed SWP/CVP north Delta intakes would be screened with state-of-the-art
36 fish screens for fish less than 15 mm in size. Because Sacramento tule perch are viviparous, newly
37 born Sacramento tule perch would be large enough to be effectively screened at the proposed north
38 delta facilities. Reduction or consolidation of Delta agricultural diversions under the Plan would also
39 reduce entrainment risk of Sacramento tule perch.

1 **NEPA Effects:** In summation, entrainment of Sacramento tule perch would be reduced compared to
2 NAA and would provide a benefit to the species. The effect on entrainment from Alternative 8 would
3 not be adverse.

4 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would
5 be the same as described immediately above. Entrainment under Alternative 8 would be reduced
6 and would be beneficial to Sacramento tule perch. The impact would be less than significant and no
7 mitigation would be required.

8 ***Sacramento-San Joaquin Roach***

9 **NEPA Effects:** The effect of water operations on entrainment of Sacramento-San Joaquin roach
10 under Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
11 AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact
12 mechanisms that are relevant to the aquatic environment and aquatic species. The effects would not
13 be adverse.

14 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento-San Joaquin roach
15 would be the same as described immediately above. The impacts would be less than significant.

16 ***Hardhead***

17 **NEPA Effects:** The effect of water operations on entrainment of hardhead under Alternative 8 would
18 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed
19 discussion, please see Alternative 1A, Impact AQUA-201. The effects would not be adverse.

20 **CEQA Conclusion:** The impact of water operations on entrainment of hardhead would be the same
21 as described immediately above. The impacts would be less than significant.

22 ***California Bay Shrimp***

23 **NEPA Effects:** The effect of water operations on entrainment of California bay shrimp under
24 Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
25 AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact
26 mechanisms that are relevant to the aquatic environment and aquatic species. California bay shrimp
27 do not occur in the vicinity of the intakes and there would be no effect.

28 **CEQA Conclusion:** The impact of water operations on entrainment of California bay shrimp would
29 be the same as described immediately above. There would be no impact.

30 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 31 **Non-Covered Aquatic Species of Primary Management Concern**

32 ***Striped Bass***

33 In general, Alternative 8 would slightly improve the quality and quantity of upstream habitat
34 conditions for striped bass relative to the NAA.

35 Also, see Alternative 1A, Impact AQUA-202 for additional background information relevant to non-
36 covered species of primary management concern.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the April through June striped bass spawning, embryo
4 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
5 habitat available for spawning, egg incubation, and rearing.

6 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
7 greater than flows under NAA except dry years during June (9% lower) (Appendix 11C, *CALSIM II*
8 *Model Results utilized in the Fish Analysis*).

9 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
10 greater than flows under NAA during April through June except in above normal years during April
11 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
13 than flows under NAA during April through June except in critical years except during April and June
14 (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

15 In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater than
16 flows under NAA during April and May in all water year types, and lower in June in all but wet years
17 (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The reductions
18 in June would be offset by substantial flow increases in the previous months.

19 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
20 under NAA throughout the period (up to 72% greater). (Appendix 11C, *CALSIM II Model Results*
21 *utilized in the Fish Analysis*).

22 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
23 always be similar to or greater than flows under NAA during April through June regardless of water
24 year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
26 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
27 relative to the NAA.

28 *Water Temperature*

29 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
30 bass spawning, embryo incubation, and initial rearing during April through June was examined in
31 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
32 range could lead to reduced spawning success and increased egg and larval stress and mortality.
33 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

34 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
35 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
36 there would be no temperature related effects in these rivers during the April through June period.

37 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the
38 range would be greater than the percentage under NAA in all water year types (up to 33% greater)
39 except critical years (6% lower) (Table 11-8-97). The increases have high relative percentages
40 based on low numbers being compared and correspond to absolute increases from 7 to 21%.

1 **Table 11-8-97. Difference and Percent Difference in the Percentage of Months during April–June in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F**
 3 **to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial**
 4 **Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	15 (35%)	10 (17%)
Above Normal	18 (40%)	21 (33%)
Below Normal	12 (28%)	10 (17%)
Dry	4 (8%)	7 (15%)
Critical	11 (29%)	-3 (-6%)
All	12 (27%)	9 (16%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

5

6 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 7 Alternative 8 would not cause a substantial reduction in striped bass spawning, incubation, or initial
 8 rearing habitat. Flows in all rivers examined during the April through June spawning, incubation,
 9 and initial rearing period under Alternative 8 would generally be similar to or greater than flows
 10 under the NAA. Moderate flow reductions in the Feather River during June would be substantially
 11 offset by flow increases in the preceding months. Persistent, moderate to substantial flow increases
 12 in the locations analyzed would have a beneficial effect on habitat conditions. The percentage of
 13 months outside the 59°F to 68°F water temperature range would generally be greater under
 14 Alternative 8 than under the NAA in the Feather River, but there are no temperature related effects
 15 in any of the other rivers examined.

16 **CEQA Conclusion:** In general, Alternative 8 would not affect the quality and quantity of upstream
 17 habitat conditions for striped bass relative to Existing Conditions.

18 **Flows**

19 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 20 Clear Creek were examined during the April through June striped bass spawning, embryo
 21 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
 22 habitat available for spawning, egg incubation, and rearing.

23 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
 24 greater than flows under Existing Conditions during April through June, except in wet years during
 25 May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
 27 greater than flows under Existing Conditions during April through June, except in critical years
 28 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than
 30 flows under Existing Conditions during April through June regardless of water year type (Appendix
 31 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows
 33 under Existing Conditions during April and May (up to 565% greater) in all water year types, and up

1 to 35% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in*
2 *the Fish Analysis*). The flow reductions in June would be offset by substantial flow increases in the
3 preceding months.

4 In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater
5 than flows under Existing Conditions throughout the period, except in above normal years during
6 April and May (9% and 29% lower, respectively), in wet years during May and June (21% and 34%
7 lower, respectively), and in critical years during June (17% lower) (Appendix 11C, *CALSIM II Model*
8 *Results utilized in the Fish Analysis*). The moderate flow reductions in wetter water year types would
9 be less critical for habitat conditions; these reductions as well as smaller reductions in drier water
10 years would not have biologically meaningful effects.

11 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
12 generally be similar to or lower than flows under Existing Conditions during April and May (to 27%
13 lower), including in drier water years, and generally similar to or greater than flows under Existing
14 Conditions during June except in above and below normal years (14% and 8% lower, respectively)
15 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate reductions
16 during the first two months of the period would have a small, localized effect.

17 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
18 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
19 reductions in flows during the period relative to Existing Conditions.

20 *Water Temperature*

21 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
22 bass spawning, embryo incubation, and initial rearing during April through June was examined in
23 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
24 range could lead to reduced spawning success and increased egg and larval stress and mortality.
25 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

26 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
27 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
28 there would be no temperature related effects in these rivers during the April through June period.

29 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of
30 the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation,
31 and initial rearing during April through June would be greater than the percentage under Existing
32 Conditions in all water years (from 8% to 40% higher depending on water year type) (Table 11-8-
33 97). The relative percentages are somewhat high based on low numbers being compared; the
34 absolute percentage increase would range from 4% to 18%.

35 Collectively, these results indicate that the impact would not be significant because Alternative 8
36 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of
37 striped bass. Therefore, no mitigation is necessary. Flows during the April through June spawning,
38 incubation, and initial rearing period under Alternative 8 would generally be similar to or greater
39 than flows under Existing Conditions. There would be small to moderate flow reductions for some
40 months and water year types in the Feather River, the American River, and the Stanislaus River, and
41 flows in the San Joaquin River would be lower under Alternative 8, although these flow reductions
42 would not be biologically meaningful to striped bass due to their high migratory ability and
43 widespread distribution in the Central Valley. The percentage of months outside the 59°F to 68°F

1 water temperature range would always be greater under Alternative 8 than under Existing
2 Conditions, although there would not be any temperature related effects in any of the other
3 locations.

4 ***American Shad***

5 In general, Alternative 8 would slightly improve the quality and quantity of upstream habitat
6 conditions for American shad relative to the NAA.

7 *Flows*

8 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
9 Clear Creek were examined during the April through June American shad adult migration and
10 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
11 quality for spawning.

12 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
13 greater than flows under NAA during April through June except in dry years during June (9% lower)
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
16 greater than flows under NAA during April through June except in above normal years during April
17 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
19 than flows under NAA during April through June except in critical years during April and June (8%
20 lower for both) Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater than
22 flows under NAA during April and May in all water year types (up to 616% greater) and would be
23 lower in all but wet years relative to NAA (to 38% lower) (Appendix 11C, *CALSIM II Model Results*
24 *utilized in the Fish Analysis*). The reductions in June would be offset by substantial flow increases in
25 the previous months.

26 In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater
27 than flows under NAA throughout the period (up to 72% greater) (Appendix 11C, *CALSIM II Model*
28 *Results utilized in the Fish Analysis*).

29 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
30 generally be similar to or greater than flows under NAA during April through June regardless of
31 water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

32 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
33 Alternative 1A. The analysis for Alternative 1A indicates that there would be and no differences in
34 flows relative to the NAA.

35 *Water Temperature*

36 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
37 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
38 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to

1 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
2 were not modeled in the San Joaquin River or Clear Creek.

3 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
4 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
5 there would be no temperature related effects in these rivers during the April through June period.

6 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the
7 60°F to 70°F water temperature range be similar or greater than the percentage under NAA by up to
8 27% (Table 11-8-98). Project-related increases are of moderate magnitude.

9 **Table 11-8-98. Difference and Percent Difference in the Percentage of Months during April–June in**
10 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F**
11 **to 70°F Water Temperature Range for American Shad Adult Migration and Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	9 (19%)	14 (26%)
Above Normal	15 (42%)	6 (12%)
Below Normal	21 (69%)	14 (27%)
Dry	15 (38%)	9 (17%)
Critical	6 (15%)	0 (0%)
All	13 (33%)	10 (19%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

12
13 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
14 Alternative 8 would not cause a substantial reduction in American shad spawning or adult
15 migration. Flows in all rivers examined during the April through June spawning, incubation, and
16 initial rearing period under Alternative 8 would generally be similar to or greater than flows under
17 the NAA. Moderate flow reductions in the Feather River during June would be substantially offset by
18 flow increases in the preceding months. Persistent, moderate to substantial flow increases in the
19 locations analyzed would have a beneficial effect on habitat conditions. The percentage of months
20 outside the 60°F to 70°F water temperature range in the Feather River would almost always be
21 greater under Alternative 8 than under NAA, although there would be no temperature related effects
22 in any of the other rivers examined.

23 **CEQA Conclusion:** In general, Alternative 8 would not affect the quality and quantity of upstream
24 habitat conditions for American shad relative to Existing Conditions.

25 *Flows*

26 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
27 Clear Creek were examined during the April through June American shad adult migration and
28 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
29 quality for spawning.

30 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
31 greater than flows under Existing Conditions during April through June, except in wet years during
32 May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
2 greater than flows under Existing Conditions during April through June, except in critical years
3 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than
5 flows under Existing Conditions during April through June regardless of water year type (Appendix
6 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 In the Feather River at Thermalito Afterbay, flows under A8_LLT would be greater than flows under
8 Existing Conditions during April and May (up to 565% greater) in all water year types, and up to
9 35% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the
10 Fish Analysis*). The flow reductions in June would be offset by substantial flow increases in the
11 preceding months.

12 In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater
13 than flows under Existing Conditions throughout the period, except in above normal years during
14 April and May (9% and 29% lower, respectively), in wet years during May and June (21% and 34%
15 lower, respectively), and in critical years during June (17% lower) (Appendix 11C, *CALSIM II Model
16 Results utilized in the Fish Analysis*). The moderate flow reductions in wetter water year types would
17 be less critical for habitat conditions; these reductions as well as smaller reductions in drier water
18 years would not have biologically meaningful effects.

19 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
20 generally be similar to or lower than flows under Existing Conditions during April and May (to 27%
21 lower), including in drier water years, and generally similar to or greater than flows under Existing
22 Conditions during June except in above and below normal years (14% and 8% lower, respectively)
23 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate reductions
24 during the first two months of the period would have a small, localized effect but would not have
25 biologically meaningful negative effects on the American shad population.

26 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
27 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
28 reductions in flows during the period relative to Existing Conditions.

29 *Water Temperature*

30 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
31 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
32 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
33 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
34 were not modeled in the San Joaquin River or Clear Creek.

35 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
36 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
37 there would be no temperature related effects in these rivers during the April through June period.

38 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of
39 the 60°F to 70°F water temperature range would be higher than the percentage under Existing
40 Conditions in all water years (up to 69% higher) (Table 11-8-98). These increases correspond to
41 absolute increases from 6% to 21%. Based on the small to moderate magnitude of the increases, and

1 the fact that they would only occur in one of the locations analyzed, they would not have biologically
2 meaningful negative effects on the American shad population.

3 Collectively, these results indicate that the impact would not be significant because Alternative 8
4 would not cause a substantial reduction in American shad adult migration and spawning habitat,
5 and no mitigation is necessary. Flows during the April through June spawning, incubation, and initial
6 rearing period under Alternative 8 would generally be similar to or greater than flows under
7 Existing Conditions. There would be small to moderate flow reductions for some months and water
8 year types in the Feather River, the American River, and the Stanislaus River, and flows in the San
9 Joaquin River would be lower under Alternative 8, although these flow reductions would not be
10 biologically meaningful to striped bass. The percentage of months outside the 60°F to 70°F water
11 temperature range would always be greater under Alternative 8 than under Existing Conditions in
12 the Feather River, but based on the small to moderate magnitude of the increases and the fact that
13 the increase would only occur in the Feather River, they would not have biologically meaningful
14 negative effects on the American shad population.

15 ***Threadfin Shad***

16 In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for
17 threadfin shad relative to the NAA.

18 ***Flows***

19 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
20 Clear Creek were examined during April through August threadfin shad spawning period. Lower
21 flows could reduce the quantity and quality of instream habitat available for spawning.

22 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
23 greater than flows under NAA during April through June except in dry years during June relative to
24 NAA (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under
25 A8_LLT would be similar to or lower than flows under NAA (to 18% lower) during July and August
26 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The moderate flow reductions
27 late in the spawning period would not have biologically meaningful effects.

28 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
29 greater than flows under NAA, except in above normal years during April and in critical years during
30 August (11% and 22% lower, respectively). (Appendix 11C, *CALSIM II Model Results utilized in the
31 Fish Analysis*).

32 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
33 than flows under NAA throughout the period, except in critical years during April and June relative
34 to NAA (8% lower for both) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

35 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than those
36 under NAA during April and May (up to 616% greater), and lower during the rest of the period (up
37 to 77% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

38 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
39 under NAA during April through June (up to 105% greater), generally lower during July (up to 49%
40 lower), and similar to NAA flows during August, with some exceptions (up to 13% lower). The flow
41 reductions during July would be offset by substantial flow increases in the preceding months.

1 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
2 always be similar to or greater than flows relative to NAA throughout the period (Appendix 11C,
3 *CALSIM II Model Results utilized in the Fish Analysis*).

4 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
5 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
6 during the period relative to NAA.

7 *Water Temperature*

8 The percentage of months below 68°F water temperature threshold for the April through August
9 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
10 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
11 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
12 Creek.

13 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
14 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
15 there would be no temperature-related effects in these rivers throughout the year.

16 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT below
17 68°F would be lower than the percentages under NAA in all water years (Table 11-8-99).

18 **Table 11-8-99. Difference and Percent Difference in the Percentage of Months during April–August**
19 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 68°F**
20 **Water Temperature Threshold for Threadfin Shad Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-15 (-24%)	-2 (-5%)
Above Normal	-35 (-45%)	-5 (-13%)
Below Normal	-27 (-39%)	-3 (-7%)
Dry	-34 (-46%)	-4 (-11%)
Critical	-32 (-49%)	-3 (-10%)
All	-27 (-39%)	-3 (-8%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

21
22 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
23 Alternative 8 would not cause a substantial reduction in spawning habitat. Flows in all rivers
24 examined during the April through August spawning period under Alternative 8 would generally be
25 similar to or greater than flows under the NAA. There would be isolated and/or small magnitude
26 flow reductions in some locations that would not have biologically meaningful effects on the
27 threadfin shad population. Moderate flow reductions in the Feather River during June through
28 August would not be biologically meaningful to threadfin shad due to their high migratory ability
29 and widespread distribution in the Central Valley. The percentage of months below the spawning
30 temperature threshold in the Feather River under Alternative 8 would be similar to or lower than
31 NAA. Also, there are no temperature-related effects in any other rivers examined.

1 **CEQA Conclusion:** In general, Alternative 8 would not affect the quality and quantity of upstream
2 habitat conditions for threadfin shad relative to Existing Conditions.

3 *Flows*

4 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
5 Clear Creek were examined during April through August spawning period. Lower flows could reduce
6 the quantity and quality of instream habitat available for spawning.

7 In the Sacramento River upstream of Red Bluff, flows under A8_LLT during April through July would
8 generally be similar to or greater than flows under Existing Conditions, with some exceptions (up to
9 11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during
10 August would generally be lower than flows under Existing Conditions by up to 19%.

11 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
12 greater than flows under Existing Conditions throughout the period, except in critical years during
13 May and August (6% and 42% lower, respectively) and in wet years during July (14% lower)
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would nearly always be similar to or
16 greater than flows under Existing Conditions throughout the period, except in critical years during
17 August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

18 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater (up to
19 565% greater) than flows under Existing Conditions during April and May, and up to 77% lower
20 during the rest of the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
21 The flow reductions during June through August would be offset by substantial flow increases in the
22 preceding months.

23 In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater
24 than flows under Existing Conditions during April through June, except in above normal years
25 during April and May (9% and 29% lower, respectively), in wet years during May and June (21%
26 and 34% lower, respectively), and in critical years during June (17% lower), and lower than flows
27 under Existing Conditions during July and August (to 42% lower) (Appendix 11C, *CALSIM II Model
28 Results utilized in the Fish Analysis*). The moderate to substantial flow reductions in drier water year
29 types during July and August would have a localized effect on spawning conditions.

30 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
31 generally be lower than Existing Conditions by up to 27% during April, May and July, but similar to
32 or greater than flows under Existing Conditions during the rest of the period with some exceptions
33 (up to 23% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

34 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
35 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
36 reductions in flows during the period relative to Existing Conditions.

37 *Water Temperature*

38 The percentage of months below 68°F water temperature threshold for the April through August
39 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
40 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful

1 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
2 Creek.

3 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
4 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
5 there would be no temperature-related effects in these rivers during the April through November
6 period.

7 In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water
8 temperature threshold for threadfin shad spawning under A8_LLT would lower than the percentage
9 under Existing Conditions in all water year types (Table 11-8-99).

10 Collectively, these results indicate that the impact would not be significant because Alternative 8
11 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers
12 examined during the April through August spawning period under Alternative 8 would generally be
13 similar to or greater than flows under Existing Conditions. There would be isolated and/or small
14 magnitude flow reductions in some locations, and more persistent, substantial flow reductions late
15 in the spawning period in the American River that would have a localized effect but would not have
16 biologically meaningful effects on the threadfin shad population. The percentage of months below
17 the suitable temperature threshold for spawning in the Feather River would be lower under
18 Alternative 8 than under Existing Conditions. Also, there are no temperature-related effects in any
19 other rivers examined.

20 **Largemouth Bass**

21 In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for
22 largemouth bass relative to the NAA.

23 *Flows*

24 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
25 Clear Creek were examined during the March through June largemouth bass spawning period.
26 Lower flows could reduce the quantity and quality of instream spawning habitat.

27 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
28 greater than flows under NAA during March through June, except in dry years during June (9%
29 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

30 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
31 greater than flows under NAA during March through June, except in above normal years during
32 April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
34 than flows under NAA during March through June, except in critical years during March, April, and
35 June (8% lower for all three) and in below normal years during March (6% lower) (Appendix 11C,
36 *CALSIM II Model Results utilized in the Fish Analysis*).

37 In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater (up
38 to 365% greater) than flows under NAA during March through May in all water year types, and up to
39 39% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the
40 Fish Analysis*).

1 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
2 under NAA during April through June (up to 105% greater), and lower during March by up to 14%
3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
5 always be similar to or greater than flows relative to NAA during March through June (Appendix
6 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
8 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
9 relative to the NAA.

10 *Water Temperature*

11 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
12 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
13 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
14 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
15 Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
17 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
18 there would be no temperature-related effects in these rivers during the March through June period.

19 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the
20 59°F to 75°F water temperature range would be greater than the percentage under NAA (from 16%
21 to 27% greater) except in critical years (45% lower) (Table 11-8-100). The increases are of
22 relatively small magnitude and occur in the Feather River. As a result, the increases would not have
23 biologically meaningful effects on the largemouth bass population.

24 **Table 11-8-100. Difference and Percent Difference in the Percentage of Months during March–**
25 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside**
26 **the 59°F to 75°F Water Temperature Range for Largemouth Bass Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	0 (0%)	9 (16%)
Above Normal	0 (0%)	14 (27%)
Below Normal	0 (0%)	11 (24%)
Dry	-13 (-26%)	6 (16%)
Critical	-21 (-48%)	-10 (-45%)
All	-6 (-12%)	6 (14%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

27

28 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse.

29 **CEQA Conclusion:** In general, Alternative 8 would reduce the quality and quantity of upstream
30 habitat conditions for largemouth bass relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the March through June largemouth bass spawning period.
4 Lower flows could reduce the quantity and quality of instream spawning habitat.

5 In the Sacramento River upstream of Red Bluff, flows under A8_LLTP would almost always be similar
6 to or greater than flows under Existing Conditions during the entire period, except in wet years
7 during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 In the Trinity River below Lewiston Reservoir, flows under A8_LLTP would generally be similar to or
9 greater than flows under Existing Conditions during March through June, except in below normal
10 years during March and critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*).

12 In Clear Creek at Whiskeytown Dam, flows under A8_LLTP would always be similar to or greater than
13 flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results*
14 *utilized in the Fish Analysis*).

15 In the Feather River at Thermalito Afterbay, flows under A8_LLTP would be substantially greater (up
16 to 565% greater) than flows under Existing Conditions during March through May, and lower during
17 June (up to 35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The
18 flow reductions in June would be offset by substantial flow increases in the preceding months.

19 In the American River at Nimbus Dam, flows under A8_LLTP would generally be similar to or greater
20 than flows under Existing Conditions throughout the period, except in dry and critical years during
21 March (6% and 14% lower, respectively), in above normal years during April and May (9% and 29%
22 lower, respectively), in wet years during May and June (21% and 34% lower, respectively), and in
23 critical years during June (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
24 *Analysis*). The moderate flow reductions in wetter water year types would be less critical for habitat
25 conditions; these reductions as well as smaller reductions in drier water years would not have
26 biologically meaningful effects.

27 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLTP would
28 generally be lower than under Existing Conditions during March through May (to 30% lower)
29 including in drier water years, and generally similar to or greater than flows under Existing
30 Conditions during June, except in above and below normal years (14% and 8% lower, respectively)
31 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The small to moderate
32 reductions during the first three months of the period would have a small, localized effect but would
33 not have biologically meaningful negative effects on the striped bass population.

34 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
35 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
36 reductions in flows during the period relative to Existing Conditions.

37 *Water Temperature*

38 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
39 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
40 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
41 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
42 Creek.

1 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
2 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
3 there would be no temperature-related effects in these rivers during the March through June period.

4 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of
5 the 59°F to 75°F water temperature range for largemouth bass spawning would be similar to or
6 lower than the percentage under Existing Conditions in all water years (Table 11-8-100).

7 ***Sacramento Tule Perch***

8 ***NEPA Effects:*** The effects of water operations on spawning habitat for Sacramento tule perch under
9 Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
10 AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact
11 mechanisms that are relevant to the aquatic environment and aquatic species. The effects would not
12 be adverse.

13 ***CEQA Conclusion:*** The impact of water operations on entrainment of Sacramento tule perch would
14 be the same as described immediately above. The impacts would be less than significant.

15 ***Sacramento-San Joaquin roach – California species of special concern***

16 In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for
17 Sacramento-San Joaquin Roach relative to the NAA.

18 ***Flows***

19 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
20 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
21 period. Lower flows could reduce the quantity and quality of instream habitat available for
22 spawning.

23 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
24 greater than flows under NAA during March through June, except in dry years during June (9%
25 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
27 greater than flows under NAA during March through June, except in above normal years during
28 April (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
30 than flows under NAA during March through June, except in critical years during March, April, and
31 June (8% lower for all three) and in below normal years during March (6% lower) (Appendix 11C,
32 *CALSIM II Model Results utilized in the Fish Analysis*).

33 In the Feather River at Thermalito Afterbay, flows under A8_LLT would be substantially greater (up
34 to 365% greater) than flows under NAA during March through May in all water year types, and up to
35 39% lower during June in all water year types (Appendix 11C, *CALSIM II Model Results utilized in the*
36 *Fish Analysis*). The reductions in June would be substantially offset by the flow increases in the
37 previous months.

1 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
2 under NAA during April through June (up to 105% greater), and lower during March by up to 14%
3 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
5 always be similar to or greater than flows relative to NAA during March through June (Appendix
6 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
8 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
9 relative to the NAA.

10 *Water Temperature*

11 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
12 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
13 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
14 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
15 River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
17 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
18 there would be no temperature-related effects in these rivers during the March through June period.

19 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT below
20 60.8°F would be slightly higher than the percentage under NAA in all water year types (up to 14%
21 higher) except in critical years (11% lower) (Table 11-8-101). These are small increases that would
22 not have biologically meaningful effects on spawning success.

23 **Table 11-8-101. Difference and Percent Difference in the Percentage of Months during March–**
24 **June in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the**
25 **60.8°F Water Temperature Threshold Range for the Initiation of Sacramento-San Joaquin Roach**
26 **Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-4 (-6%)	9 (14%)
Above Normal	-5 (-8%)	2 (5%)
Below Normal	0 (0%)	5 (11%)
Dry	-8 (-15%)	3 (6%)
Critical	-19 (-33%)	-4 (-11%)
All	-6 (-11%)	4 (8%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

27

28 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse.

29 **CEQA Conclusion:** In general, Alternative 8 would reduce the quality and quantity of upstream
30 habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
4 period. Lower flows could reduce the quantity and quality of instream habitat available for
5 spawning.

6 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would almost always be similar
7 to or greater than flows under Existing Conditions during the entire period, except in wet years
8 during May (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
10 greater than flows under Existing Conditions during March through June, except in below normal
11 years during March and in critical years during May (6% lower in both) (Appendix 11C, *CALSIM II*
12 *Model Results utilized in the Fish Analysis*).

13 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than
14 flows under Existing Conditions during March through June (Appendix 11C, *CALSIM II Model Results*
15 *utilized in the Fish Analysis*).

16 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be substantially
17 greater (up to 565% greater) than flows under Existing Conditions during March through May, and
18 lower during June (up to 35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
19 *Analysis*). The flow reductions in June would be offset by substantial flow increases in the preceding
20 months.

21 In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater
22 than flows under Existing Conditions throughout the period, except in dry and critical years during
23 March (6% and 14% lower, respectively), in above normal years during April and May (9% and 29%
24 lower, respectively), in wet years during May and June (21% and 34% lower, respectively), and in
25 critical years during June (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
26 *Analysis*). The moderate flow reductions in wetter water year types would be less critical for habitat
27 conditions; these reductions as well as smaller reductions in drier water years would not have
28 biologically meaningful effects.

29 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
30 generally be lower than under Existing Conditions during March through May (to 30% lower)
31 including in drier water years, and generally similar to or greater than flows under Existing
32 Conditions during June, except in above and below normal years (14% and 8% lower, respectively)
33 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The small to moderate
34 reductions during the first three months of the period would have a small, localized effect but would
35 not have biologically meaningful negative effects on the Sacramento-San Joaquin roach population.

36 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
37 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
38 reductions in flows during the period relative to Existing Conditions.

39 *Water Temperature*

40 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
41 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
42 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could

1 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
2 River or Clear Creek.

3 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
4 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
5 there would be no temperature-related effects in these rivers during the March through June period.

6 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures
7 would be below the 60.8°F water temperature threshold for roach spawning initiation under
8 A8_LLT would be similar to or lower than the percentage under Existing Conditions in all water
9 years (Table 11-8-101).

10 ***Hardhead – California Species of Special Concern***

11 In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for
12 hardhead relative to the NAA.

13 ***Flows***

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
15 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
16 could reduce the quantity and quality of instream habitat available for spawning.

17 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
18 greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*
19 *utilized in the Fish Analysis*).

20 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
21 greater than flows under NAA throughout the period, except in above normal years during April
22 (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally to be similar to or greater
24 than flows under NAA throughout the period, except in critical years during April (8% lower)
25 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be substantially
27 greater than flows under NAA throughout the period (Appendix 11C, *CALSIM II Model Results*
28 *utilized in the Fish Analysis*).

29 In the American River at Nimbus Dam, flows under A8_LLT would always be similar to or greater
30 than flows under NAA throughout the period, regardless of water year type (Appendix 11C, *CALSIM*
31 *II Model Results utilized in the Fish Analysis*).

32 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
33 always be similar to flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
34 *Analysis*).

35 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
36 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
37 relative to the NAA.

1 *Water Temperature*

2 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
3 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
4 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
5 spawning success and increased egg and larval stress and mortality. Water temperatures were not
6 modeled in the San Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
9 there would be no temperature-related effects in these rivers throughout the year.

10 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the
11 range would be lower than the percentage under NAA in dry and critical water years but higher in
12 all other water year types (up to 13% higher) (Table 11-8-102). The percentage of months under
13 A8_LLT outside the range would be lower than the percentage under NAA in critical water year
14 types (15% lower) and similar to or greater than this percentage in all other water year types (up to
15 18% higher). These are relatively small increases that would not have biologically meaningful
16 effects.

17 **Table 11-8-102. Difference and Percent Difference in the Percentage of Months during April–May**
18 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are Outside the**
19 **59°F to 64°F Water Temperature Range for Hardhead Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	5 (7%)	4 (5%)
Above Normal	9 (12%)	15 (18%)
Below Normal	10 (15%)	0 (0%)
Dry	-4 (-5%)	4 (6%)
Critical	-14 (-20%)	-8 (-15%)
All	2 (2%)	3 (4%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

20

21 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse.

22 **CEQA Conclusion:** In general, Alternative 8 would reduce the quality and quantity of upstream
23 spawning habitat conditions for hardhead relative to Existing Conditions.

24 *Flows*

25 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
26 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
27 could reduce the quantity and quality of instream habitat available for spawning.

28 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
29 greater than flows under Existing Conditions throughout the period, except in wet years during May
30 (8% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 In the Trinity River below Lewiston Reservoir, flows under A8_LLTP would generally be similar to or
2 greater than flows under Existing Conditions throughout the period, except in critical years during
3 May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A8_LLTP would always be similar to flows under
5 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*
6 *Fish Analysis*).

7 In the Feather River at Thermalito Afterbay, flows under A8_LLTP would always be substantially
8 greater than flows under Existing Conditions throughout the period (up to 565% greater)(Appendix
9 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

10 In the American River at Nimbus Dam, flows under A8_LLTP would generally be similar to or greater
11 than flows under Existing Conditions, except in above normal years during April (9% lower) and in
12 wet and above normal years during May (21% and 29% lower, respectively) (Appendix 11C, *CALSIM*
13 *II Model Results utilized in the Fish Analysis*).

14 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLTP would
15 generally be lower relative to Existing Conditions by up to 27% throughout the period (Appendix
16 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
18 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
19 reductions in flows during the period relative to Existing Conditions.

20 *Water Temperature*

21 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
22 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
23 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
24 spawning success and increased egg and larval stress and mortality. Water temperatures were not
25 modeled in the San Joaquin River or Clear Creek.

26 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
27 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
28 Alternative 1A.

29 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLTP outside the
30 range would be lower than the percentage under Existing Conditions in dry and critical water years
31 and higher in all other water year types (up to 15% higher) (Table 11-8-102). These are small
32 increases that would not have a biologically meaningful negative effect on spawning success.

33 **California Bay Shrimp**

34 **NEPA Effects:** The effect of water operations on spawning habitat of California bay shrimp under
35 Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
36 AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact
37 mechanisms that are relevant to the aquatic environment and aquatic species. The effects would not
38 be adverse.

39 **CEQA Conclusion:** The impact of water operations on spawning habitat of California bay shrimp
40 would be the same as described immediately above. The impacts would be less than significant.

1 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**
2 **Species of Primary Management Concern**

3 Also, see Alternative 1A, Impact AQUA-203 for additional background information relevant to non-
4 covered species of primary management concern.

5 ***Striped Bass***

6 The discussion under Alternative 8, Impact AQUA-202 for striped bass also addresses the embryo
7 incubation and initial rearing period. That analysis indicates that there is no adverse effect on
8 striped bass rearing during that period. Other effects of water operations on rearing habitat for
9 striped bass under Alternative 8 would be similar to that described for Alternative 1A (see
10 Alternative 1A, Impact AQUA-3). That discussion under delta smelt addresses the type, magnitude
11 and range of impact mechanisms that are relevant to the aquatic environment and aquatic species.

12 ***NEPA Effects:*** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

13 ***CEQA Conclusion:*** As described above the impacts on striped bass rearing habitat would be less
14 than significant.

15 ***American Shad***

16 The effects of water operations on rearing habitat for American shad under Alternative 8 would be
17 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-5). That discussion
18 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
19 to the aquatic environment and aquatic species.

20 ***NEPA Effects:*** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

21 ***CEQA Conclusion:*** As described above the impacts on American shad rearing habitat would be less
22 than significant.

23 ***Threadfin Shad***

24 The effects of water operations on rearing habitat for threadfin shad under Alternative 8 would be
25 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-5). That discussion
26 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
27 to the aquatic environment and aquatic species.

28 ***NEPA Effects:*** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

29 ***CEQA Conclusion:*** As described above the impacts on threadfin shad rearing habitat would be less
30 than significant.

31 ***Largemouth Bass***

32 ***Juveniles***

33 ***Flows***

34 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
35 Clear Creek were examined during the April through November juvenile largemouth bass rearing
36 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
37 rearing.

1 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
2 greater than flows under NAA during April through June, with two small exceptions (to 9% lower),
3 and flows under A8_LLT would be similar to or lower than flows under NAA (to 26% lower) during
4 July through November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Project-
5 related flow reductions (A8_LLT compared to NAA) in drier water years, when effects would be
6 more critical for habitat conditions, consist of small to moderate reductions in below normal years
7 (to 26% lower), small reductions in dry years (to 11% lower), and an isolated reduction in critical
8 years (21% lower during October) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
9 *Analysis*). Based on the duration and magnitude of these reductions, there would be a localized effect
10 on rearing conditions in below normal years that would not have biologically meaningful negative
11 effects on the largemouth bass population.

12 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
13 greater than flows under NAA, except in above normal years during April (11% lower), in critical
14 years during August, October, and November (to 22% lower), and in wet years during November
15 (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow
16 reductions in drier water years would be more critical for habitat conditions and would be limited to
17 relatively infrequent, small to moderate reductions in critical years that would not have biologically
18 meaningful negative effects.

19 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
20 than NAA throughout the year, except in critical years during April and June (8% lower for both)
21 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the Feather River at Thermalito Afterbay, flows under A8_LLT would be greater than flows under
23 NAA during April and May (up to 616% greater) in all water years, and would be lower than flows
24 under NAA (to 76% lower) during June through November (Appendix 11C, *CALSIM II Model Results*
25 *utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of
26 these months (June through November) except September and October.

27 In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or greater
28 than flows under NAA during April through June, and August through October (to 105% greater),
29 with some exceptions (flow reductions to 14%), and similar to or lower than flows under NAA
30 during November in all water years (to 17% lower) (Appendix 11C, *CALSIM II Model Results utilized*
31 *in the Fish Analysis*). These are relatively small-magnitude flow reductions and/or would not be
32 persistent month to month and, therefore, would not have biologically meaningful negative effects.

33 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
34 always be similar to or greater than flows relative to NAA during April through November
35 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
37 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
38 relative to the NAA.

39 *Water Temperature*

40 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
41 rearing during April through November was examined in the Sacramento, Trinity, Feather,
42 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and

1 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
2 temperatures were not modeled in the San Joaquin River or Clear Creek.

3 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
4 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
5 there would be no temperature-related effects in these rivers during the April through November
6 period.

7 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under
8 NAA or A8_LLT (Table 11-8-103). As a result, there would be no difference in the percentage of
9 months in which the 88°F water temperature threshold is exceeded between Alternative 8 and NAA.

10 **Table 11-8-103. Difference and Percent Difference in the Percentage of Months during April–**
11 **November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed**
12 **the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

13

14 *Adults*

15 *Flows*

16 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
17 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows
18 could reduce the quantity and quality of instream habitat available for adult rearing.

19 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
20 greater than flows under NAA during December through June, with isolated exceptions (to 11%
21 lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows
22 under A8_LLT during July through November would be lower than flows under NAA (to 26% lower).
23 Flow reductions in drier water years, when effects would be more critical for habitat conditions,
24 would be persistent during July through November with small to moderate reductions in below
25 normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated
26 reduction in critical years (21% lower during October). Based on the duration and magnitude of
27 these reductions, there would be a localized effect on rearing conditions in below normal years that
28 would not have biologically meaningful negative effects on the largemouth bass population.

29 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
30 greater than flows under NAA, except in above normal years during April (11% lower), in critical
31 years during August and October through November (to 22% lower), and in wet years during

1 November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The
2 flow reductions in drier water years would be more critical for habitat conditions and would be
3 limited to relatively infrequent, small to moderate reductions in critical years that would not have
4 biologically meaningful negative effects.

5 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
6 than NAA throughout the year, except in critical years during March, April, June, and December (5%
7 to 8% lower), wet years during February (7% lower), and below normal years during March (6%
8 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater
10 than those under NAA during January through May (up to 616% greater), and lower during the rest
11 of the year (to 76% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow
12 reductions in drier water years would be substantial in each of these months except September and
13 October, but would be offset by much more substantial increases in flow in the preceding months.

14 In the American River at Nimbus Dam, flows under A8_LLT would generally be similar to or lower
15 than flows under NAA during July through December (up to 49% lower) (Appendix 11C, *CALSIM II*
16 *Model Results utilized in the Fish Analysis*). There would be persistent, moderate flow reductions (to
17 25% lower) in below normal years during July and September through November, an isolated
18 reduction in dry years during July (25% lower), and persistent, small to substantial reductions in
19 critical years during July through September (49%, 13%, and 8% lower, respectively), November
20 and December (to 17% lower). The fairly persistent, small to moderate reductions would have a
21 localized effect on habitat conditions for portions of the year in specific water year types.

22 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
23 always be similar to or greater than flows relative to NAA throughout the year, except in below
24 normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
25 *Fish Analysis*).

26 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
27 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
28 relative to the NAA.

29 *Water Temperature*

30 The percentage of months above the 86°F water temperature threshold for year-round adult
31 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and
32 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
33 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
34 modeled in the San Joaquin River or Clear Creek.

35 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
36 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
37 there would be no temperature-related effects in these rivers during the year-round period.

38 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under
39 NAA or A8_LLT (Table 11-8-104). As a result, there would be no difference in the percentage of
40 months in which the 86°F water temperature threshold is exceeded between Alternative 8 and NAA.

1 **Table 11-8-104. Difference and Percent Difference in the Percentage of Months Year-Round in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F**
 3 **Water Temperature Threshold for Adult Largemouth Bass Survival^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4
 5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 Alternative 8 would not cause a substantial reduction in juvenile and adult rearing or spawning
 7 habitat. Flows in all rivers examined during the year under Alternative 8 are generally similar to or
 8 greater than flows under the NAA in most months. There would be small to moderate flow
 9 reductions in drier water years in the Sacramento and Trinity rivers that would have localized
 10 effects for portions of the spawning and rearing periods, however, they would not be persistent
 11 enough or of sufficient magnitude in any single water year type to have biologically meaningful
 12 negative effects. There would also be substantial flow reductions during July through December in
 13 most water year types in the Feather River and the American River, however, these would be offset
 14 by more substantial increases in flow in the preceding months and would not be biologically
 15 meaningful to the largemouth bass population. The percentage of months outside the 86°F and 88°F
 16 temperature thresholds for adult and juvenile rearing conditions (respectively) in the Feather River
 17 under Alternative 8 would be similar to those under the NAA. The percentage of months outside the
 18 59°F to 75°F threshold for spawning is greater under A8_LLT than NAA and would have a small,
 19 localized effect on spawning conditions, but based on the magnitude of the effect and occurrence at a
 20 single location, it would not have biologically meaningful negative effects on the largemouth bass
 21 population. There are no temperature-related effects in any other rivers examined.

22 **CEQA Conclusion:** In general, Alternative 8 would reduce the quality and quantity of upstream
 23 habitat conditions for largemouth bass relative to Existing Conditions.

24 *Juveniles*

25 *Flows*

26 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 27 Clear Creek were examined during the April through November juvenile largemouth bass rearing
 28 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
 29 rearing.

30 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
 31 greater than flows under Existing Conditions during April through June and in wetter water years
 32 during September, and would be similar to or lower than flows under Existing Conditions (to 30%
 33 lower) during July through November, including drier water years during September (Appendix

1 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years
2 would consist of small to moderate reductions and/or isolated reductions that would have a
3 localized effect during a portion of the July through November time-frame in specific water years.

4 In the Trinity River below Lewiston Reservoir, flows under A8_LLТ during April through July would
5 generally be similar to or greater than flows under Existing Conditions, with isolated exceptions of
6 relatively small flow reductions (to 14% lower), similar to flows under Existing Conditions during
7 August and September except in critical years (42% and 42% lower, respectively), and similar to or
8 lower than flows under Existing Conditions during October through November (to 39% lower)
9 (*Appendix 11C, CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water
10 year types, when effects would be more critical for habitat conditions, would consist of small
11 magnitude, isolated reductions, with more persistent, substantial reductions in critical years during
12 August through November (25% to 42% lower) (*Appendix 11C, CALSIM II Model Results utilized in*
13 *the Fish Analysis*). This would have a localized effect during these months in critical water years but
14 would not have biologically meaningful effects on the largemouth bass population.

15 In Clear Creek at Whiskeytown Dam, flows under A8_LLТ would generally be similar to or greater
16 than flows under Existing Conditions throughout the April through November period, except in
17 critical years during August and September (18% and 19% lower, respectively) (*Appendix 11C,*
18 *CALSIM II Model Results utilized in the Fish Analysis*).

19 In the Feather River at Thermalito Afterbay, flows under A8_LLТ would always be substantially
20 greater (up to 565% greater) than flows under Existing Conditions during April and May, and up to
21 77% lower during the rest of the period (*Appendix 11C, CALSIM II Model Results utilized in the Fish*
22 *Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat
23 conditions, would consist of persistent, substantial reductions in below normal years (to 76%
24 lower), dry years (to 77% lower), and critical years (to 56% lower) (*Appendix 11C, CALSIM II Model*
25 *Results utilized in the Fish Analysis*). These flow reductions would be offset by even more substantial
26 increases in flow during the preceding months.

27 In the American River at Nimbus Dam, flows under A8_LLТ would generally be similar to or greater
28 than flows under Existing Conditions during April through June and October, with the exception of
29 small to moderate flow reductions in wetter water years (up to 34% lower) when effects on habitat
30 conditions would be less critical, a relatively small flow reduction in critical years during June (17%
31 lower) that would be offset by a substantial increase in the preceding month (72% greater), and
32 small decreases in wet (7% lower) and dry years (16% lower) during October (*Appendix 11C,*
33 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A8_LLТ during July through
34 September and November would be lower by up to 53% relative to Existing Conditions, with
35 persistent, moderate to substantial reductions in drier water year types that would have a localized
36 effect during July through November.

37 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLТ would
38 generally be lower than Existing Conditions during April through November (to 27% lower) except
39 in wet and critical years during June (*Appendix 11C, CALSIM II Model Results utilized in the Fish*
40 *Analysis*). The persistent, small to moderate flow reductions in drier water years, when effects would
41 be more critical for habitat conditions, would be preceded by small to substantial reductions during
42 January through March and would have a localized effect on rearing conditions throughout the
43 period.

1 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
2 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
3 reductions in flows during the period relative to Existing Conditions.

4 *Water Temperature*

5 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
6 rearing during April through November was examined in the Sacramento, Trinity, Feather,
7 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
8 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
9 temperatures were not modeled in the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
11 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
12 there would be no temperature-related effects in these rivers during the April through November
13 period.

14 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F
15 water temperature threshold for year-round juvenile largemouth bass occurrence under Existing
16 Conditions or A8_LLT (Table 11-8-103). As a result, there would be no difference in the percentage
17 of months in which the 88°F water temperature threshold is exceeded between Alternative 8 and
18 Existing Conditions.

19 *Adults*

20 *Flows*

21 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
22 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower
23 flows could reduce the quantity and quality of instream habitat available for adult rearing.

24 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
25 greater than flows under Existing Conditions during January through June and in wetter water years
26 during September, and would be similar to or lower than flows under Existing Conditions (to 30%
27 lower) during July through December, including drier water years during September (Appendix 11C,
28 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would
29 consist of small to moderate reductions and/or isolated reductions that would have a localized
30 effect during a portion of the July through December time-frame in specific water years.

31 In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July
32 would generally be similar to or greater than flows under Existing Conditions, with isolated
33 exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing
34 Conditions during August and September except in critical years (42% and 42% lower,
35 respectively), and similar to or lower than flows under Existing Conditions during October through
36 December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
37 Flows under A8_LLT during October and November would be up to 39% lower than flows under
38 Existing Conditions. Flow reductions in drier water year types, when effects would be more critical
39 for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent,
40 substantial reductions in critical years during August through December (18% to 42% lower)
41 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized

1 effect during these months in critical water years but would not have biologically meaningful effects
2 on the largemouth bass population.

3 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than
4 flows under Existing Conditions throughout the year, except in critical years during August and
5 September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
6 *the Fish Analysis*).

7 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows
8 under Existing Conditions during January through May (up to 565% greater), and up to 77% lower
9 during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow
10 reductions in drier water years, when effects would be more critical for habitat conditions, would
11 consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to
12 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
13 *Fish Analysis*).

14 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
15 under Existing Conditions during February through June (up to 72% greater) with isolated,
16 relatively small magnitude exceptions (to 34% lower in isolated, wetter water years and to 24%
17 lower in isolated, drier water years), and would be lower than flows under Existing Conditions in
18 drier water years during January (to 32% lower), and during July through September, November
19 and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
20 *Analysis*). The persistent small to substantial flow reductions, including in drier water years, during
21 most of the year would affect rearing conditions.

22 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
23 generally be lower than under Existing Conditions by up to 36% throughout the year except in wet
24 and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
25 The persistent, small to moderate flow reductions, including in drier water years, when effects
26 would be more critical for habitat conditions, would affect rearing conditions throughout the year.

27 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
28 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
29 reductions in flows during the period relative to Existing Conditions.

30 *Water Temperature*

31 The percentage of months above the 86°F water temperature threshold for year-round adult
32 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and
33 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
34 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
35 modeled in the San Joaquin River or Clear Creek.

36 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
37 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
38 there would be no temperature-related effects in these rivers during the April through November
39 period.

40 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F
41 water temperature range for year-round adult largemouth bass occurrence under Existing
42 Conditions or A8_LLT (Table 11-8-104). As a result, there would be no difference in the percentage

1 of months in which the 86°F water temperature threshold is exceeded between Alternative 8 and
2 Existing Conditions.

3 **CEQA Conclusion:** Collectively, these results indicate that the impact would be significant because
4 Alternative 8 would cause a substantial reduction in largemouth bass habitat. In several locations,
5 there would be isolated and/or small flow reductions in drier water years that would have a
6 localized effect during a limited portion of the juvenile and adult rearing periods. There would be
7 persistent, moderate to substantial flow reductions for much of the year in the Feather, American,
8 and Stanislaus rivers that would have a biologically meaningful effect on the largemouth bass
9 population. The percentages of years outside temperature thresholds in the Sacramento, Trinity,
10 Feather, American and Stanislaus rivers for rearing adults and are generally similar April through
11 November under Alternative 8 compared to Existing Conditions. This impact is a result of the
12 specific reservoir operations and resulting flows associated with this alternative. Applying
13 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to
14 reduce this impact to a less-than-significant level would fundamentally change the alternative,
15 thereby making it a different alternative than that which has been modeled and analyzed. As a
16 result, this impact is significant and unavoidable because there is no feasible mitigation available.

17 The NEPA and CEQA conclusions differ for this impact statement because they were determined
18 using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA
19 and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These
20 baselines differ in two ways. First, NAA includes the Fall X2 standard in wet above normal water
21 years, whereas the Existing Conditions do not. Second, NAA is assumed to occur during the late long-
22 term implementation period, whereas the CEQA baseline is assumed to occur during existing climate
23 conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 8
24 are due primarily to both the alternative and future climate change.

25 ***Sacramento Tule Perch***

26 In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for
27 Sacramento tule perch relative to the NAA.

28 ***Flows***

29 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
30 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
31 reduce the quantity and quality of instream habitat available for rearing.

32 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
33 greater than flows under NAA during December through June, with isolated exceptions (to 11%
34 lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows
35 under A8_LLT during July through November would be lower than flows under NAA (to 26% lower).
36 Flow reductions in drier water years, when effects would be more critical for habitat conditions,
37 would be persistent during July through November with small to moderate reductions in below
38 normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated
39 reduction in critical years (21% lower during October). Based on the duration and magnitude of
40 these reductions, there would be a localized effect on rearing conditions in below normal years that
41 would not have biologically meaningful negative effects on the Sacramento tule perch population.

1 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
2 greater than flows under NAA, except in above normal years during April (11% lower), in critical
3 years during August and October through November (to 22% lower), and in wet years during
4 November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The
5 flow reductions in drier water years would be more critical for habitat conditions and would be
6 limited to relatively infrequent, small to moderate reductions in critical years that would not have
7 biologically meaningful negative effects.

8 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
9 than flows under NAA throughout the year, except in critical years during March, April, June, and
10 December (5% to 8% lower), in wet years during February (7% lower), and in below normal years
11 during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater
13 than those under NAA during January through May (up to 616% greater), and lower during the rest
14 of the year compared to flow under NAA (to 76% lower) (Appendix 11C, *CALSIM II Model Results
15 utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of
16 these months except September and October.

17 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
18 under NAA during January through June (up to 105% greater) with isolated, small exceptions (to
19 14% lower), and similar to or lower than flows under NAA during July through December (up to
20 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be
21 persistent, moderate flow reductions (to 25% lower) in below normal years during July and
22 September through November, an isolated reduction in dry years during July (25% lower), and
23 persistent, small to substantial reductions in critical years during July through September (49%,
24 13%, and 8% lower, respectively), and November and December (to 17% lower). The fairly
25 persistent, small to moderate reductions would have a localized effect on habitat conditions for
26 portions of the year in specific water year types.

27 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
28 always be similar to or greater than flows relative to NAA throughout the year, except in below
29 normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the
30 Fish Analysis*).

31 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
32 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
33 relative to the NAA.

34 *Water Temperature*

35 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-
36 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,
37 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds
38 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water
39 temperatures were not modeled in the San Joaquin River or Clear Creek.

40 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
41 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
42 there would be no temperature-related effects in these rivers throughout the year.

1 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT exceeding
2 the 72°F threshold would be higher than the percentage under NAA by 19% to 95% depending on
3 water year type (Table 11-8-105).

4 The percentage of months under A8_LLT exceeding the 75°F threshold would be greater than the
5 percentage under NAA in all water years (17% to 100% higher), with absolute differences between
6 1 and 6% (Table 11-8-105).

7 **Table 11-8-105. Difference and Percent Difference in the Percentage of Months Year-Round in**
8 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F**
9 **Water Temperature Thresholds for Sacramento Tule Perch Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
72°F Threshold		
Wet	11 (500%)	12 (86%)
Above Normal	17 (NA)	16 (95%)
Below Normal	19 (NA)	16 (84%)
Dry	19 (NA)	13 (73%)
Critical	14 (333%)	3 (19%)
All	15 (1,146%)	12 (73%)
75°F Threshold		
Wet	6 (NA)	6 (100%)
Above Normal	4 (NA)	4 (100%)
Below Normal	6 (NA)	6 (100%)
Dry	5 (NA)	4 (82%)
Critical	8 (1,100%)	1 (17%)
All	6 (5,600%)	5 (79%)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

10

11 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
12 Alternative 8 would not cause a substantial reduction in rearing habitat. Flows in all rivers examined
13 during the year under Alternative 8 are generally similar to or greater than flows under the NAA in
14 most months. There would be small to moderate flow reductions in drier water years in the
15 Sacramento and Trinity rivers that would have localized effects for portion of the spawning and
16 rearing periods, however, they would not be persistent enough or of sufficient magnitude in any
17 single water year type to have biologically meaningful negative effects. There would also be
18 substantial flow reductions during July through December in most water year types in the Feather
19 River and the American River, however, these would be offset by more substantial increases in flow
20 in the preceding months and would not be biologically meaningful to the Sacramento tule perch
21 population. The percentages of years above suitable temperature thresholds under Alternative 8 in
22 the Feather River are generally similar to or slightly greater than the percentages under the NAA.
23 However, there are no temperature related effects in any of the other rivers examined.

24 **CEQA Conclusion:** In general, Alternative 8 would reduce the quality and quantity of upstream
25 habitat conditions for Sacramento tule perch relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the Sacramento tule perch rearing period. Lower flows could
4 reduce the quantity and quality of instream habitat available for adult rearing.

5 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
6 greater than flows under Existing Conditions during January through June and in wetter water years
7 during September, and would be similar to or lower than flows under Existing Conditions (to 30%
8 lower) during July through December, including drier water years during September (Appendix 11C,
9 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would
10 consist of small to moderate reductions and/or isolated reductions that would have a localized
11 effect during a portion of the July through December time-frame in specific water years.

12 In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July
13 would generally be similar to or greater than flows under Existing Conditions, with isolated
14 exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing
15 Conditions during August and September except in critical years (42% and 42% lower,
16 respectively), and similar to or lower than flows under Existing Conditions during October through
17 December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
18 Flows under A8_LLT during October and November would be up to 39% lower than flows under
19 Existing Conditions. Flow reductions in drier water year types, when effects would be more critical
20 for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent,
21 substantial reductions in critical years during August through December (18% to 42% lower)
22 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized
23 effect during these months in critical water years but would not have biologically meaningful effects
24 on the Sacramento tule perch population.

25 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than
26 flows under Existing Conditions throughout the year, except in critical years during August and
27 September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
28 *the Fish Analysis*).

29 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows
30 under Existing Conditions during January through May (up to 565% greater), and up to 77% lower
31 during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow
32 reductions in drier water years, when effects would be more critical for habitat conditions, would
33 consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to
34 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
35 *Fish Analysis*).

36 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
37 under Existing Conditions during February through June (up to 72% greater) with isolated,
38 relatively small magnitude exceptions (to 34% lower in isolated, wetter water years and to 24%
39 lower in isolated, drier water years), and would be lower than flows under Existing Conditions in
40 drier water years during January (to 32% lower), and during July through September, November
41 and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
42 *Analysis*). The persistent small to substantial flow reductions, including in drier water years, during
43 most of the year would affect rearing conditions.

1 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
2 generally be lower than under Existing Conditions by up to 36% throughout the year except in wet
3 and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
4 The persistent, small to moderate flow reductions, including in drier water years, when effects
5 would be more critical for habitat conditions, would affect rearing conditions throughout the year.

6 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
7 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
8 reductions in flows during the period relative to Existing Conditions.

9 *Water Temperature*

10 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round
11 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,
12 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead
13 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not
14 modeled in Clear Creek or the San Joaquin River.

15 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
16 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
17 there would be no temperature-related effects in these rivers during the year.

18 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT exceeding
19 72°F would be similar to or greater than the percentage under Existing Conditions, by up to 500%,
20 but with relatively small absolute increases (to 19%) that would not have biologically meaningful
21 effects (Table 11-8-105).

22 The percentage of months under A8_LLT exceeding 75°F would be slightly higher than the
23 percentage under Existing Conditions in all water years with a high relative increase in critical years
24 (1,100% higher) based on the small numbers being compared, with absolute increases between 4
25 and 8% (Table 11-8-105). These are small increases that would not have biologically meaningful
26 effects.

27 **CEQA Conclusion:** Collectively, these results indicate that the impact would be significant because
28 Alternative 8 would cause a substantial reduction in Sacramento tule perch habitat. Flows under
29 A8_LLT would generally be similar to or greater than flows under Existing Conditions. Flows would
30 be substantially lower during portions of the year-round adult rearing period in the American,
31 Feather, and Stanislaus rivers, which would not have biologically meaningful negative effects on the
32 Sacramento tule perch population. Reduced flows in other rivers would not have biologically
33 meaningful effects on Sacramento tule perch. The percentages of years outside both temperature
34 thresholds are slightly higher under Alternative 8 than under Existing Conditions and would not
35 have biologically meaningful effects on spawning and rearing success. This impact is a result of the
36 specific reservoir operations and resulting flows associated with this alternative. Applying
37 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to
38 reduce this impact to a less-than-significant level would fundamentally change the alternative,
39 thereby making it a different alternative than that which has been modeled and analyzed. As a
40 result, this impact is significant and unavoidable because there is no feasible mitigation available.

41 The NEPA and CEQA conclusions differ for this impact statement because they were determined
42 using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA
43 and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These

1 baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water
2 years, whereas the Existing Conditions do not. Second, the NAA is assumed to occur during the late
3 long-term implementation period, whereas the CEQA baseline is assumed to occur during existing
4 climate conditions. Therefore, differences in model outputs between Existing Conditions and
5 Alternative 8 are due primarily to both the alternative and future climate change.

6 ***Sacramento-San Joaquin Roach***

7 In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for
8 Sacramento-San Joaquin roach relative to the NAA.

9 *Flows*

10 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
11 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
12 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
13 rearing.

14 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
15 greater than flows under NAA during December through June, with isolated exceptions (to 11%
16 lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows
17 under A8_LLT during July through November would be lower than flows under NAA (to 26% lower).
18 Flow reductions in drier water years, when effects would be more critical for habitat conditions,
19 would be persistent during July through November with small to moderate reductions in below
20 normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated
21 reduction in critical years (21% lower during October). Based on the duration and magnitude of
22 these reductions, there would be a localized effect on rearing conditions in below normal years that
23 would not have biologically meaningful negative effects on the Sacramento-San Joaquin roach
24 population.

25 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
26 greater than flows under NAA, except in above normal years during April (11% lower), in critical
27 years during August and October through November (to 22% lower), and in wet years during
28 November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The
29 flow reductions in drier water years would be more critical for habitat conditions and would be
30 limited to relatively infrequent, small to moderate reductions in critical years that would not have
31 biologically meaningful negative effects.

32 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
33 than NAA throughout the year, except in critical years during March, April, June, and December (5%
34 to 8% lower), wet years during February (7% lower), and below normal years during March (6%
35 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater
37 than those under NAA during January through May (up to 616% greater), and lower during the rest
38 of the year compared to flow under NAA (to 76% lower) (Appendix 11C, *CALSIM II Model Results
39 utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of
40 these months except September and October, but would be offset by much more substantial
41 increases in flow in the preceding months.

1 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
2 under NAA during January through June (up to 105% greater) with isolated, small exceptions (to
3 14% lower), and similar to or lower than flows under NAA during July through December (up to
4 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be
5 persistent, moderate flow reductions (to 25% lower) in below normal years during July and
6 September through November, an isolated reduction in dry years during July (25% lower), and
7 persistent, small to substantial reductions in critical years during July through September (49%,
8 13%, and 8% lower, respectively), and November and December (to 17% lower). The fairly
9 persistent, small to moderate reductions would have a localized effect on habitat conditions for
10 portions of the year in specific water year types.

11 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
12 always be similar to or greater than flows relative to NAA throughout the year, except in below
13 normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
14 *Fish Analysis*).

15 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
16 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
17 relative to the NAA.

18 *Water Temperature*

19 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
20 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
21 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing
22 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San
23 Joaquin River or Clear Creek.

24 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
25 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
26 there would be no temperature-related effects in these rivers throughout the year.

27 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under
28 NAA or A8_LLT (Table 11-8-106). As a result, there would be no difference in the percentage of
29 months in which the 86°F water temperature threshold is exceeded between Alternative 8 and NAA.

1 **Table 11-8-106. Difference and Percent Difference in the Percentage of Months Year-Round in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay at Exceed the 86°F**
 3 **Water Temperature Range for Sacramento-San Joaquin Roach Survival^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 Alternative 8 would not cause a substantial reduction in spawning and juvenile and adult
 7 Sacramento-San Joaquin roach rearing habitat. Flows in all rivers examined during the year under
 8 Alternative 8 are generally similar to or greater than flows under the NAA in most months. There
 9 would be small to moderate flow reductions in drier water years in the Sacramento and Trinity
 10 rivers that would have localized effects for portions of the spawning and rearing periods, however,
 11 they would not be persistent enough or of sufficient magnitude in any single water year type to have
 12 biologically meaningful negative effects. There would also be substantial flow reductions during July
 13 through December in most water year types in the Feather River and the American River, however,
 14 these would be offset by more substantial increases in flow in the preceding months and would not
 15 be biologically meaningful to the roach population. The percentage of months outside temperature
 16 thresholds are generally similar to or lower under Alternative 8 than under the NAA, except below
 17 the 60.8 °F threshold where exceedances would generally be higher (up to 14% higher) but would
 18 not have biologically meaningful negative effects.

19 **CEQA Conclusion:** In general, Alternative 8 would reduce the quality and quantity of upstream
 20 habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

21 *Flows*

22 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 23 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
 24 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
 25 rearing.

26 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
 27 greater than flows under Existing Conditions during January through June and in wetter water years
 28 during September, and would be similar to or lower than flows under Existing Conditions (to 30%
 29 lower) during July through December, including drier water years during September (Appendix 11C,
 30 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would
 31 consist of small to moderate reductions and/or isolated reductions that would have a localized
 32 effect during a portion of the July through December time-frame in specific water years.

1 In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July
2 would generally be similar to or greater than flows under Existing Conditions, with isolated
3 exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing
4 Conditions during August and September except in critical years (42% and 42% lower,
5 respectively), and similar to or lower than flows under Existing Conditions during October through
6 December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
7 Flows under A8_LLT during October and November would be up to 39% lower than flows under
8 Existing Conditions. Flow reductions in drier water year types, when effects would be more critical
9 for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent,
10 substantial reductions in critical years during August through December (18% to 42% lower)
11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized
12 effect during these months in critical water years but would not have biologically meaningful effects
13 on the Sacramento-San Joaquin roach population.

14 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than
15 flows under Existing Conditions throughout the year, except in critical years during August and
16 September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
17 *the Fish Analysis*).

18 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than flows
19 under Existing Conditions during January through May (up to 565% greater), and up to 77% lower
20 during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow
21 reductions in drier water years, when effects would be more critical for habitat conditions, would
22 consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to
23 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
24 *Fish Analysis*).

25 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
26 under Existing Conditions during February through June (up to 72% greater) with isolated,
27 relatively small magnitude exceptions (to 34% lower in isolated, wetter water years and to 24%
28 lower in isolated, drier water years), and would be lower than flows under Existing Conditions in
29 drier water years during January (to 32% lower), and during July through September, November
30 and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
31 *Analysis*). The persistent small to substantial flow reductions, including in drier water years, during
32 most of the year would affect rearing conditions.

33 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
34 generally be lower than under Existing Conditions by up to 36% throughout the year except in wet
35 and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
36 The persistent, small to moderate flow reductions, including in drier water years, when effects
37 would be more critical for habitat conditions, would affect rearing conditions throughout the year.

38 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
39 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
40 reductions in flows during the period relative to Existing Conditions.

41 *Water Temperature*

42 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
43 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,

1 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced
2 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.
3 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

4 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
5 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
6 there would be no temperature-related effects in these rivers during the April through November
7 period.

8 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water
9 temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or
10 A8_LLT (Table 11-8-106). As a result, there would be no difference in the percentage of months in
11 which the 86°F water temperature threshold is exceeded between Alternative 8 and Existing
12 Conditions.

13 **CEQA Conclusion:** Collectively, these results indicate that the impact would be significant because
14 Alternative 8 would cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows
15 would be substantially lower during portions of the year-round adult rearing period in the
16 American, Feather, and Stanislaus rivers, which would have biologically meaningful negative effects
17 on the roach population. Reduced flows in other rivers would not have biologically meaningful
18 effects on roach. The percentages of years outside both temperature thresholds are generally lower
19 under Alternative 8 than under Existing Conditions. This impact is a result of the specific reservoir
20 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
21 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
22 less-than-significant level would fundamentally change the alternative, thereby making it a different
23 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
24 unavoidable because there is no feasible mitigation available.

25 The NEPA and CEQA conclusions differ for this impact statement because they were determined
26 using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA
27 and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These
28 baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water
29 years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-
30 term implementation period, whereas the CEQA baseline is assumed to occur during existing climate
31 conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 8
32 are due primarily to both the alternative and future climate change.

33 **Hardhead**

34 In general, Alternative 8 would not affect the quality and quantity of upstream habitat conditions for
35 hardhead relative to the NAA.

36 *Flows*

37 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
38 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
39 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
40 adult rearing.

41 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
42 greater than flows under NAA during December through June, with isolated exceptions (to 11%

1 lower compared to NAA) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows
2 under A8_LLT during July through November would be lower than flows under NAA (to 26% lower).
3 Flow reductions in drier water years, when effects would be more critical for habitat conditions,
4 would be persistent during July through November with small to moderate reductions in below
5 normal years (to 26% lower), small reductions in dry years (to 11% lower), and an isolated
6 reduction in critical years (21% lower during October). Based on the duration and magnitude of
7 these reductions, there would be a localized effect on rearing conditions in below normal years that
8 would not have biologically meaningful negative effects on the hardhead population.

9 In the Trinity River below Lewiston Reservoir, flows under A8_LLT would generally be similar to or
10 greater than flows under NAA, except in above normal years during April (11% lower), in critical
11 years during August and October through November (to 22% lower), and in wet years during
12 November (28% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The
13 flow reductions in drier water years would be more critical for habitat conditions and would be
14 limited to relatively infrequent, small to moderate reductions in critical years that would not have
15 biologically meaningful negative effects.

16 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would generally be similar to or greater
17 than NAA throughout the year, except in critical years during March, April, June, and December (5%
18 to 8% lower), wet years during February (7% lower), and below normal years during March (6%
19 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 In the Feather River at Thermalito Afterbay, flows under A8_LLT would almost always be greater
21 than those under NAA during January through May (up to 616% greater), and lower during the rest
22 of the year compared to flow under NAA (to 76% lower) (Appendix 11C, *CALSIM II Model Results
23 utilized in the Fish Analysis*). Flow reductions in drier water years would be substantial in each of
24 these months except September and October.

25 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
26 under NAA during January through June (up to 105% greater) with isolated, small exceptions (to
27 14% lower), and similar to or lower than flows under NAA during July through December (up to
28 49% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be
29 persistent, moderate flow reductions (to 25% lower) in below normal years during July and
30 September through November, an isolated reduction in dry years during July (25% lower), and
31 persistent, small to substantial reductions in critical years during July through September (49%,
32 13%, and 8% lower, respectively), and November and December (to 17% lower). The fairly
33 persistent, small to moderate reductions would have a localized effect on habitat conditions for
34 portions of the year in specific water year types.

35 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
36 always be similar to or greater than flows relative to NAA throughout the year, except in below
37 normal years during December (9% lower) (Appendix 11C, *CALSIM II Model Results utilized in the
38 Fish Analysis*).

39 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
40 Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows
41 relative to the NAA.

1 *Water Temperature*

2 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for
3 juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American,
4 and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat
5 quality and increased stress and mortality. Water temperatures were not modeled in the San
6 Joaquin River or Clear Creek.

7 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
8 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
9 there would be no temperature-related effects in these rivers throughout the year.

10 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside the
11 range would be similar to or lower than the percentage under NAA in all water years (Table 11-8-
12 107).

13 **Table 11-8-107. Difference and Percent Difference in the Percentage of Months Year-Round in**
14 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F**
15 **to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A8_LLT	NAA vs. A8_LLT
Wet	-8 (-11%)	-5 (-8%)
Above Normal	-11 (-16%)	-7 (-11%)
Below Normal	-9 (-13%)	2 (3%)
Dry	-8 (-11%)	-0.5 (-1%)
Critical	-10 (-15%)	-3 (-6%)
All	-9 (-13%)	-3 (-5%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

16
17 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
18 Alternative 8 would not cause a substantial reduction in spawning and juvenile and adult hardhead
19 rearing. Flows in all rivers examined during the year under Alternative 8 are generally similar to or
20 greater than flows under the NAA in most months. There would be small to moderate flow
21 reductions in drier water years in the Sacramento and Trinity rivers that would have localized
22 effects for portion of the spawning and rearing periods, however, they would not be persistent
23 enough or of sufficient magnitude in any single water year type to have biologically meaningful
24 negative effects. There would also be substantial flow reductions during July through December in
25 most water year types in the Feather River and the American River, however, due to the migration
26 ability and widespread distribution of hardhead in the Central Valley, flows reductions in these two
27 rivers would not be biologically meaningful to the hardhead population. The percentages of years
28 outside the 59°F to 64°F temperature threshold are slightly higher under Alternative 8 than under
29 the NAA, but generally lower for the 65°F to 82.4°F threshold, and would not have biologically
30 meaningful effects on spawning or rearing success.

31 **CEQA Conclusion:** In general, Alternative 8 would reduce the quality and quantity of upstream
32 habitat conditions for hardhead relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
4 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
5 adult rearing.

6 In the Sacramento River upstream of Red Bluff, flows under A8_LLT would generally be similar to or
7 greater than flows under Existing Conditions during January through June and in wetter water years
8 during September, and would be similar to or lower than flows under Existing Conditions (to 30%
9 lower) during July through December, including drier water years during September (Appendix 11C,
10 *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions in drier water years would
11 consist of small to moderate reductions and/or isolated reductions that would have a localized
12 effect during a portion of the July through December time-frame in specific water years.

13 In the Trinity River below Lewiston Reservoir, flows under A8_LLT during January through July
14 would generally be similar to or greater than flows under Existing Conditions, with isolated
15 exceptions of relatively small flow reductions (to 16% lower), similar to flows under Existing
16 Conditions during August and September except in critical years (42% and 42% lower,
17 respectively), and similar to or lower than flows under Existing Conditions during October through
18 December (to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
19 Flows under A8_LLT during October and November would be up to 39% lower than flows under
20 Existing Conditions. Flow reductions in drier water year types, when effects would be more critical
21 for habitat conditions, would consist of small magnitude, isolated reductions, with more persistent,
22 substantial reductions in critical years during August through December (18% to 42% lower)
23 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). This would have a localized
24 effect during these months in critical water years but would not have biologically meaningful effects
25 on the hardhead population.

26 In Clear Creek at Whiskeytown Dam, flows under A8_LLT would always be similar to or greater than
27 flows under Existing Conditions throughout the year, except in critical years during August and
28 September (17% and 19% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
29 *the Fish Analysis*).

30 In the Feather River at Thermalito Afterbay, flows under A8_LLT would always be greater than those
31 under Existing Conditions during January through May (up to 565% greater), and up to 77% lower
32 during the rest of the year (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow
33 reductions in drier water years, when effects would be more critical for habitat conditions, would
34 consist of persistent, substantial reductions in below normal years (to 76% lower), dry years (to
35 77% lower), and critical years (to 56% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
36 *Fish Analysis*).

37 In the American River at Nimbus Dam, flows under A8_LLT would generally be greater than flows
38 under Existing Conditions during February through June (up to 72% greater) with isolated,
39 relatively small magnitude exceptions (to 34% lower in isolated, wetter water year and to 24%
40 lower in isolated, drier water years), and would be lower than flows under Existing Conditions in
41 drier water years during January (to 32% lower), and during July through September, November
42 and December (up to 53% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
43 *Analysis*). The persistent, small to substantial flow reductions, including in drier water years, during
44 most of the year would affect rearing conditions.

1 In the Stanislaus River at the confluence with the San Joaquin River, flows under A8_LLT would
2 generally be lower than under Existing Conditions by up to 36% throughout the year except in wet
3 and critical years during June (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
4 The persistent, small to moderate flow reductions, including in drier water years, when effects
5 would be more critical for habitat conditions, would affect rearing conditions throughout the year.

6 Flow rates in the San Joaquin River under Alternative 8 would be the same as those under
7 Alternative 1A. The analysis for Alternative 1A indicates that there would be small to moderate
8 reductions in flows during the period relative to Existing Conditions.

9 *Water Temperature*

10 The percentage of months in which year-round in-stream temperatures would be outside of the
11 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was
12 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures
13 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.
14 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

15 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 8
16 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
17 there would be no temperature-related effects in these rivers during the April through November
18 period.

19 In the Feather River below Thermalito Afterbay, the percentage of months under A8_LLT outside of
20 the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be
21 lower than the percentage under Existing Conditions in all water years (Table 11-8-107).

22 **CEQA Conclusion:** Collectively, these results indicate that the impact would be significant because
23 Alternative 8 would cause a substantial reduction in hardhead habitat. Flows would be substantially
24 lower during portions of the year-round adult rearing period in the American, Feather, and
25 Stanislaus rivers, which would have biologically meaningful negative effects on hardhead. Reduced
26 flows in other rivers would not have biologically meaningful effects on hardhead. The percentages of
27 years outside both temperature thresholds are generally lower or slightly higher under Alternative
28 8 than under Existing Conditions and would not have biologically meaningful effects on spawning or
29 rearing success. This impact is a result of the specific reservoir operations and resulting flows
30 associated with this alternative. Applying mitigation (e.g., changing reservoir operations in order to
31 alter the flows) to the extent necessary to reduce this impact to a less-than-significant level would
32 fundamentally change the alternative, thereby making it a different alternative than that which has
33 been modeled and analyzed. As a result, this impact is significant and unavoidable because there is
34 no feasible mitigation available.

35 The NEPA and CEQA conclusions differ for this impact statement because they were determined
36 using two unique baselines. The NEPA conclusion was based on the comparison of A8_LLT with NAA
37 and the CEQA conclusion was based on the comparison of A8_LLT with Existing Conditions. These
38 baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water
39 years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-
40 term implementation period, whereas the CEQA baseline is assumed to occur during existing climate
41 conditions. Therefore, differences in model outputs between the Existing Conditions and Alternative
42 8 are due primarily to both the alternative and future climate change.

1 **California Bay Shrimp**

2 **NEPA Effects:** The effect of water operations on rearing habitat of California bay shrimp under
3 Alternative 8 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
4 AQUA-3). That discussion under delta smelt addresses the type, magnitude and range of impact
5 mechanisms that are relevant to the aquatic environment and aquatic species. These effects would
6 not be adverse.

7 **CEQA Conclusion:** As described above the impacts on rearing habitat of California bay shrimp would
8 be less than significant.

9 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered**
10 **Aquatic Species of Primary Management Concern**

11 Also, see Alternative 1A, Impact AQUA-204 for additional background information relevant to non-
12 covered species of primary management concern.

13 **Striped Bass**

14 Adult striped bass migrate up the Delta via the Sacramento River to reach suitable spawning habitat
15 upstream. It is assumed that this migration period occurs around the same timing as spawning.

16 Flows in the Sacramento River downstream of the north Delta diversion facilities would be reduced
17 relative to NAA. Flows would be similar to NAA in April and May, but reduced by 18% in June.

18 Sacramento River flows are highly variable inter-annually, and striped bass are still able to migrate
19 upstream the Sacramento River during lower flow years.

20 **NEPA Effects:** The effect of reduced Sacramento flows under Alternative 8 would not be adverse.

21 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
22 significant because the changes in flow (13–26% lower compared to Existing Conditions in May and
23 June) would not interfere substantially with movement of spawning striped bass through the Delta.
24 No mitigation would be required.

25 **American Shad**

26 Adult American shad migrate up the Delta to reach suitable spawning habitat upstream around
27 March-May. American shad migrate up the Sacramento River while some shad spawn in the San
28 Joaquin River basin. Flows in the Sacramento River below the north Delta diversion facilities would
29 be reduced relative to NAA during March–May. Monthly flows on average would be similar to NAA
30 in April and May, but reduced 16% in March. Flows from the San Joaquin River at Vernalis would be
31 unchanged under Alternative 8. Sacramento River flows are highly variable inter-annually, and
32 American shad are still able to migrate upstream the Sacramento River during lower flow years.

33 **NEPA Effects:** Overall, the impact to American shad migration habitat conditions would not be
34 adverse under Alternative 8.

35 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
36 significant because the changes in flow (reduced 4–15% lower compared to Existing Conditions)
37 would not interfere substantially with movement of American shad from the Delta to upstream
38 spawning habitat. No mitigation would be required.

1 **Threadfin Shad**

2 **NEPA Effects:** Threadfin shad are semi-anadromous, moving between freshwater and brackish
3 water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn.
4 Therefore there is no effect on migration habitat conditions.

5 **CEQA Conclusion:** Impacts would be as described immediately above and would be less than
6 significant because flow changes in the Delta under Alternative 8 would not alter movement
7 patterns for threadfin shad. No mitigation would be required.

8 **Largemouth Bass**

9 **NEPA Effects:** Largemouth bass are non-migratory fish within the Delta. Therefore they do not use
10 the Delta as migration habitat corridor. There would be no effect.

11 **CEQA Conclusion:** As described immediately above, flow changes under Alternative 8 would not
12 affect largemouth movements within the Delta. No mitigation would be required.

13 **Sacramento Tule Perch**

14 **NEPA Effects:** Similar to largemouth bass, Sacramento tule perch are a non-migratory species and do
15 not use the Delta as a migration corridor as they are a resident Delta species. There would be no
16 effect.

17 **CEQA Conclusion:** As described immediately above, flow changes would not affect Sacramento tule
18 perch movements within the Delta. No mitigation would be required.

19 **Sacramento-San Joaquin Roach**

20 **NEPA Effects:** For Sacramento-San Joaquin roach the overall flows and temperature in upstream
21 rivers during migration to their spawning grounds would be similar to those described under
22 Alternative 1A, Impact AQUA-202 for spawning. As described there, the flows would slightly
23 improve the upstream conditions relative to the NAA. These conditions would not be adverse.

24 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
25 conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

26 **Hardhead**

27 **NEPA Effects:** For hardhead the overall flows and temperature in upstream rivers during migration
28 to their spawning grounds would be similar to those described under Alternative 1A, Impact AQUA-
29 202 for spawning. As described there, the flows would slightly improve the upstream conditions
30 relative to the NAA. These conditions would not be adverse.

31 **CEQA Conclusion:** As described immediately above, the impacts of water operations on migration
32 conditions for hardhead would not be significant and no mitigation is required.

33 **California Bay Shrimp**

34 **NEPA Effects:** Because California bay shrimp occur primarily in saline and low salinity waters the
35 overall flow effects on them would not be adverse.

36 **CEQA Conclusion:** Because California bay shrimp occur primarily in saline and low salinity water
37 the overall flow effects on them would be less than significant and no mitigation would be required.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 The effects of restoration measures under Alternative 8 would be similar for all non-covered
3 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by
4 individual species.

5 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic**
6 **Species of Primary Management Concern**

7 Refer to Impact AQUA-7 under delta smelt for a discussion of the likely effects of construction of
8 restoration measures on non-covered species of primary management concern. That discussion
9 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
10 to the aquatic environment and aquatic species. The potential effects of the construction of
11 restoration measures under Alternative 8 would be similar to those described for Alternative 1A
12 (see Alternative 1A, Impact AQUA-7).

13 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-7, these effects would not be adverse.

14 **CEQA Conclusion:** As described immediately above, the impacts of the construction of restoration
15 measures would be less than significant.

16 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**
17 **Covered Aquatic Species of Primary Management Concern**

18 Refer to Impact AQUA-8 under delta smelt for a discussion of the potential effects of contaminants
19 associated with restoration measures on non-covered species of primary management concern. That
20 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that
21 are relevant to the aquatic environment and aquatic species. For a detailed discussion, please see
22 Alternative 1A, Impact AQUA-8.

23 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-8, these effects would not be adverse.

24 **CEQA Conclusion:** As described immediately above, the impacts of contaminants associated with
25 restoration measures would be less than significant.

26 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**
27 **Primary Management Concern**

28 Refer to Impact AQUA-9 under delta smelt for a discussion of the potential effects of restored habitat
29 conditions on non-covered species of primary management concern. Although there are minor
30 differences, the overall effects are similar. That discussion under delta smelt addresses the type,
31 magnitude and range of impact mechanisms that are relevant to the aquatic environment and
32 aquatic species. For a detailed discussion, please see Alternative 1A, Impact AQUA-8.

33 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-207, the different effects on non-
34 covered species of primary management concern range from slightly beneficial to beneficial.

35 **CEQA Conclusion:** As described immediately above, the impacts of restored habitat conditions
36 would range from slightly beneficial to beneficial.

1 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**
2 **Primary Management Concern (CM12)**

3 Refer to Impact AQUA-10 under delta smelt for a discussion of the potential effects of
4 methylmercury management on non-covered species of primary management concern. That
5 discussion under delta smelt addresses the type, magnitude and range of impact mechanisms that
6 are relevant to the aquatic environment and aquatic species.

7 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-10, the effects would not be adverse.

8 **CEQA Conclusion:** As described immediately above, the impacts of methylmercury management
9 would be less than significant.

10 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**
11 **Aquatic Species of Primary Management Concern (CM13)**

12 **NEPA Effects:** The potential effects of invasive aquatic vegetation management on non-covered
13 species of primary management concern under Alternative 8 would be similar to those described for
14 Alternative 1A (see Alternative 1A, Impact AQUA-11) except for predatory species (striped bass and
15 largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding habitat for
16 predatory fish which improves their hunting success. Sacramento tule perch also use the cover of
17 aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh. Consequently,
18 reducing the amount of invasive aquatic habitat will negatively affect these predatory species and
19 Sacramento tule perch. However, this control will not substantially reduce the ability of the
20 predatory species to hunt and there will still be many other habitats in which the predatory species
21 can successfully hunt and in which Sacramento tule perch will thrive. The effect on them will not be
22 adverse.

23 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt for a discussion of the potential
24 effects of invasive aquatic vegetation management on non-covered species of primary management
25 concern. There are minor differences and the effects are similar except for predatory species
26 (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides
27 hiding habitat for predatory fish which improves their hunting success. Sacramento tule perch use
28 the cover of aquatic plants in the Sacramento and San Joaquin rivers and in Suisun marsh.
29 Consequently, reducing the amount of invasive aquatic habitat will negatively affect the predatory
30 species and Sacramento tule perch. However, this control will not substantially reduce the ability of
31 the predatory species to hunt and there will still be many other habitats in which the predatory
32 species can successfully hunt and in which Sacramento tule perch will thrive. Therefore the effect on
33 them will not be significant and no mitigation is required.

34 **Other Conservation Measures (CM12–CM19 and CM21)**

35 The effects of other conservation measures under Alternative 8 would be similar for all non-covered
36 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by
37 individual species.

38 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**
39 **Species of Primary Management Concern (CM14)**

40 Refer to Impact AQUA-12 under delta smelt for a discussion of the effects of dissolved oxygen
41 management on non-covered species of primary management concern. That discussion under delta

1 smelt addresses the type, magnitude and range of impact mechanisms that are relevant to the
2 aquatic environment and aquatic species. The potential effects of dissolved oxygen management
3 under Alternative 8 would be similar to those described for

4 **NEPA Effects:** As concluded for Alternative 1A, these effects would be beneficial.

5 **CEQA Conclusion:** As described immediately above, the impacts of oxygen level management would
6 be beneficial.

7 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**
8 **Species of Primary Management Concern (CM15)**

9 **NEPA Effects:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the
10 effects of predatory fish (striped bass and largemouth bass) and predator management on non-
11 predatory fish. The purpose of predatory fish management is to reduce the numbers of predatory
12 fish and to reduce their hunting success. This management will have negative effects on predatory
13 fish. However, the numbers of predatory fish are high and the extent of the habitats in which they
14 hunt is extensive. Therefore the effects of this management will not be adverse.

15 **CEQA Conclusion:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the
16 potential effects of predatory fish and predator management on non-predatory fish. The purpose of
17 predatory fish management is to reduce the numbers of predatory fish and to reduce their hunting
18 success. This management will have negative effects on predatory fish. However, the numbers of
19 predatory fish are high and the extent of the habitats in which they hunt is extensive. Therefore the
20 effects of this management will not be significant. No mitigation is required.

21 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**
22 **Primary Management Concern (CM16)**

23 **NEPA Effects:** Refer to Impact AQUA-14 under delta smelt for a discussion of the effects of
24 nonphysical fish barriers on non-covered species of primary management concern. The potential
25 effects of nonphysical fish barriers under Alternative 8 would be similar to those described for
26 Alternative 1A. For a detailed discussion, please see Alternative 1A, Impact AQUA-14. The effects
27 would be similar except for Sacramento-San Joaquin roach and hardhead which are unlikely to be
28 present in their vicinity. The effects would not be adverse.

29 **CEQA Conclusion:** As described immediately above, the impacts of nonphysical fish barriers would
30 be less than significant.

31 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**
32 **Primary Management Concern (CM17)**

33 **NEPA Effects:** Refer to Impact AQUA-15 under delta smelt for a discussion of the potential effects of
34 illegal harvest reduction on non-covered species of primary management concern. The potential
35 effects of illegal harvest reduction under Alternative 8 would be similar to those described for
36 Alternative 1A. For a detailed discussion, please see Alternative 1A, Impact AQUA-15. The effects
37 would not be adverse.

38 **CEQA Conclusion:** As described immediately above, the impacts of illegal harvest reduction would
39 be less than significant.

1 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**
2 **Primary Management Concern (CM18)**

3 *NEPA Effects:* The potential effects of conservation hatcheries on non-covered species of primary
4 management concern under Alternative 8 would be similar to those described for Alternative 1A.
5 For a detailed discussion, please see Alternative 1A, Impact AQUA-16. There would be no effect.

6 *CEQA Conclusion:* As described immediately above, conservation hatcheries would have not impact.

7 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**
8 **of Primary Management Concern (CM19)**

9 *NEPA Effects:* Refer to Impact AQUA-17 under delta smelt for a discussion of the potential effects of
10 stormwater treatment on non-covered species of primary management concern. That discussion
11 under delta smelt addresses the type, magnitude and range of impact mechanisms that are relevant
12 to the aquatic environment and aquatic species. The potential effects of stormwater treatment under
13 Alternative 8 would be similar to those described for Alternative 1A. For a detailed discussion,
14 please see Alternative 1A, Impact AQUA-17. These effects would be beneficial.

15 *CEQA Conclusion:* As described immediately above, the impacts of stormwater management would
16 be beneficial.

17 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**
18 **Aquatic Species of Primary Management Concern (CM21)**

19 *NEPA Effects:* Refer to Impact AQUA-18 under delta smelt for a discussion of the potential effects of
20 removal/relocation of nonproject diversions on non-covered species of primary management
21 concern. The potential effects of removal/relocation of nonproject diversions under Alternative 8
22 would be similar to those described for Alternative 1A (see Alternative 1A, Impact AQUA-18). The
23 effects would be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch
24 which are unlikely to be present near these diversions. The effects would not be adverse.

25 *CEQA Conclusion:* As described immediately above, the impacts of removal/relocation of nonproject
26 diversions would be less than significant.

27 **Upstream Reservoirs**

28 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

29 *NEPA Effects:* Similar to the description for Alternative 1A, this effect would not be adverse because
30 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 8 would not be
31 substantially reduced when compared to the NAA.

32 *CEQA Conclusion:* Similar to the description for Alternative 1A, Alternative 8 would reduce the
33 quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be
34 a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant
35 impact. These results are primarily caused by four factors: differences in sea level rise, differences in
36 climate change, future water demands, and implementation of the alternative. The analysis
37 described above comparing Existing Conditions to Alternative 8 does not partition the effect of
38 implementation of the alternative from those of sea level rise, climate change and future water
39 demands using the model simulation results presented in this chapter. However, the increment of

1 change attributable to the alternative is well informed by the results from the NEPA analysis, which
2 found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 8, if
3 adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
4 therefore would not in itself result in a significant impact on coldwater habitat in upstream
5 reservoirs. This impact is found to be less than significant and no mitigation is required.

1 **11.3.4.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs;**
2 **Operational Scenario G)**

3 Construction activities under Alternative 9 could affect environmental conditions in the Sacramento
4 River where the Delta Cross Channel (DCC) gates would be modified to include fish screens, and
5 possibly a new gate, and where the Georgiana Slough screened diversion is constructed. In-water
6 construction would affect environmental conditions at several other locations in the Delta: where 12
7 additional operable gates and five barge landings would be constructed; where several waterways
8 would be dredged to increase channel capacity in order to convey required flows; where levees
9 would be constructed or modified; and where canals, bridges, and pump stations would be
10 constructed. Table 11-9-1 lists the in-water and near-water construction activities under Alternative
11 9 that could directly affect fish and the area affected (see Chapter 3, *Description of Alternatives*, for a
12 detailed description of construction activities).

13 Alternative 9 includes the activities and facilities listed in Table 11-9-1 below and their impact
14 lengths and/or affected areas.

15 In addition to construction of the conveyance elements of Alternative 9, construction occurring
16 during implementation of numerous conservation measures would affect aquatic habitats. The
17 conservation measures involving in-water construction would be similar to those identified and
18 analyzed under Alternative 1A. Under Alternative 9, impacts on fish could result from temporary
19 changes in water quality (e.g., turbidity and accidental spills); exposure to construction related noise
20 (e.g., pile driving); direct physical injury during construction; and temporary and permanent
21 changes in spawning and rearing habitat area, migration habitat conditions, and predation.

22 Operations under Alternative 9 would result in changes in flow and potentially changes in water
23 quality, habitat, impingement, entrainment, and predation. The operable barriers also would restrict
24 fish movement in the Delta by reducing fish entry into the conveyance corridor or, in the case of the
25 Mokelumne River and San Joaquin River Separate Fish Movement Corridors, by providing fish
26 passage that would minimize fish entrainment through the DCC and south Delta intakes,
27 respectively.

28 The Sacramento River channel and bank would be affected by construction of the two fish-screened
29 gates at the DCC and Georgiana Slough. Operable barriers would be installed to minimize fish
30 movement into the Separate Water Supply Corridor, reduce flood potential downstream of the DCC,
31 and allow floodwaters to continue to pass down Georgiana Slough and improve water quality.

32 Each of the operable barriers on DCC and Georgiana Slough would include 2,800-foot-long, fish-
33 screened gates on the Sacramento River, with a capacity of 7,500 cfs. The Georgiana Slough gate also
34 would have a navigation lock and channel.

1 **Table 11-9-1. In-Water and Near-Water Construction Activities under Alternative 9**

Activity or Facility	Temporary In-Water Footprint (Acres)	Permanent In-Water Footprint (Acres)	Dredging (Acres)	Rock Bank Protection (Lineal feet)
Operable Gates				
Mokelumne River near Lost Slough ^a	0.11	0.11	1.29	400
Meadows Slough near Sacramento River ^b	0.17	0.17	1.93	400
Snodgrass Slough north of Delta Cross Channel ^a	0.40	0.40	4.59	400
Delta Cross Channel at Sacramento River ^b	3.21	5.25	-	-
Georgiana Slough at Sacramento River ^b	3.21	5.25	-	-
Threemile Slough at Sacramento River ^b	0.48	0.48	5.51	400
San Joaquin River at head of Old River ^a	0.92	0.92	10.56	400
Middle River South of Victoria Canal ^a	0.26	0.26	2.94	400
Victoria Canal / North Canal – Type ^c	0.40	0.40	4.59	400
Woodward Canal / North Victoria Canal ^c	0.34	0.34	3.86	400
Railroad Cut – Type ^c	0.21	0.21	2.39	400
Connection Slough ^c	0.31	0.31	3.49	400
Franks Tract ^c	0.88	0.88	10.10	400
Fisherman’s Cut ^c	0.46	0.46	5.23	400
Channel Enlargements				
Between Mildred Island and Railroad Cut–Middle River	0	0	0.11	
Between Railroad Cut and Woodward Canal – Middle River	0	0	0.10	
Between Woodward Canal and Victoria Canal– Middle River	0	0	0.07	
Victoria Canal	0	0	0.19	
Culvert Siphons				
Old River Culvert Siphon	1.69	0		
West Canal Culvert Siphon	1.11	0		
New Canals				
Coney Island Canal	0	0	0	0
CCF Intertie Canal	0	0	0	0
Levees				
Near River’s End Marina	0	0	0	0
Pumping Plants				
Middle River	0.05			
Old River	0.05			
Barge Landings				
Webb Tract Landing 1	0.34	0		
Webb Tract Landing 2	0.34	0		
Bacon Island Landing	0.34	0		
Woodward Island Landing 1	0.34	0		
Woodward Island Landing 2	0.34	0		
Bridges				
Levee road on north bank Mokelumne River	0	0	0	
River road at proposed channel connection with Meadows Slough	0	0	0	
CCF maintenance road	0	0	0	
Herdlyn Road at the proposed Intertie Canal	0	0	0	
Total	15.9	15.5	56.9	4,800

^a Type I Gate.

^b Type II Gate.

^c Type III Gate.

1 Operable barriers to be installed in the Mokelumne River region would provide a migration channel
2 between the Mokelumne and Cosumnes Rivers and the Sacramento River, and would prevent fish
3 from migrating into the DCC system. The operable barrier to be installed in Threemile Slough would
4 reduce the possibility of higher-salinity Delta water entering the San Joaquin River system and being
5 conveyed into the Separate Water Supply Corridors. The Threemile Slough operable barrier also
6 would minimize the potential for fish migration from the Sacramento River into the San Joaquin
7 River. The operable barriers included on the San Joaquin River, Middle River, False River, and
8 Franks Tract would prevent fish from migrating into the Separate Water Supply Corridors.

9 Construction of the fish screens, operable barriers, and culvert siphons would require in-water work
10 and construction of cofferdams. In-water work at most locations would need to occur during low
11 water periods for driving steel sheeting to construct cofferdams and performing any work activities
12 in the water (e.g., excavation using a dragline). Once the cofferdams are completed and the
13 enclosure is in place, work can continue (e.g., dewatering, excavation, pile driving, and concreting)
14 inside the cofferdam for the remainder of the year.

15 Pile driving (e.g., for cofferdams and foundation piles) would occur during construction of the fish
16 screens, operable barriers, culvert siphons, pumping plants, and bridges. The details regarding the
17 types, numbers, and locations of piles to be driven are not available at this time. DWR intends to
18 install sheet piles and foundation piles by vibratory methods, but impact driving may be required
19 for some pile installation. The use of impact pile driving is dependent on site-specific geologic
20 conditions, which have not yet been evaluated at the construction locations.

21 Type I barriers would use bottom-hinged navigable gates in locations where the majority of the
22 waterway width requires gates and where depth is less than 20 feet. Type II barriers involve the use
23 of unnavigable radial gates for flow control and navigable wicket or miter gates for the operable
24 portions; these would be used where waterway depth exceeds 20 feet. Type III barriers also would
25 use bottom-hinged navigable gates for operable portions (like Type I) but would use a rock wall for
26 the fixed portion. This type of barrier would be used where gates are required only for recreational
27 boat passage and where flood neutrality is not an issue.

28 The Obermeyer gates for Type I and III barriers could be constructed within existing waterways
29 either wet or dry. The dry construction scenario is the same as described below for the Type II
30 barriers. Constructing the Obermeyer gates in-the-wet would require the gates to be prefabricated
31 offsite, with concrete sills attached prior to being transported to the site. The site would be dredged,
32 and the sheet piles and H-piles could be installed while the gates are being fabricated. Once the site
33 is prepared, the sills with the gates attached would be lifted in place using either catamarans made
34 of Flexi-floats or barge-mounted cranes. The sills would be set on the piles and between sheet pile
35 cut-off walls. Underwater grout would be used to connect the concrete sills to the preinstalled
36 foundations.

37 The Type II barriers would be constructed in multiple stages during summer low-flow periods. A
38 closed steel sheet pile cofferdam would be constructed across part of the waterway, leaving the
39 remainder of the waterway open to pass natural flows. The structure would be constructed within
40 the cofferdam after dewatering. The configuration of the cofferdam would include the upstream and
41 downstream retaining walls adjacent to the main structure. When part of the structure is completed,
42 the cofferdam would be removed and a new cofferdam installed for the next adjacent section to be
43 constructed. Water flowing in the channel would pass through completed structure bays and
44 through any open natural channel that is not blocked by cofferdam. It is possible that some of the

1 longer structures could require multiple construction seasons to complete. However, construction
2 through the winter high-flow periods is not anticipated. Additional temporary cofferdams may also
3 be required upstream and downstream of the deeper gate bays after the entire structure is
4 completed, in order to facilitate dewatering for installation of the gate panels in each bay.

5 The Type III barrier rock wall would be constructed by placing rock from a barge with a crane. DWR
6 routinely installs such barriers across waterways in the south Delta for agriculture and fish benefits.

7 Five temporary barge unloading facilities would be constructed under Alternative 9 to facilitate the
8 transport of equipment and materials to and from the construction sites. The temporary landings
9 would be located at Bacon Island, Woodward Island (two sites), and Webb Tract (two sites). The
10 landings on Bacon Island and Woodward Island are the same locations as those in Alternative 1A.
11 The Webb Tract landings would be located on the northwest corner and on the eastern side of Webb
12 Tract. It was assumed that the docks for the temporary unloading facilities would be piling support
13 structures as described for Alternative 1A.

14 A work area of up to 15 acres could be required in the vicinity of each barrier structure. This area
15 would be needed for temporary storage of materials (e.g., sheet piling and foundation piling),
16 concrete form fabrication, possible field fabrication of miter or radial gate panels, stockpiles, office
17 trailers, shops, and construction equipment maintenance. The proposed Middle River South Delta
18 Improvement Program barrier would consist of a 2.4-acre staging area, a 4.52-acre spoil area, a
19 0.5-acre stockpile area, and 1.6 acres in Middle River.

20 The duration for construction of the Threemile Slough Barrier with Obermeyer gates was estimated
21 at 8 months, assuming that the gates are pre-ordered and that the off-site precast sills are built
22 concurrently with the onsite dredging and pile driving operations.

23 Some excavation (dredging) would be required for several hundred feet upstream and downstream
24 of all gate structures to transition the sides of the existing channel to the required depth and width
25 of the gate structures. It is anticipated that the conformed cut bottom upstream and downstream
26 would be protected by riprap to control erosion.

27 Each gate bay would be inspected annually at the end of the wet season for accumulation of
28 sediment on the bottom that could impede gate operation. Sediment should be removed during
29 summer, by suction or mechanical removal.

30 Alternative 9 would include construction of a 4,000-foot segment of new levees at Old River,
31 isolating Old River from the Tracy Fish Collection Facility and connecting CCF to the fish facility.
32 Setback levees on the south side of Victoria Canal also would be constructed to accommodate the
33 dredged and expanded canal under this conveyance alternative. New levees would be constructed
34 around pumping plants and operation equipment for the operable barriers. New levees or levee
35 modifications constructed for the separate corridor conveyance would be designed to meet similar
36 flood protection levels as the existing levee.

37 The Separate Corridors Alternative would require approximately 4 years to construct. Installation of
38 the DCC and Georgiana Slough fish screens would each be constructed in two phases, lasting 2 years
39 for each phase. The construction duration of the other operable barriers would range between 1.5
40 and 2.5 years, spaced over the 4 year construction period. Channel enlargement would occur over
41 approximately 3.5 years. Culvert siphons would require approximately 2 years each. Levee and new
42 canal construction would last from 3 to 3.5 years, respectively.

1 There is a potential that some of the in-water work associated with construction cofferdams for the
2 operable gates would need to occur through the November timeframe because of the need to
3 construct the cofferdams during the dry season (August through November timeframe). If in-water
4 work is required outside of the expected in-water work window (June 1 through October 31), DWR
5 would consult with the appropriate resource agencies (NMFS, USFWS, and DFG) to obtain
6 permissions.

7 **Delta Smelt**

8 **Construction and Maintenance of CM1**

9 Small numbers of delta smelt eggs, larvae, and adults could be present in the north and west Delta in
10 June during construction of DCC and Georgiana Slough facilities and the operable gates in the west
11 Delta (refer to Table 11-6 for the temporal and spatial distribution of fish in the Delta). During
12 construction of the operable gates and barge unloading facilities in the east Delta, small numbers of
13 delta smelt eggs, larvae, and spawners could be present in June. During construction of the operable
14 gates, barge unloading facilities, culvert siphons, and channel dredging in the south Delta, juveniles
15 and adults are present during the construction months of June to October, with the majority of fish
16 occurring in September and October. All of these construction and maintenance sites occur entirely
17 within designated delta smelt critical habitat.

18 **Impact AQUA-1: Effects of Construction of Water Conveyance Facilities on Delta Smelt**

19 The potential effects of construction of water conveyance facilities on delta smelt or critical habitat
20 would be similar to but greater than those described under Impact AQUA-1 under Alternative 1A.
21 Alternative 9 would have more impact locations because of the construction of fourteen operable
22 gates (Table 11-9-1). Alternative 9 would have two diversions at the DCC and Georgiana Slough
23 facilities while Alternative 1A would have five intakes. Alternative 9 would have one less barge
24 landing (five total) than Alternative 1A. Alternative 9 would have a temporary and permanent in-
25 water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5).
26 Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under
27 Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet
28 compared to 3,600 feet under Alternative 1A (Table 11-5). Because Alternative 9 has more in-water
29 construction locations, the potential for noise effects is greater proportional to the increased
30 number of sites compared to Alternative 1A. Similarly, the increased dredging will have
31 proportionally greater effects. The effects related to temporary increases in turbidity, accidental
32 spills, and disturbance of contaminated sediments would be similar to Alternative 1A and the
33 implementation of the mitigation measures described under Impact AQUA-1 for delta smelt and in
34 Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution*
35 *Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill*
36 *Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and*
37 *Dredged Material; and Barge Operations Plan)* would be available to avoid and minimize potential
38 effects. Additional details on underwater noise, in-water work activities, and the loss of spawning,
39 rearing, or migration habitat are provided below.

40 **Underwater Noise**

41 Alternative 9 would require pile driving to install the cofferdams, gate foundations, and barge
42 unloading facilities. DWR proposes to use vibratory methods to install sheet pile for cofferdams at

1 the DCC and Georgiana Slough facilities, the other operable gates, the culvert siphons, and the piles
2 to support the temporary docks at the barge unloading facilities.

3 The evaluation of underwater noise effects is discussed in detail under Section 11.3.1.1 Potential
4 Impacts Resulting from Construction and Maintenance of Water Conveyance Facilities – *Underwater*
5 *Noise*. The potential for pile driving under Alternative 9 to expose delta smelt to underwater noise
6 exceeding the interim injury threshold criteria of 183 dB SEL_{cumulative} (for fish smaller than 2 grams)
7 is much greater than under the other alternatives due to the number of sites where pile driving
8 would be required, the broader distribution of the sites within the Delta, and the potential need for
9 pile driving over two or more in-water work windows at some sites. Should impact driving be
10 needed for installation of the piles, underwater noise would exceed criteria as illustrated in
11 Table 11-10 (Length, Width, and Area of Water bodies Potentially Exposed to Impact Pile Driving
12 Noise above the 183 dB SEL_{cumulative} Level) and Table 11-11 (Species and Duration of Exposure to
13 Impact Pile Driving during Cofferdam Installation). As with the other alternatives, these tables
14 reflect the assumption that impact pile driving would be required up to about 30% of the time.

15 Delta smelt eggs would not experience underwater sound generated from pile driving because the
16 locations of the Alternative 9 in-water facilities are not considered suitable habitat for this life stage
17 of the species; therefore, effects would not occur.

18 There is a slight potential for adult or larval delta smelt to be in the vicinity of the DCC and
19 Georgiana Slough, other operable gates, siphon culverts, pumping stations, channel dredging, and
20 the barge unloading facilities during in-water construction in the Delta (in June and between June
21 and July, respectively). Delta smelt tend to occupy the west Delta and would be in very low
22 abundance in the north, east, and south Delta during this time; therefore, fish densities within areas
23 affected by pile driving would be exceedingly low. Most adult delta smelt complete their spawning
24 cycle and die by mid- to late June. Larval delta smelt, which move with the currents utilize tidal
25 cycles to move downstream to the low-salinity zone, could potentially drift through areas affected
26 by underwater sound; however, their distribution during this time is predominately in the west
27 Delta rather than the north and south Delta, where most of the pile driving could occur.

28 Alternative 9 includes three operable gates and two barge unloading facilities in the west Delta
29 (gates at Threemile Slough, head of Old River, and Franks Tract; two barge unloading facilities on
30 Webb Tract). There is a moderate possibility that delta smelt could be present in these areas of the
31 west Delta.

32 Individual larval delta smelt that are present in an area affected by underwater sound from impact
33 pile driving above the 183-dB SEL_{cumulative} injury threshold level (for fish smaller than 2 grams), and
34 proximate to an impact-driven pile, could experience an adverse effect, such as injury or mortality.
35 Implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize the effects from
36 underwater noise on delta smelt.

37 ***In-Water Work Activities***

38 Construction activities under Alternative 9 would have greater potential to injure or kill delta smelt
39 than Alternative 1A because of the greater in-water construction activities, including installation of
40 sheet pile cofferdams at the DCC and Georgiana Slough facilities, the other operable gates, pumping
41 stations, culvert siphons, piles at each barge unloading facility, dredging of the Middle River and
42 Victoria Canal, and placement of riprap to protect the streambanks adjacent to the facilities from
43 erosion.

1 The timing of cofferdam and riprap installation for the intakes (June through August) would avoid
 2 most of the spawning season (January through June, with peak numbers in the north Delta during
 3 February through May) when delta smelt are most likely to be present (see Table 11-4). The culvert
 4 siphons would be built during the low-flow season (August through November). Delta smelt
 5 juveniles and adults could be present in the east and south Delta during June and July, so most
 6 would be avoided during the August to November construction period. Effects would be minimized
 7 by implementation of the environmental commitments described under Impact AQUA-1 for delta
 8 smelt and in Appendix 3B, *Environmental Commitments*.

9 ***Loss of Spawning, Rearing, or Migration Habitat***

10 The temporary and permanent loss of habitat, including designated critical habitat, would be
 11 substantially greater for Alternative 9 than Alternative 1A. Temporary loss of delta smelt rearing
 12 and migration habitat would occur within the footprints of the cofferdams used to construct the DCC
 13 and Georgiana Slough facilities, the other operable gates, pumping stations, culvert siphons, and the
 14 footprints of the barge landing docks. Permanent loss of delta smelt rearing and migration habitat
 15 would occur within the footprints of the DCC and Georgiana Slough facilities, the other operable
 16 gates, pumping stations, culvert siphons, and dredged areas. Together, the in-water footprint of
 17 operable gates would cover 15.5 acres and associate dredging would affect 56.5 acres, culvert
 18 siphons would cover 2.8 acres, and barge landings would cover 1.7 acres. Approximately 4,800
 19 linear feet of river bank would be affected by rock bank protection. All of these habitat areas are
 20 designated critical habitat for delta smelt. Permanent habitat lost by installation of the other
 21 facilities is included in Table 11-9-1. The area dredged for channel enlargement in the Middle River
 22 and Victoria channel totals approximately 0.5 acre. Effects would be minimized by implementation
 23 of the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix
 24 3B, *Environmental Commitments (Environmental Training; Erosion and Sediment Control Plan; Spill
 25 Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and
 26 Dredged Material; and Barge Operations Plan)*.

27 ***NEPA Effects:*** The potential construction related effects of Alternative 9 would be greater than those
 28 under Alternative 1A (see Impact AQUA-1) due to construction of operable gates, culvert siphons,
 29 barge landings, and channel enlargements. Effects of in-water construction activities would not be
 30 adverse because construction would typically occur during the approved in-water work window,
 31 and implementation of environmental commitments described under Impact AQUA-1 for delta smelt
 32 and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater Pollution
 33 Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill
 34 Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and
 35 Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan)*—as well as the species'
 36 tolerance to turbidity—would minimize the effects of construction activities on turbidity, accidental
 37 spills, onsite and offsite sediment transport to surface waters, and re-suspension and redistribution
 38 of potentially contaminated sediments.

39 The timing of pile installation and implementation of the avoidance and minimization measures
 40 included in Mitigation Measures AQUA-1a and AQUA-1b (see Alternative 1A, Impact AQUA-1) would
 41 minimize adverse effects from impact pile driving (e.g., injury or mortality) on delta smelt.
 42 Implementation of environmental commitments *Fish Rescue and Salvage Plan* and *Barge Operations
 43 Plan* (as described under Impact AQUA-1 for delta smelt and in Appendix 3B) would also minimize
 44 the potential effects of construction activities on delta smelt.

1 The effect of temporary and permanent rearing and migration habitat loss for delta smelt is also not
2 adverse due to the relatively small areas occupied by the gates, barge landings, and culvert siphons.
3 The low abundance of delta smelt in the vicinity of these facilities during construction, the low
4 quality of the habitat affected by construction, and implementation of environmental commitment
5 *Barge Operations Plan* (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental*
6 *Commitments*) would also minimize the potential effects on delta smelt from construction activities.
7 Overall, the effects of Alternative 9 on delta smelt or designated critical habitat would not be
8 adverse.

9 **CEQA Conclusion:** Although Alternative 9 affects a larger in-water area than Alternative 1A, the
10 impact of construction of the water conveyance facilities on delta smelt or critical habitat would be
11 less than significant except for construction noise associated with pile driving. There are more
12 construction sites where noise impacts would potentially occur under Alternative 9 than under
13 Alternative 1A. However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure
14 AQUA-1b would reduce the noise impact on delta smelt to less than significant.

15 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
16 **of Pile Driving and Other Construction-Related Underwater Noise**

17 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

18 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
19 **and Other Construction-Related Underwater Noise**

20 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

21 **Impact AQUA-2: Effects of Maintenance of Water Conveyance Facilities on Delta Smelt**

22 **NEPA Effects:** Although the facilities involved in maintenance activities under Alternative 9 (screen
23 and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from
24 maintenance activities would apply. Consequently, the potential effects of the maintenance of water
25 conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A
26 (see Impact AQUA-2). As concluded in Alternative 1A, Impact AQUA-2, the effect would not be
27 adverse for delta smelt.

28 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
29 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects
30 resulting from maintenance activities would apply. Consequently, as described in Alternative 1A,
31 Impact AQUA-2 for delta smelt, the impact of the maintenance of water conveyance facilities on
32 delta smelt would be less than significant and no mitigation would be required.

33 **Water Operations of CM1**

34 **Impact AQUA-3: Effects of Water Operations on Entrainment of Delta Smelt**

35 ***Water Exports from SWP/CVP South Delta Facilities***

36 Overall, operational activities under Alternative 9 would benefit delta smelt by substantially
37 reducing entrainment losses at the south Delta facilities for adults and juveniles compared to NAA.
38 Because of the divergent changes in Old River and Middle River flows under Alternative 9, the
39 impacts are assessed qualitatively rather than with the OMR proportional entrainment index. The

1 Old River corridor, currently a major pathway for entrainment, would no longer convey water to
2 those facilities and therefore delta smelt in the north and central Delta regions would experience
3 much less pumping effects (reverse OMR flows) or south Delta entrainment. The small proportion of
4 the delta smelt population that moves up the mainstem San Joaquin River into the east Delta would
5 encounter southward conveyance flows between the mouth of the Mokelumne River and Middle
6 River.

7 **Water Exports from SWP/CVP North Delta Intake Facilities**

8 In general, the potential for delta smelt entrainment is low because the north Delta intakes are
9 upstream of most delta smelt occurrence. Water exports from the Sacramento River would come
10 through new fish-screened intakes at DCC and Georgiana Slough near Walnut Grove. The risk of
11 entrainment into the north Delta water supply corridor is currently low because delta smelt (mainly
12 adults) occur infrequently in the north Delta. This low entrainment risk would be further reduced by
13 fish screens on the intake designed to meet criteria to prevent entrainment and impingement of
14 juvenile delta smelt.

15 **Water Exports with a Dual Conveyance for the SWP North Bay Aqueduct**

16 Potential entrainment of larval delta smelt at the NBA, as estimated by particle tracking models was
17 1.3% under Alternative 9 compared to 2.0% under NAA, a 37% relative decrease (Table 11-9-2).
18 Fish screens would prevent entrainment of adults and juveniles.

19 **Table 11-9-2. Average Percentage (and Difference) of Particles Representing Larval Delta Smelt**
20 **Entrained by the North Bay Aqueduct under Alternative 9 and Baseline Scenarios**

Average Percent Particles Entrained at NBA			Difference (and Relative Difference)	
EXISTING CONDITIONS	NAA	A9_LLТ	A9_LLТ vs. EXISTING CONDITIONS	A9_LLТ vs. NAA
2.1	2.0	1.3	-0.84 (-40%)	-0.73 (-37%)

Note: 60-day DSM2-PTM simulation. Negative difference indicates lower entrainment under the alternative compared to the baseline scenario.

21

22 **Predation Associated with Entrainment**

23 As described under Alternative 1A, Impact AQUA-1 reduced entrainment toward the south Delta
24 facilities would result in overall reduced predation losses of Delta smelt.

25 Predation loss at the north Delta intakes would be limited because few delta smelt occur that far
26 upstream. Predators may aggregate near the physical barriers placed along the corridors, but the
27 effect may not be substantially greater than NAA because predators are already abundant in the
28 interior and south Delta. Overall, the effect would be beneficial for delta smelt because fewer delta
29 smelt would be lost to predation compared to Existing Conditions at the south Delta facilities.

30 **NEPA Effects:** Under Alternative 9 overall potential entrainment of delta smelt would be reduced at
31 the south Delta SWP/CVP facilities and the NBA. Entrainment and impingement could potentially
32 occur at the proposed north Delta intakes, but the risk would be low due to the location, design and
33 operation of intakes, and offset by reduced entrainment at the south Delta facilities. The effect of
34 Alternative 9 on delta smelt is considered to be beneficial due to the substantial entrainment
35 reductions.

1 **CEQA Conclusion:** As described above, Alternative 9 would result in a substantial reduction in delta
2 smelt proportional entrainment and predation loss at the south Delta facilities. The risk of
3 entrainment and predation losses at the north Delta intake facilities is low due to low abundance of
4 delta smelt in the vicinity, while entrainment would be minimized by fish screens. Overall,
5 Alternative 9 would benefit delta smelt due to a substantial reduction in entrainment of delta smelt.
6 Therefore, the impact would be beneficial and no mitigation would be required.

7 **Impact AQUA-4: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
8 **Delta Smelt**

9 The effects of operations under Alternative 9 on abiotic spawning habitat would be the same as
10 described for Alternative 1A (Impact AQUA-4). Flow reductions below the north Delta intakes would
11 not reduce available spawning habitat. In-Delta water temperatures, which can affect spawning
12 timing, would not change across Alternatives, because they would be in thermal equilibrium with
13 atmospheric conditions and not strongly influenced by the flow changes.

14 **NEPA Effects:** The effect of Alternative 9 operations on spawning would not be adverse, because
15 there would be little change in abiotic spawning conditions for delta smelt.

16 **CEQA Conclusion:** As described above, operations under Alternative 9 would not reduce abiotic
17 spawning habitat availability or change spawning temperatures for delta smelt. Consequently, the
18 impact would be less than significant, and no mitigation would be required.

19 **Impact AQUA-5: Effects of Water Operations on Rearing Habitat for Delta Smelt**

20 **NEPA Effects:** The potential effects of water operations and associated habitat restoration would be
21 similar to those described for Alternative 8, Impact AQUA-5. Under Alternative 9, the abiotic habitat
22 index without habitat restoration would be similar to the NAA. Habitat restoration under Alternative
23 9 may substantially increase the abiotic habitat index across all water year types (20–27% greater
24 than the NAA), assuming 100% habitat use (Figure 11-9-1, Table 11-9-3).

25 **CEQA Conclusion:** The average delta smelt abiotic habitat index would increase under Alternative 9
26 without restoration (21% greater) and with restoration (53% greater) compared to Existing
27 Conditions (Figure 11-9-1, Table 11-9-3). Overall, the impact on delta smelt rearing habitat would
28 be beneficial because of the substantial increase in abiotic habitat under Alternative 9 even without
29 habitat restoration actions. No mitigation would be required.

1 **Table 11-9-3. Differences in Delta Smelt Fall Abiotic Index (hectares) between Alternative 9 and**
 2 **Existing Biological Conditions Scenarios, with Habitat Restoration, Averaged by Prior Water Year**
 3 **Type**

Water Year	Without Restoration		With Restoration	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
All	851 (21%)	-35 (-1%)	2,109 (53%)	1,224 (25%)
Wet	2,175 (46%)	-21 (0%)	4,063 (86%)	1,866 (27%)
Above Normal	1,668 (44%)	0 (0%)	3,163 (83%)	1,495 (27%)
Below Normal	-152 (-4%)	-4 (0%)	847 (20%)	995 (25%)
Dry	-215 (-6%)	-123 (-4%)	596 (17%)	687 (20%)
Critical	0 (0%)	0 (0%)	655 (22%)	655 (22%)

Note: Negative values indicate lower habitat indices under the alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

4

5 **Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt**

6 **NEPA Effects:** The effects of operations under Alternative 9 on turbidity and water temperature
 7 would be the same as described for Alternative 1A (Impact AQUA-6). Alternative 9 would not affect
 8 the first flush of winter precipitation and the turbidity cues associated with adult delta smelt
 9 migration. In-Delta water temperatures would not change across alternatives, because they would
 10 be in thermal equilibrium with atmospheric conditions and not strongly influenced by the flow
 11 changes under BDCP operations. There would be no substantial change in the number of stressful or
 12 lethal condition days under Alternative 9.

13 Unlike the other alternatives, Alternative 9 includes 16 physical barriers that would limit movement
 14 of delta smelt, particularly the barriers in the east Delta (Middle River and Old River) and north
 15 Delta (DCC and Georgiana). The barriers may alter migration pathways for spawning adults entering
 16 the Delta from the west, and juvenile and adult smelt that would be in the east Delta and south Delta
 17 under the NAA. However, limiting some migration pathways might reduce the risk of entrainment at
 18 the south Delta facilities.

19 **CEQA Conclusion:** As described above, operations under Alternative 9 would not substantially alter
 20 the turbidity cues associated with winter flush events that may initiate migration, nor would there
 21 be appreciable changes in water temperatures. The physical barriers would limit smelt movement
 22 into suboptimal habitat regions. The impact on migrating delta smelt would be less than significant,
 23 and no mitigation would be required.

24 **Restoration Measures (CM2, CM4–CM7, and CM10)**

25 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
 26 differences in restoration-related fish effects are anticipated anywhere in the affected environment
 27 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
 28 restoration measures described for delta smelt under Alternative 1A (Impact AQUA-7 through
 29 Impact AQUA-9) also appropriately characterize effects under Alternative 9.

30 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

1 **Impact AQUA-7: Effects of Construction of Restoration Measures on Delta Smelt**

2 **Impact AQUA-8: Effects of Contaminants Associated with Restoration Measures on Delta**
3 **Smelt**

4 **Impact AQUA-9: Effects of Restored Habitat Conditions on Delta Smelt**

5 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
6 delta smelt, and most would be at least slightly beneficial. Specifically for AQUA-8, the effects of
7 contaminants on delta smelt with respect to selenium, copper, ammonia and pesticides would not be
8 adverse. The effects of methylmercury on delta smelt are uncertain.

9 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial,
10 or less than significant, and no mitigation is required.

11 **Other Conservation Measures (CM12–CM19 and CM21)**

12 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
13 differences in other conservation-related fish effects are anticipated anywhere in the affected
14 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
15 effects of other conservation measures described for delta smelt under Alternative 1A (Impact
16 AQUA-10 through Impact AQUA-18) also appropriately characterize effects under Alternative 9.

17 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

18 **Impact AQUA-10: Effects of Methylmercury Management on Delta Smelt (CM12)**

19 **Impact AQUA-11: Effects of Invasive Aquatic Vegetation Management on Delta Smelt (CM13)**

20 **Impact AQUA-12: Effects of Dissolved Oxygen Level Management on Delta Smelt (CM14)**

21 **Impact AQUA-13: Effects of Localized Reduction of Predatory Fish on Delta Smelt (CM15)**

22 **Impact AQUA-14: Effects of Nonphysical Fish Barriers on Delta Smelt (CM16)**

23 **Impact AQUA-15: Effects of Illegal Harvest Reduction on Delta Smelt (CM17)**

24 **Impact AQUA-16: Effects of Conservation Hatcheries on Delta Smelt (CM18)**

25 **Impact AQUA-17: Effects of Urban Stormwater Treatment on Delta Smelt (CM19)**

26 **Impact AQUA-18: Effects of Removal/Relocation of Nonproject Diversions on Delta Smelt**
27 **(CM21)**

28 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
29 adverse effect, or beneficial effects on delta smelt for NEPA purposes, for the reasons identified for
30 Alternative 1A.

31 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
32 less than significant, or beneficial on delta smelt, for the reasons identified for Alternative 1A, and no
33 mitigation is required.

1 Longfin Smelt

2 Construction and Maintenance of CM1

3 Longfin smelt are not expected to occur in the construction areas during the in-water construction
4 window (expected to be June through October) (see Table 11-4). While there might still be a slight
5 risk of effects from construction activities, longfin smelt are pelagic species and are less likely to be
6 present in the construction zones than other fish species.

7 Impact AQUA-19: Effects of Construction of Water Conveyance Facilities on Longfin Smelt

8 The potential effects of construction of water conveyance facilities on longfin smelt would be similar
9 to but greater than those described under Alternative 1A, Impact AQUA-19. Alternative 9 would
10 have more impact locations because of the construction of fourteen operable gates (Table 11-9-1).
11 Alternative 9 would have two diversions at the DCC and Georgiana Slough facilities while Alternative
12 1A would have five intakes. There would be one less barge landing under Alternative 9 (five total)
13 compared to Alternative 1A. Alternative 9 would have a temporary and permanent in-water
14 footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5).
15 Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under
16 Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet
17 compared to 3,600 feet under Alternative 1A (Table 11-5). Because Alternative 9 has more in-water
18 construction locations the potential for noise effects is greater proportional to the increased number
19 of sites compared to Alternative 1A. Similarly, the increased dredging will have proportionally
20 greater effects. The effects related to temporary increases in turbidity, accidental spills, disturbance
21 of contaminated sediments and in-water work activities would be similar to Alternative 1A and the
22 same environmental commitments and mitigation measures described under Impact AQUA-1 for
23 delta smelt and in Appendix 3B, *Environmental Commitments (Environmental Training; Stormwater
24 Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management
25 Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel
26 Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge Operations Plan)* would be
27 available to avoid and minimize potential effects. Additional details on underwater noise and the
28 loss of spawning, rearing, or migration habitat are provided below.

29 Underwater Noise

30 Underwater sound generated by impact pile driving in or near surface waters can potentially harm
31 longfin smelt. Potential effects on longfin smelt from impact pile driving would be similar to those
32 described for delta smelt (see Alternative 1A, Impact AQUA-1). Because of the overall low densities
33 of larval longfin smelt expected in all pile driving locations, the relatively low incidence of impact
34 pile driving expected, and implementation of the avoidance and minimization measures included in
35 Mitigation Measures AQUA-1a and AQUA-1b, the potential for longfin smelt to experience an
36 adverse effect from impact pile driving (e.g., injury or mortality) would be very low.

37 Loss of Spawning, Rearing, or Migration Habitat

38 As described above for delta smelt in Alternative 1A, Impact AQUA-1, above, in-water construction
39 would temporarily or permanently alter habitat conditions in the vicinity of the construction
40 activities. As noted above, juvenile longfin smelt are not likely to occur in the construction areas
41 during the typical in-water construction window (see Table 11-6). Most longfin smelt spawning is
42 believed to take place in the Sacramento River near or downstream of Rio Vista, and downstream of

1 Medford Island on the San Joaquin River (Wang 1986). Therefore, fish passage and migration would
2 not be affected by Alternative 9 facilities.

3 As described in Alternative 1A, Impact AQUA-1, there would be in-water and over-water structures
4 at the five barge landings for several years each while the tunnel is constructed. The barge landings
5 would each occupy approximately 15,000 square feet of shoreline habitat within their respective
6 delta channels. Implementation of the environmental commitments described under Impact AQUA-1
7 for delta smelt and in Appendix 3B, *Environmental Commitments (Barge Operations Plan)* would
8 minimize potential effects on longfin smelt habitat from construction and operations of the barge
9 landings.

10 **NEPA Effects:** The potential effects of construction activities on longfin smelt would be similar to but
11 greater than those described for Alternative 1A (see Impact AQUA-19) because of more construction
12 locations. In-water construction activities would be scheduled to occur during the approved in-
13 water work windows, when the least numbers of longfin smelt would be present in or near the
14 construction areas. In addition, longfin smelt typically do not occur as far upstream as the
15 construction areas. With implementation of environmental commitments, effects of construction
16 activities on turbidity, accidental spills, onsite and offsite sediment transport to surface waters, and
17 re-suspension and redistribution of potentially contaminated sediments would be minimized (see
18 Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental Commitments: Environmental*
19 *Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous*
20 *Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; Disposal of*
21 *Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan; and Barge*
22 *Operations Plan*).

23 Implementation of Mitigation Measures AQUA-1a and AQUA-1b would minimize adverse effects
24 from impact pile driving (e.g., injury or mortality).

25 The effect of temporary and permanent rearing and migration habitat loss for longfin smelt would
26 not be adverse due to the relatively small areas occupied by the construction and barge landing
27 sites, the low abundance of longfin smelt in the vicinity of these facilities during construction, the
28 low quality of the habitat affected by construction, and implementation of environmental
29 commitment *Barge Operations Plan* (described under Impact AQUA-1 for delta smelt and in
30 Appendix 3B, *Environmental Commitments*). Overall, potential effects on longfin smelt from
31 construction activities would not be adverse.

32 **CEQA Conclusion:** Although Alternative 9 affects a larger in-water area than Alternative 1A, as
33 described in Alternative 1A, Impact AQUA-19, the impact of construction of the water conveyance
34 facilities on longfin smelt would be less than significant except for construction noise associated
35 with pile driving. There are more construction sites where noise impacts would potentially occur
36 under Alternative 9 than under Alternative 1A. However, implementation of Mitigation Measure
37 AQUA-1a and Mitigation Measure AQUA-1b would reduce the noise impact on delta smelt to less
38 than significant.

39 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
40 **of Pile Driving and Other Construction-Related Underwater Noise**

41 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

1 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
2 **and Other Construction-Related Underwater Noise**

3 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

4 **Impact AQUA-20: Effects of Maintenance of Water Conveyance Facilities on Longfin Smelt**

5 Although the facilities involved in maintenance activities under Alternative 9 (screen and gates)
6 would differ from the intakes of Alternative 1A, the same types of effects resulting from
7 maintenance activities would apply. Consequently, the potential effects of the maintenance of water
8 conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A
9 (see Impact AQUA-20).

10 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-20, the effect on longfin smelt would
11 not be adverse.

12 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
13 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects
14 resulting from maintenance activities would apply. Consequently, as described in Alternative 1A,
15 Impact AQUA-20 for longfin smelt, the impact of the maintenance of water conveyance facilities on
16 longfin smelt would be less than significant and no mitigation would be required.

17 **Water Operations of CM1**

18 **Impact AQUA-21: Effects of Water Operations on Entrainment of Longfin Smelt**

19 **Water Exports from SWP/CVP South Delta Facilities**

20 Under Alternative 9, Old River would no longer convey water or entrained fish to the south Delta
21 facilities. Middle River, the new main conveyance channel to the south Delta facilities, would be
22 screened at DCC and Georgiana Slough. These new fish screens would prevent entrainment of adult
23 and juvenile longfin smelt but not larvae. However, spawning rarely occurs that far upstream except
24 in very dry years, so only a very small population portion would be vulnerable.

25 For larval longfin smelt, entrainment risk was simulated using particle tracking modeling.
26 Entrainment loss of longfin smelt larvae to the south Delta facilities under the wetter starting
27 distribution was 3.1% for Alternative 9 compared to 1.6% for NAA, an 82% increase in relative
28 terms (Table 11-9-4). Under the drier starting distribution, average entrainment was 3.3% under
29 Alternative 9 compared to 2.2% for NAA, a 45% relative increase. Entrainment risk for larval longfin
30 smelt to the south Delta facilities would be increased under Alternative 9 relative to NAA.

31 **Table 11-9-4. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae**
32 **Entrained by the South Delta Facilities under Alternative 9 and Baseline Scenarios**

Starting Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A9_LLТ	A9_LLТ vs. EXISTING CONDITIONS	A9_LLТ vs. NAA
Wetter	1.9	1.6	3.1	1.22 (65%)	1.40 (82%)
Drier	2.5	2.2	3.3	0.75 (30%)	1.02 (45%)

33

Water Exports from SWP/CVP North Delta Intake Facilities

Entrainment of longfin smelt at the north Delta would be extremely low because this species is not expected to occur this far upstream. Further, state-of-the-art fish screens on the intakes at Georgiana Slough and DCC screening would exclude juvenile and adult longfin smelt.

Water Export with a Dual Conveyance for the SWP North Bay Aqueduct

Overall, larval entrainment under Alternative 9 would be low, and similar compared to NAA. Average entrainment loss as modeled by PTM under the wetter starting distribution was 0.15% under Alternative 9 compared to 0.08% under NAA, an 87% relative increase (Table 11-9-5). Under the drier starting distribution, average entrainment was 0.18% under Alternative 9 compared to 0.11% under NAA, a 72% increase in relative terms. Overall, entrainment of larval longfin smelt under Alternative 9 to the NBA is expected to be low and similar to NAA.

Table 11-9-5. Percentage of Particles (and Difference) Representing Longfin Smelt Larvae Entrained by the North Bay Aqueduct under Alternative 9 and Baseline Scenarios

Distribution	Percent Particles Entrained			Difference (and Relative Difference)	
	EXISTING CONDITIONS	NAA	A9_LLТ	A9_LLТ vs. EXISTING CONDITIONS	A9_LLТ vs. NAA
Wetter	0.20	0.08	0.15	-0.05 (-26.3%)	0.07 (86.7%)
Drier	0.25	0.11	0.18	-0.06 (-26.2%)	0.08 (71.5%)

In summation, under Alternative 9 potential entrainment of adult and juvenile longfin smelt would be substantially reduced at the south Delta facilities. Potential entrainment of larval longfin smelt would be slightly greater at the south Delta facilities compared to NAA and rare at the north Delta facilities as this species does not generally occur that far upstream. Larval longfin smelt entrainment at the NBA would change negligibly compared to NAA.

Predation Associated with Entrainment

Pre-screen losses of longfin smelt at the SWP/CVP facilities are believed to be high. Because the entrances to the DCC and Georgiana Slough would be screened and the Old River fish corridor would be isolated from the south Delta export pumping under Alternative 9, juvenile and adult longfin smelt entrainment to the south Delta would be decreased. Thus pre-screen predation losses at the SWP/CVP south Delta facilities would also be reduced. Predation loss at the proposed north Delta intakes would be limited because longfin smelt rarely occur that far upstream. There would potentially be predators attracted to the operable barriers intended to isolate the Old River fish migration corridor from the Middle River water conveyance corridor. Predators though are already abundant in the central and south Delta. In conclusion, the effect under Alternative 9 would not be adverse and may provide a benefit because of the likely reduction in combined entrainment and predation loss associated with the proposed operational design.

NEPA Effects: The overall effects of Alternative 9 on entrainment and entrainment-related predation of longfin smelt would be beneficial.

CEQA Conclusion: The results of the PTM model indicate that larval longfin smelt entrainment at the south Delta would increase about 1% relative to Existing Conditions. Larval entrainment would also increase at the NBA, but the difference would be negligible.

1 South Delta entrainment would be reduced under Alternative 9, thus entrainment-related predation
2 loss would also be reduced. Predation losses at the north Delta intakes would be limited because
3 longfin smelt rarely occur in that vicinity. There would be potential increased predation in the
4 vicinity of the operable barriers that isolate the Old River from the Middle River, but the isolation of
5 and the increased flows in Old River would help mitigate potential predation losses.

6 In conclusion, the impact for entrainment and predation loss on longfin smelt under Alternative 9
7 would provide a benefit because of the likely reductions in combined entrainment and predation
8 loss.

9 **Impact AQUA-22: Effects of Water Operations on Spawning, Egg Incubation, and Rearing**
10 **Habitat for Longfin Smelt**

11 **NEPA Effects:** Predicted average relative longfin smelt abundance under Alternative 9 would be
12 increased 6–8% relative to NAA. In wet water years, relative abundance would be increased 12–
13 15% compared to NAA.

14 **Table 11-9-6. Estimated Differences between Scenarios for Longfin Smelt Relative Abundance in the**
15 **Fall Midwater Trawl or Bay Otter Trawl^a**

WY Type	Fall Midwater Trawl Relative Abundance		Bay Otter Trawl Relative Abundance	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
All	-1,238 (-24%)	239 (6%)	-4,009 (-28%)	747 (8%)
Wet	-4,901 (-27%)	1,463 (12%)	-20,341 (-31%)	5,807 (15%)
Above Normal	-2,749 (-32%)	83 (1%)	-9,762 (-37%)	283 (2%)
Below Normal	-1,125 (-26%)	174 (6%)	-3,499 (-31%)	522 (7%)
Dry	-356 (-17%)	137 (8%)	-973 (-20%)	364 (10%)
Critical	-155 (-16%)	-20 (-2%)	-361 (-19%)	-47 (-3%)

Shading indicates a relative abundance decrease of 10% or greater.

^a Based on the X2-Relative Abundance Regression of Kimmerer et al. (2009).

16
17 During January-June, Delta outflows would be similar (<10% difference) to NAA. Longfin smelt may
18 benefit from habitat restoration actions (CM2 and CM4), intended to provide additional food
19 production and export to longfin smelt rearing areas. This potential benefit is not reflected in the X2-
20 longfin smelt abundance regression.

21 **CEQA Conclusion:** Flows at Rio Vista under Alternative 9 would be similar (<10% difference) to
22 Existing Conditions during the longfin smelt spawning period. Therefore the impact from
23 Alternative 9 on spawning habitat would be less than significant because flow conditions would be
24 largely similar to Existing Conditions.

25 In general, under Alternative 9 water operations, the quantity and quality of longfin smelt rearing
26 habitat would be reduced relative to the CEQA baseline. Differences between the anticipated future
27 conditions under this alternative and Existing Conditions are largely attributable to sea level rise
28 and climate change, and not to the operational scenarios. As a result, the differences between
29 Alternative 9 (which is under LLT conditions that include future sea level rise and climate change)
30 and Existing Conditions may therefore either overstate the effects of Alternative 9 or indicate

1 significant effects that are largely attributable to sea level rise and climate change, and not to
2 Alternative 9.

3 Relative longfin smelt abundance averaged across all water year types would be reduced by 24–28%
4 compared to Existing Conditions. Longfin smelt abundances would be reduced most substantially in
5 wet (27–31%), above normal (32–37%) and below normal (26–31%) water year types. In drier
6 water year types, longfin smelt abundance would be reduced by 16–20% compared to Existing
7 Conditions. Delta outflows would be increased in January and February by 10%, but reduced by
8 15% in May and June relative to Existing Conditions. Several habitat restoration conservation
9 measures (CM2 and CM4) may improve the quality of spawning and rearing habitat for longfin smelt
10 by increasing suitable habitat area and food production in the Delta.

11 Collectively, the results of the Impact AQUA-22 CEQA analysis indicate that the difference between
12 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
13 alternative could substantially reduce modeled population indices of longfin smelt, contrary to the
14 NEPA conclusion set forth above.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate
16 change, future water demands, and implementation of the alternative. The analysis described above
17 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
18 alternative from those of sea level rise, climate change and future water demands using the model
19 simulation results presented in this chapter. However, the increment of change attributable to the
20 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
21 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
22 implementation period, which does include future sea level rise, climate change, and water
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
27 term implementation period and Alternative 9 indicates that flows in the locations and during the
28 months analyzed above would generally be similar between Existing Conditions during the LLT and
29 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
30 found above would generally be due to climate change, sea level rise, and future demand, and not
31 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
32 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
33 result in a significant impact on rearing habitat for longfin smelt. This impact is found to be less than
34 significant and no mitigation is required.

35 In addition to the above assessment, with implementation of Mitigation Measures AQUA-22a
36 through 22c, habitat restoration and reduced larval entrainment would further reduce potential
37 impacts, and could result in slightly beneficial effects.

38 **Mitigation Measure AQUA-22a: Following Initial Operations of CM1, Conduct Additional**
39 **Evaluation and Modeling of Impacts to Longfin Smelt to Determine Feasibility of**
40 **Mitigation to Reduce Impacts to Spawning and Rearing Habitat**

41 Please refer to Mitigation Measure AQUA-22a under Impact AQUA-22 of Alternative 1A.

1 **Mitigation Measure AQUA-22b: Conduct Additional Evaluation and Modeling of Impacts**
2 **on Longfin Smelt Rearing Habitat Following Initial Operations of CM1**

3 Please refer to Mitigation Measure AQUA-22b under Impact AQUA-22 of Alternative 1A.

4 **Mitigation Measure AQUA-22c: Consult with USFWS and CDFW to Identify and Implement**
5 **Feasible Means to Minimize Effects on Longfin Smelt Rearing Habitat Consistent with CM1**

6 Please refer to Mitigation Measure AQUA-22c under Impact AQUA-22 of Alternative 1A.

7 **Impact AQUA-23: Effects of Water Operations on Rearing Habitat for Longfin Smelt**

8 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on rearing habitat
9 for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on Spawning, Egg
10 Incubation, and Rearing Habitat for Longfin Smelt.

11 **Impact AQUA-24: Effects of Water Operations on Migration Conditions for Longfin Smelt**

12 The analysis, NEPA Effects and CEQA Conclusion for effects of water operations on migration
13 conditions for longfin smelt is included in Impact AQUA-22: Effects of Water Operations on
14 Spawning, Egg Incubation, and Rearing Habitat for Longfin Smelt.

15 **Restoration Measures (CM2, CM4–CM7, and CM10)**

16 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
17 differences in restoration-related fish effects are anticipated anywhere in the affected environment
18 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
19 restoration measures described for longfin smelt under Alternative 1A (Impact AQUA-25 through
20 Impact AQUA-27) also appropriately characterize effects under Alternative 9.

21 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

22 **Impact AQUA-25: Effects of Construction of Restoration Measures on Longfin Smelt**

23 **Impact AQUA-26: Effects of Contaminants Associated with Restoration Measures on Longfin**
24 **Smelt**

25 **Impact AQUA-27: Effects of Restored Habitat Conditions on Longfin Smelt**

26 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
27 longfin smelt, and most would be at least slightly beneficial. Specifically for AQUA-26, the effects of
28 contaminants on longfin smelt with respect to selenium, copper, ammonia and pesticides would not
29 be adverse. The effects of methylmercury on longfin smelt are uncertain.

30 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial,
31 or less than significant, and no mitigation is required.

32 **Other Conservation Measures (CM12–CM19 and CM21)**

33 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
34 differences in other conservation-related fish effects are anticipated anywhere in the affected
35 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish

1 effects of other conservation measures described for longfin smelt under Alternative 1A (Impact
2 AQUA-28 through Impact AQUA-36) also appropriately characterize effects under Alternative 9.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

4 **Impact AQUA-28: Effects of Methylmercury Management on Longfin Smelt (CM12)**

5 **Impact AQUA-29: Effects of Invasive Aquatic Vegetation Management on Longfin Smelt**
6 **(CM13)**

7 **Impact AQUA-30: Effects of Dissolved Oxygen Level Management on Longfin Smelt (CM14)**

8 **Impact AQUA-31: Effects of Localized Reduction of Predatory Fish on Longfin Smelt (CM15)**

9 **Impact AQUA-32: Effects of Nonphysical Fish Barriers on Longfin Smelt (CM16)**

10 **Impact AQUA-33: Effects of Illegal Harvest Reduction on Longfin Smelt (CM17)**

11 **Impact AQUA-34: Effects of Conservation Hatcheries on Longfin Smelt (CM18)**

12 **Impact AQUA-35: Effects of Urban Stormwater Treatment on Longfin Smelt (CM19)**

13 **Impact AQUA-36: Effects of Removal/Relocation of Nonproject Diversions on Longfin Smelt**
14 **(CM21)**

15 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
16 adverse effect, or beneficial effects on longfin smelt for NEPA purposes, for the reasons identified for
17 Alternative 1A.

18 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
19 less than significant, or beneficial on longfin smelt, for the reasons identified for Alternative 1A, and
20 no mitigation is required.

21 **Winter-Run Chinook Salmon**

22 **Construction and Maintenance of CM1**

23 **Impact AQUA-37: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
24 **(Winter-Run ESU)**

25 The potential effects of construction of water conveyance facilities on Chinook salmon would be
26 similar to but greater than Alternative 1A, Impact AQUA-37. Alternative 9 would have more impact
27 locations because of the construction of fourteen operable gates (Table 11-9-1). Alternative 9 would
28 have two diversions at the DCC and Georgiana Slough facilities while Alternative 1A would have five
29 intakes. There would be one less barge landing under Alternative 9 (five total), compared to
30 Alternative 1A. Alternative 9 would have a temporary and permanent in-water footprint of 31.4
31 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under
32 Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A
33 (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet compared to 3,600
34 feet under Alternative 1A (Table 11-5). Because Alternative 9 has more in-water construction
35 locations the potential for noise effects is greater proportional to the increased number of sites

1 compared to Alternative 1A. Similarly, the increased dredging will have proportionally greater
2 effects. The effects related to temporary increases in turbidity, accidental spills, in-water work
3 activities and disturbance of contaminated sediments would be similar to Alternative 1A and the
4 same environmental commitments and mitigation measures would be available to avoid and
5 minimize potential effects (see Impact AQUA-1 and Appendix 3B, *Environmental Commitments:*
6 *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan;*
7 *Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan;*
8 *Disposal of Spoils, Reusable Tunnel Material, and Dredged Material; Fish Rescue and Salvage Plan;* and
9 *Barge Operations Plan*). Additional details on underwater noise, and the loss of spawning, rearing, or
10 migration habitat are provided below.

11 **Underwater Noise**

12 Underwater sound generated by impact pile driving in or near surface waters can potentially harm
13 fish, including Chinook salmon (see Alternative 1A, Impact AQUA-1 for delta smelt). Table 11-6
14 illustrates the species and life stages of Chinook salmon present in the north, east, and south Delta
15 during the in-water construction window (expected to be June 1–October 31). Winter-run Chinook
16 salmon eggs and fry would not experience underwater sound because the construction locations are
17 not considered suitable habitat for these two life stages of this species, and they would not be
18 present during the in-water construction period. Therefore, these life history stages would not be
19 affected.

20 Adult winter-run Chinook salmon would generally not be present near the construction areas during
21 the in-water construction period (expected to be June 1 through October 31) except that adult
22 migration can extend into June. Juvenile winter-run Chinook salmon would likely only occur in the
23 north Delta area the late portion of the window (September–October).

24 Installation of sheet piles would occur over an 8-hour period in a day and would be quiet between
25 sheet pile-driving events. As noted above, if all piles in a day can successfully be installed with a
26 vibratory hammer, underwater noise would not be expected to injure salmon. Although some
27 avoidance of the area may occur, the activity would not be expected to delay upstream or
28 downstream migrations of salmon.

29 All Chinook salmon potentially present during installation of cofferdams and piles are expected to be
30 greater than 2 grams in size; therefore, the 187-dB SEL_{cumulative} injury threshold would be
31 appropriate for Chinook salmon. Exceedance of this criterion over some distance of the river would
32 likely be substantial if impact driving is required. As noted above, there are no effective methods to
33 attenuate sound from impact driving of sheet pile because the sheets need to be interlaced, and
34 individual sheets cannot be isolated. Attenuation devices could be used if impact pile driving is
35 required for installation of individual piles, such as for the barge landings.

36 Table 11-10 illustrates the estimated area where the cumulative SEL threshold would be exceeded if
37 impact pile driving is required. Table 11-11 indicates the number of days of impact driving for the
38 various life history stages of Chinook that would be present near the pile driving sites during the
39 June through October period assuming 5-day work weeks and impact driving being required for
40 30% of the days.

41 Adult Chinook salmon are large and have the mobility to avoid injurious exposure to underwater
42 noise from pile driving. They may experience short delays in migration past the construction sites in
43 the Sacramento River when pile driving is occurring; however, pile driving would occur only

1 intermittently through 8 hours per day, and minor migration delays would not affect their ability to
2 successfully reach spawning grounds. Therefore, the potential for adult Chinook salmon to
3 experience an adverse effect (e.g., injury or mortality, or migratory disturbance) would be low
4 because of their size, ability to move away from the underwater sound, and their potentially low to
5 moderate temporal and spatial migration distribution around the facility construction areas.

6 Individual Chinook salmon that are present in an area affected by underwater sound from impact
7 pile driving above the 187-dB SEL_{cumulative} injury threshold level, and proximate to an impact-driven
8 pile, could experience an adverse effect, such as injury or mortality. Implementation of Mitigation
9 Measures AQUA-1a and AQUA-1b would minimize the effects from underwater noise on Chinook
10 salmon.

11 ***Loss of Spawning, Rearing, or Migration Habitat***

12 As noted in Alternative 1A, Impact AQUA-1 for delta smelt, in-water construction would temporarily
13 or permanently alter habitat conditions in the vicinity of the construction activities. Alternative 9
14 facilities would alter habitat as shown in Table 11-9-1. The mainstem Sacramento River and
15 Georgiana Slough is designated as critical habitat for all runs of Chinook salmon, providing
16 migration and rearing habitat. No suitable Chinook salmon spawning habitat is found in the vicinity
17 of the proposed in-water work; therefore, construction would not affect Chinook salmon spawning
18 habitat. Construction of the approach canal and Byron Tract Forebay would not affect fish-accessible
19 waterways and therefore would not affect Chinook salmon.

20 Permanent loss of Chinook salmon rearing and migration habitat would occur within the footprints
21 of the DCC and Georgiana Slough facilities, the other operable gates, pumping stations, culvert
22 siphons, and dredged areas.

23 The affected habitat associated with installation of the DCC, Georgiana Slough, and other gates is
24 currently armored levee bank with limited riparian vegetation that has low value for salmonid
25 rearing. However, the mainstem Sacramento River is designated as critical habitat for all runs of
26 Chinook salmon, providing migration habitat for adult and juvenile life stages and rearing habitat for
27 fry, presmolt, and smolt juvenile life stages. At each of the gate structures on the Sacramento River,
28 fish screens would be installed across the channel openings. The total temporary in-water footprint
29 area enclosed would be approximately 15.9 acres and the permanent in-water footprint area would
30 be slightly less at about 15.5 acres (see Table 11-9-1). The armored levee bank habitat that would be
31 permanently lost would be replaced by the fish screen structures. Some riparian trees and shrubs
32 that currently grow on the levee banks would be lost, slightly reducing cover and shade, and the
33 input of leaves and insects falling into the river from overhanging vegetation. However, bank
34 armoring and lack of physical structure currently limit the quality of this habitat. Approximately
35 4,800 linear feet of river bank would be affected. The area dredged for channel enlargement in the
36 Middle River and Victoria Channel totals approximately 0.5 acre.

37 No suitable Chinook salmon spawning habitat is found in the vicinity of the proposed in-water work;
38 therefore, construction would not affect Chinook salmon spawning habitat. Because the habitat
39 areas affected by construction of the Alternative 9 facilities are relatively small, and are primarily
40 migration and poor-quality rearing habitat, the effects on Chinook salmon would not be adverse at
41 the population level.

42 ***NEPA Effects:*** Overall, the effects of water conveyance facility construction under Alternative 9 on
43 Chinook salmon are not expected to be adverse.

1 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-37 for Chinook salmon, the impact
2 of the construction of water conveyance facilities on Chinook salmon would be less than significant
3 except for construction noise associated with pile driving. There are more construction sites where
4 noise impacts would potentially occur under Alternative 9 than under Alternative 1A. However,
5 implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce the
6 noise impact on Chinook salmon to less than significant.

7 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
8 **of Pile Driving and Other Construction-Related Underwater Noise**

9 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

10 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
11 **and Other Construction-Related Underwater Noise**

12 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

13 **Impact AQUA-38: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
14 **(Winter-Run ESU)**

15 **NEPA Effects:** Although the facilities involved in maintenance activities under Alternative 9 (screen
16 and gates) would differ from the intakes of Alternative 1A, the same types of effects resulting from
17 maintenance activities would apply. Consequently, the potential effects of the maintenance of water
18 conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A,
19 Impact AQUA-38. As concluded in Alternative 1A, Impact AQUA-38, the impact would not be adverse
20 for Chinook salmon.

21 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
22 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects
23 resulting from maintenance activities would apply. Consequently, as described in Alternative 1A,
24 Impact AQUA-38, the impact of the maintenance of water conveyance facilities on Chinook salmon
25 would be less than significant and no mitigation would be required.

26 **Water Operations of CM1**

27 **Impact AQUA-39: Effects of Water Operations on Entrainment of Chinook Salmon (Winter-**
28 **Run ESU)**

29 **Water Exports from SWP/CVP South Delta Facilities**

30 Alternative 9 would substantially reduce entrainment of winter-run Chinook salmon compared to
31 NAA, due to screening at the DCC and head of Georgiana Slough, which would exclude outmigrating
32 juvenile winter-run Chinook salmon from leaving the Sacramento River and entering the central
33 Delta through these channels. Furthermore the Old River channel would no longer be subject to
34 impacts from water exports at the SWP/CVP south Delta export facilities under Alternative 9,
35 reducing the potential for entrainment loss for salmon that enter the central Delta via Three Mile
36 Slough or the western San Joaquin River. Limited numbers of winter-run Chinook salmon juveniles
37 would be entrained at the south Delta facilities by entering the water conveyance corridor at the
38 mouth of the Middle River. The effect would be beneficial.

1 **Water Exports from SWP/CVP North Delta Intake Facilities**

2 Entrainment of winter-run Chinook salmon would be minimal because the north Delta intakes at
3 Georgiana Slough and DCC would be screened to exclude juvenile Chinook salmon. There would be
4 some risk of injury from impingement associated with these north Delta intakes. Overall the impact
5 would be similar to those described for Alternative 1A, Impact AQUA-39, except there would be two
6 7,500 cfs screens instead of five 3,000 cfs screens. The effect would be beneficial.

7 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

8 Entrainment to the NBA would be the same as described for delta smelt under Alternative 1A,
9 Impact AQUA-3.

10 **Agricultural Diversions**

11 Since juvenile winter-run Chinook salmon would be prevented from entering the interior Delta via
12 state-of-the-art fish screens at Georgiana Slough and DCC, fewer fish would be exposed to
13 entrainment loss to agricultural diversions in the central Delta. The effect would not be adverse.

14 **Predation Associated with Entrainment**

15 Under Alternative 9, predation related to water operations would include changes in predation risk
16 at the south Delta facilities (particularly CCF). Chinook salmon predation loss at the south Delta
17 facilities is assumed to be proportional to entrainment loss. Because substantially fewer fish would
18 be entrained to the CCF and SWP facilities due to the screened intakes located on the DCC and
19 Georgiana Sloughs and numerous operable barriers limiting fish movement into conveyance
20 channels, predation loss at the south Delta facilities would be substantially decreased under
21 Alternative 9.

22 **NEPA Effects:** The overall effect on entrainment and entrainment-related predation of Chinook
23 salmon under Alternative 9 would be beneficial.

24 **CEQA Conclusion:** Entrainment loss would be reduced at the south Delta facilities because the north
25 Delta intakes at the entrances to the DCC and Georgiana Slough would be screened, preventing
26 juvenile winter-run salmon migrating down the Sacramento River from entering the designated
27 water conveyance corridor. Furthermore the north Delta screens would prevent salmon from
28 entering the interior Delta, thus reducing entrainment risk to Delta agricultural diversions.
29 Entrainment to the NBA dual conveyance system would be the same as described for Alternative 1A.
30 Because south Delta entrainment would be reduced, pre-screen predation loss would also be
31 reduced. Predation loss at the north Delta intakes would be minor, representing less than 0.2% of
32 the winter-run juvenile Chinook salmon population.

33 Overall, the impact of water operations on winter-run Chinook salmon would be beneficial because
34 of the reduction in entrainment and pre-screen predation loss at the south Delta facilities. No
35 mitigation would be required.

36 **Impact AQUA-40: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
37 **Chinook Salmon (Winter-Run ESU)**

38 In general, Alternative 9 would not affect the quantity and quality of spawning and egg incubation
39 habitat for winter-run Chinook salmon relative to the NAA.

1 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam were
 2 examined during the May through September winter-run spawning period (Appendix 11C, *CALSIM II*
 3 *Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for
 4 spawning and egg incubation. Flows under A9_LLT throughout the period would nearly always be
 5 similar to or greater than flows under NAA, except in above normal years during August (7% lower
 6 for both locations). These results indicate that there would be no biologically meaningful flow-
 7 related effects of Alternative 9 on spawning and egg incubation habitat.

8 Shasta Reservoir storage volume at the end of May influences flow rates below the dam during the
 9 May through September winter-run spawning and egg incubation period. May Shasta storage
 10 volume under A9_LLT would be similar to storage under NAA for all water year types (Table 11-9-
 11 7).

12 **Table 11-9-7. Difference and Percent Difference in May Water Storage Volume (thousand**
 13 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-37 (-1%)	-3 (-0.1%)
Above Normal	-86 (-2%)	0 (0%)
Below Normal	-249 (-6%)	-51 (-1%)
Dry	-559 (-15%)	-115 (-3%)
Critical	-592 (-24%)	-8 (-0.4%)

14
 15 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
 16 examined during the May through September winter-run spawning period (Appendix 11D,
 17 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
 18 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
 19 NAA and Alternative 9 in any month or water year type throughout the period at either location.

20 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
 21 determined for each month (May through September) and year of the 82-year modeling period
 22 (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were
 23 further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and
 24 Alternative 9 in the highest level of concern across all months and all 82 modeled years are
 25 presented in Table 11-9-10. There would be no difference in levels of concern between NAA and
 26 Alternative 9.

1 **Table 11-9-8. Maximum Water Temperature Criteria for Covered Salmonids and Sturgeon Provided by**
2 **NMFS and Used in the BDCP Effects Analysis**

Location	Period	Maximum Water Temperature (°F)	Purpose
Upper Sacramento River			
Bend Bridge	May-Sep	56	Winter- and spring-run spawning and egg incubation
		63	Green sturgeon spawning and egg incubation
Red Bluff	Oct-Apr	56	Spring-, fall-, and late fall-run spawning and egg incubation
Hamilton City	Mar-Jun	61 (optimal), 68 (lethal)	White sturgeon spawning and egg incubation
Feather River			
Robinson Riffle (RM 61.6)	Sep-Apr	56	Spring-run and steelhead spawning and incubation
	May-Aug	63	Spring-run and steelhead rearing
Gridley Bridge	Oct-Apr	56	Fall- and late fall-run spawning and steelhead rearing
	May-Sep	64	Green sturgeon spawning, incubation, and rearing
American River			
Watt Avenue Bridge	May-Oct	65	Juvenile steelhead rearing

3

4 **Table 11-9-9. Number of Days per Month Required to Trigger Each Level of Concern for Water**
5 **Temperature Exceedances in the Sacramento River for Covered Salmonids and Sturgeon Provided**
6 **by NMFS and Used in the BDCP Effects Analysis**

Exceedance above Water Temperature Threshold (°F)	Level of Concern			
	None	Yellow	Orange	Red
1	0-9 days	10-14 days	15-19 days	≥20 days
2	0-4 days	5-9 days	10-14 days	≥15 days
3	0 days	1-4 days	5-9 days	≥10 days

7

8 **Table 11-9-10. Differences between Baseline and Alternative 9 Scenarios in the Number of Years**
9 **in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**
10 **Sacramento River at Bend Bridge, May through September**

Level of Concern ^a	EXISTING CONDITIONS vs. A9_LL T	NAA vs. A9_LL T
Red	33 (67%)	0 (0%)
Orange	-14 (-100%)	0 (NA)
Yellow	-16 (-100%)	0 (NA)
None	-3 (-100%)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a For definitions of levels of concern, see Table 11-9-9.

11

1 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type
 2 during May through September (Table 11-9-11). Total degree-days under Alternative 9 would be up
 3 to 6% lower than under NAA during May and September and up to 7% higher during June through
 4 August.

5 **Table 11-9-11. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days**
 6 **(°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the**
 7 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	1,192 (316%)	-10 (-1%)
	Above Normal	356 (167%)	1 (0%)
	Below Normal	479 (219%)	16 (2%)
	Dry	152 (82%)	-262 (-44%)
	Critical	420 (190%)	10 (2%)
	All	2,600 (214%)	-244 (-6%)
June	Wet	769 (200%)	58 (5%)
	Above Normal	214 (145%)	-15 (-4%)
	Below Normal	382 (275%)	30 (6%)
	Dry	603 (321%)	69 (10%)
	Critical	625 (156%)	75 (8%)
	All	2,594 (206%)	218 (6%)
July	Wet	686 (132%)	80 (7%)
	Above Normal	296 (365%)	26 (7%)
	Below Normal	554 (377%)	98 (16%)
	Dry	1,184 (420%)	256 (21%)
	Critical	1,725 (209%)	-61 (-2.3%)
	All	4,444 (240%)	398 (7%)
August	Wet	2,050 (294%)	87 (3%)
	Above Normal	781 (191%)	122 (11%)
	Below Normal	1,106 (417%)	71 (5%)
	Dry	1,719 (257%)	109 (5%)
	Critical	2,482 (167%)	-137 (-3%)
	All	8,138 (231%)	251 (2%)
September	Wet	550 (75%)	-159 (-11%)
	Above Normal	371 (52%)	-29 (-3%)
	Below Normal	1,088 (146%)	-58 (-3%)
	Dry	2,604 (204%)	8 (0%)
	Critical	1,914 (92%)	23 (1%)
	All	6,530 (118%)	-215 (-2%)

8
 9 The Reclamation egg mortality model predicts that winter-run Chinook salmon egg mortality in the
 10 Sacramento River under A9_LLT would be similar to or lower than mortality under NAA except in
 11 below normal and dry water years (30% and 7%, respectively), although the absolute increase in
 12 these water years would be only 1% (Table 11-9-12). Therefore, the increase in mortality from NAA
 13 to A9_LLT, although relatively large, would be negligible at an absolute scale to the winter-run
 14 population.

Table 11-9-12. Difference and Percent Difference in Percent Mortality of Winter-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	1 (289%)	0.05 (3%)
Above Normal	2 (348%)	-0.03 (-1%)
Below Normal	1 (142%)	1 (30%)
Dry	6 (416%)	1 (7%)
Critical	39 (145%)	-5 (-7%)
All	8 (171%)	-0.5 (-4%)

SacEFT predicts that the percentages of years with good spawning availability, measured as weighted usable area, and redd scour risk under A9_LLT would be identical to those under NAA (Table 11-9-13). SacEFT predicts that the percentage of years with good egg incubation conditions under A9_LLT would be 7% lower (5% on an absolute scale) than under NAA. SacEFT predicts that the percentage of years with good (lower) redd dewatering risk under A9_LLT would be similar to NAA. These results indicate that there would be no biologically meaningful effects of Alternative 9 on spawning or egg incubation habitat.

Table 11-9-13. Difference and Percent Difference in Percentage of Years with “Good” Conditions for Winter-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-26 (-45%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-28 (-29%)	-5 (-7%)
Redd Dewatering Risk	3 (12%)	-1 (-3%)
Juvenile Rearing WUA	-21 (-42%)	4 (16%)
Juvenile Stranding Risk	11 (55%)	0 (0%)

WUA = Weighted Usable Area.

NEPA Effects: Considering the range of results presented here for winter-run Chinook salmon spawning and egg incubation, this effect would not be adverse because it does not have the potential to substantially reduce suitable spawning or egg incubation habitat. There are no effects that would cause biologically meaningful effects to the winter-run population.

CEQA Conclusion: In general, Alternative 9 would not affect the quantity and quality of spawning and egg incubation habitat for winter-run Chinook salmon relative to Existing Conditions.

CALSIM flows in the Sacramento River between Keswick and upstream of Red Bluff were examined during the May through September winter-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). On both Sacramento River locations, flows under A9_LLT would generally be similar to or greater than flows under Existing Conditions throughout the period, with few exceptions (up to 27% lower).

Shasta Reservoir storage volume at the end of May under A9_LLT would be similar to Existing Conditions in wet and above normal water years and lower than storage volume under Existing

1 Conditions in below normal, dry, and critical water years (6%, 15%, and 24% lower, respectively)
2 (Table 11-9-7). This indicates that there would be a small to moderate effect of Alternative 9 on
3 flows during the spawning and egg incubation period.

4 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
5 examined during the May through September winter-run spawning period (Appendix 11D,
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
8 Existing Conditions and Alternative 9 during June. Mean monthly water temperature would be up to
9 11% higher under Alternative 9 in May and July through September depending on month, water
10 year type, and location.

11 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
12 determined for each month (May through September) and year of the 82-year modeling period
13 (Table 11-9-8). The combination of number of days and degrees above the 56°F threshold were
14 further assigned a “level of concern”, as defined in Table 11-9-9. The number of years classified as
15 “red” would increase by 67% under Alternative 9 relative to Existing Conditions (Table 11-9-10).

16 Total degree-days exceeding 56°F at Bend Bridge were summed by month and water year type
17 during May through September (Table 11-9-11). Total degree-days under Alternative 9 would be up
18 to 240% higher than under Existing Conditions during May through September. The Reclamation
19 egg mortality model predicts that winter-run Chinook salmon egg mortality in the Sacramento River
20 under A9_LLT would be 142% to 416% greater than mortality under Existing Conditions depending
21 on water year type (Table 11-9-12). However, only in dry (6% higher) and critical (39% higher)
22 years would the increase be >5% of the winter-run population and, therefore, biologically
23 meaningful. These results indicate that Alternative 9 would cause increased winter-run Chinook
24 salmon mortality in the Sacramento River in drier years.

25 SacEFT predicts that there would be a 45% decrease in the percentage of years with good spawning
26 availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table
27 11-9-13). SacEFT predicts that the percentage of years with good (lower) redd scour risk under
28 A9_LLT would be identical to the percentage of years under Existing Conditions. SacEFT predicts
29 that the percentage of years with good egg incubation conditions under A9_LLT would be 29%
30 lower than under Existing Conditions. SacEFT predicts that the percentage of years with good
31 (lower) redd dewatering risk under A9_LLT would be 12% greater than the percentage of years
32 under Existing Conditions. These results indicate that Alternative 9 would cause small to moderate
33 reductions in spawning WUA and egg incubation conditions.

34 **Summary of CEQA Conclusion**

35 Collectively, the results of the Impact AQUA-40 CEQA analysis indicate that the difference between
36 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
37 alternative could substantially reduce suitable spawning habitat and substantially reduce the
38 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above. Egg
39 mortality (according to the Reclamation egg mortality model) in drier years, during which winter-
40 run Chinook salmon would already be stressed due to reduced flows and increased temperatures,
41 would be up to 39% greater due to Alternative 9 compared to the Existing Conditions (Table 11-9-
42 12). Egg incubation conditions according to the SacEFT model are predicted to be 29% lower than
43 under Existing Conditions. Further, the extent of spawning habitat would be 45% lower due to

1 Alternative 9 compared to Existing Conditions (Table 11-9-13), which represents a substantial
2 reduction in spawning habitat and, therefore, in adult spawning and redd carrying capacity.

3 These results are primarily caused by four factors: differences in sea level rise, differences in climate
4 change, future water demands, and implementation of the alternative. The analysis described above
5 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
6 alternative from those of sea level rise, climate change and future water demands using the model
7 simulation results presented in this chapter. However, the increment of change attributable to the
8 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
9 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
10 implementation period, which does include future sea level rise, climate change, and water
11 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
12 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
13 effect of the alternative from those of sea level rise, climate change, and water demands.

14 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
15 term implementation period and Alternative 9 indicates that flows in the locations and during the
16 months analyzed above would generally be similar between Existing Conditions during the LLT and
17 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
18 found above would generally be due to climate change, sea level rise, and future demand, and not
19 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
20 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
21 result in a significant impact on spawning and egg incubation habitat for winter-run Chinook
22 salmon. This impact is found to be less than significant and no mitigation is required.

23 **Impact AQUA-41: Effects of Water Operations on Rearing Habitat for Chinook Salmon** 24 **(Winter-Run ESU)**

25 In general, Alternative 9 would not affect the quantity and quality of rearing habitat for fry and
26 juvenile winter-run Chinook salmon relative to the NAA.

27 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
28 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
29 *in the Fish Analysis*). Lower flows can lead to reduced extent and quality of fry and juvenile rearing
30 habitat. Flows under A9_LLTP would generally be similar to or greater than flows under NAA, except
31 during the month of October (up to 13% lower) and in above normal years during August (7%
32 lower).

33 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
34 examined during the August through December winter-run juvenile rearing period (Appendix 11D,
35 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
36 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
37 NAA and Alternative 9 in any month or water year type throughout the period at either location.
38 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
39 measured as weighted usable area, under A9_LLTP would be 16% greater than the percentage of
40 years under NAA (Table 11-9-12). The percentage of years with good (low) juvenile stranding risk
41 under A9_LLTP is predicted to be similar to that the percentage under NAA. These results indicate
42 that the quantity of juvenile rearing habitat in the Sacramento River would be higher under A9_LLTP
43 relative to NAA, and habitat quality would be similar to conditions under NAA.

1 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A9_LLT would
2 be 5% higher than under NAA.

3 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
4 not have the potential to substantially reduce the amount of suitable habitat or substantially
5 interfere with the movement of fish. Differences in flows are generally small and inconsistent among
6 months and water year types. In addition, effects on juvenile stranding risk are negligible.

7 **CEQA Conclusion:** In general, Alternative 9 would not reduce the quantity and quality of rearing
8 habitat for fry and juvenile winter-run Chinook salmon relative to Existing Conditions.

9 Sacramento River flows upstream of Red Bluff were examined for the juvenile winter-run Chinook
10 salmon rearing period (August through December) (Appendix 11C, *CALSIM II Model Results utilized*
11 *in the Fish Analysis*). Flows under A9_LLT would generally be similar to or greater than flows under
12 Existing Conditions throughout the period, with some exceptions (up to 25% lower).

13 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
14 examined during the August through December winter-run rearing period (Appendix 11D,
15 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
16 *Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 9 in
17 August through October depending on month, water year type, and location, and up to 5% higher
18 during November and December at Bend Bridge.

19 SacEFT predicts that the percentage of years with good juvenile rearing habitat availability,
20 measured as weighted usable area, under A9_LLT would be 42% lower than under Existing
21 Conditions (Table 11-9-13). In addition, the percentage of years with good (low) juvenile stranding
22 risk under A9_LLT is predicted to be greater than under Existing Conditions. This indicates that the
23 quantity of juvenile rearing habitat in the Sacramento River would be lower under A9_LLT relative
24 to Existing Conditions, but the quality juvenile rearing habitat would improve.

25 SALMOD predicts that winter-run smolt equivalent habitat-related mortality under A9_LLT would
26 be 20% higher than under Existing Conditions.

27 **Summary of CEQA Conclusion**

28 Collectively, the results of the Impact AQUA-41 CEQA analysis indicate that the difference between
29 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
30 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
31 the movement of fish, contrary to the NEPA conclusion set forth above. Although flows are generally
32 comparable between Alt 9 and Existing Conditions, there would be a large reduction in predicted
33 rearing habitat extent according to SacEFT (Table 11-9-13). Further, habitat-related mortality would
34 be 20% greater under Alt 9 relative to Existing Conditions.

35 These results are primarily caused by four factors: differences in sea level rise, differences in climate
36 change, future water demands, and implementation of the alternative. The analysis described above
37 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
38 alternative from those of sea level rise, climate change and future water demands using the model
39 simulation results presented in this chapter. However, the increment of change attributable to the
40 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
41 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
42 implementation period, which does include future sea level rise, climate change, and water

1 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
2 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
3 effect of the alternative from those of sea level rise, climate change, and water demands.

4 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
5 term implementation period and Alternative 9 indicates that flows in the locations and during the
6 months analyzed above would generally be similar between Existing Conditions during the LLT and
7 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
8 found above would generally be due to climate change, sea level rise, and future demand, and not
9 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
10 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
11 result in a significant impact on juvenile rearing habitat for winter-run Chinook salmon. This impact
12 is found to be less than significant and no mitigation is required.

13 **Impact AQUA-42: Effects of Water Operations on Migration Conditions for Chinook Salmon** 14 **(Winter-Run ESU)**

15 In general, Alternative 9 would not affect migration conditions for juvenile winter-run Chinook
16 salmon relative to the NAA.

17 **Upstream of the Delta**

18 Flows in the Sacramento River upstream of Red Bluff were examined for the July through November
19 juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). A
20 reduction in flow may reduce the ability of juvenile winter-run to migrate effectively down the
21 Sacramento River. Flows under A9_LL T would generally be similar to flows under NAA throughout
22 the period, except during October, in which flows would be up to 13% lower depending on water
23 year type.

24 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
25 examined during the July through November winter-run juvenile emigration period (Appendix 11D,
26 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
27 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
28 NAA and Alternative 9 in any month or water year type throughout the period at either location.

29 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run
30 Chinook salmon upstream migration period (December through August). A reduction in flows may
31 reduce the olfactory cues needed by adult winter-run to return to natal spawning grounds in the
32 upper Sacramento River. Flows under A9_LL T would generally be similar to or greater than those
33 under NAA with few exceptions.

34 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
35 examined during the December through August winter-run upstream migration period (Appendix
36 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
37 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
38 between NAA and Alternative 9 in any month or water year type throughout the period at either
39 location.

1 **Through-Delta**

2 **Juveniles**

3 Fish screens at the DCC and Georgiana Slough would improve survival of outmigrating winter-run
4 juveniles by preventing straying into the interior Delta. Studies of acoustic tagged smolts found
5 lower survival on the longer interior Delta migration route (Perry et al. 2010).

6 During the juvenile winter-run Chinook salmon emigration period (November to early May), mean
7 monthly flows in the Sacramento River at Rio Vista under Alternative 9 would be similar (<5%
8 difference) averaged across years compared to NAA during most months, and slightly reduced (6%
9 to 7% decrease) in April and May. Flows would be reduced up to 17% and 18% in April of dry and
10 below normal years.

11 The fish screens to be constructed at the mouths of the DCC and Georgiana Slough may attract
12 piscivorous fish around these structures. By way of comparison, potential predation losses for
13 Alternative 5, which has one longer intake for the north Delta diversion facility ranged from 0.3% up
14 to 4% of the annual winter-run production from the Sacramento River basin (see Impact AQUA-42
15 for Alternative 5). Potential predation losses for Alternative 9 would be minimal by comparison,
16 given the less extensive screen.

17 Fourteen new operable barriers would be installed as part of Alternative 9 at various locations in
18 the Delta such as the San Joaquin River downstream of Old River, Middle River, Woodward Cut,
19 Railroad Cut, Connection Slough and at the mouth of Old River. There is the risk of predatory fish
20 aggregating at these locations and preying on juvenile salmonids as they migrate past. However,
21 predators are already abundant in the south and central regions of the Delta, so the effect of adding
22 the new structures would have to be determined. Under Alternative 9, increased flows in the Old
23 River channel would increase salmon migration speed and reduce exposure to many of these
24 structures and any associated predators.

25 Through-Delta survival to Chipps Island by emigrating juvenile winter-run Chinook salmon as
26 modeled by the DPM would average 36% across all years, 49% in wetter years and 29% in drier
27 years compared to NAA (Table 11-9-14). Juvenile survival would increase slightly by 2.4% across all
28 years (a 7% relative increase). Overall, Alternative 9 would not have an adverse effect on winter-run
29 Chinook salmon juvenile survival due to minor differences in survival across all water years.

30 **Table 11-9-14. Through-Delta Survival (%) of Emigrating Juvenile Winter-Run Chinook Salmon**
31 **under Alternative 9**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A9_LL T	EXISTING CONDITIONS vs. A9_LL T	NAA vs. A9_LL T
Wetter Years	46.3	46.1	48.6	2.2 (5%)	-.06 (-1%)
Drier Years	28.0	27.1	29.0	1.0 (4%)	11.1 (-4%)
All Years	34.9	34.2	36.3	1.5 (4%)	-0.9 (-3%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and Above Normal Water Years (6 years).

Drier = Below Normal, Dry and Critical Water Years (10 years).

32

1 **Adults**

2 The proportion of Sacramento River flows at Collinsville decreased less than 10% under Alternative
3 9 during the December through June migration period for winter-run adults (Table 11-9-15).
4 Sacramento River flows would still represent 59–65% of flows during the adult winter-run
5 migration period. Therefore it is expected that olfactory cues would be adequate and not
6 substantially affected by flow operations under Alternative 9.

7 Overall the impact would not be adverse.

8 **Table 11-9-15. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and**
9 **San Joaquin River during the Adult Chinook Migration Period for Alternative 9**

Month	EXISTING CONDITIONS	NAA	A9_LLТ	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
Sacramento River					
September	60	65	60	0	-5
October	60	68	59	-1	-9
November	60	66	57	-3	-9
December	67	66	59	-8	-7
January	76	75	65	-11	-10
February	75	72	63	-12	-9
March	78	76	66	-12	-10
April	77	75	64	-13	-9
May	69	65	57	-12	-10
June	64	62	58	-6	-4
San Joaquin River					
September	0.3	0.1	3.9	3.6	3.8
October	0.2	0.3	6.2	6.0	5.9
November	0.4	1.0	7.9	7.5	6.9
December	0.9	1.0	6.0	5.1	5.0
January	1.6	1.7	7.3	5.7	5.6
February	1.4	1.5	8.2	6.8	6.7
March	2.6	2.8	8.9	6.3	6.1
April	6.3	6.6	14.2	7.9	7.6
Shading indicates 10% or greater absolute difference.					

10

11 **NEPA Effects:** Collectively, these results indicate that Alternative 9 operations would not adversely
12 affect upstream or through-Delta migration conditions. Due to similarities in migration flows and
13 water temperatures between Alternative 9 and the NAA, upstream habitat and movement
14 conditions are not substantially reduced, for juvenile or adult winter-run Chinook salmon. Through-
15 Delta juvenile survival under Alternative 9, would be similar to NAA, averaged across all years.
16 Despite minor reduction is through-Delta flows, during the adult migration period, the olfactory
17 cues would be adequate and not substantially affected by flow operations under Alternative 9.

18 **CEQA Conclusion:** In general, Alternative 9 would not affect migration conditions for winter-run
19 Chinook salmon relative to Existing Conditions.

1 **Upstream of the Delta**

2 Flows in the Sacramento River upstream of Red Bluff were examined during the July through
3 November juvenile emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A9_LLTP for juvenile migrants would nearly always be similar to or greater
5 than flows under Existing Conditions, except during November, in which flows would be up to 22%
6 greater depending on water year type.

7 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
8 examined during the July through November winter-run juvenile emigration period (Appendix 11D,
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
10 *Fish Analysis*). Mean monthly water temperature would be up to 13% higher under Alternative 9 in
11 July through October depending on month, water year type, and location. There would be a 5%
12 increase in mean monthly water temperature between Existing Conditions and Alternative 9 during
13 November of below normal years at Bend Bridge.

14 Flows in the Sacramento River upstream of Red Bluff were examined during the adult winter-run
15 Chinook salmon upstream migration period (December through August) (Appendix 11C, *CALSIM II*
16 *Model Results utilized in the Fish Analysis*). Flows under A9_LLTP would generally be similar to or
17 greater than flows under Existing Conditions with few exceptions.

18 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
19 examined during the December through August winter-run upstream migration period (Appendix
20 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
21 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
22 between Existing Conditions and Alternative 9 during December through June, except for a 5%
23 increase under Alternative 9 in May of wet years at Bend Bridge. Mean monthly water temperature
24 would be up to 13% higher under Alternative 9 in July through August depending on month, water
25 year type, and location

26 **Through-Delta**

27 **Juveniles**

28 As described above, through-Delta survival by emigrating juvenile winter-run Chinook salmon
29 would increase slightly averaged across all water years (1.8% greater survival, a 5% relative
30 increase) compared to Existing Conditions (Table 11-9-14). Juveniles may also encounter increased
31 predation risk at the two screens in the north Delta and at the fourteen new operable barriers at
32 various locations, but the overall effect of this predation would not likely be significant compared to
33 Existing Conditions.

34 **Adults**

35 Attraction flows for migrating adult winter-run Chinook salmon, as measured as the proportion of
36 Sacramento River flows at Collinsville from December to June, would decrease 6-13% compared to
37 Existing Conditions. Since Sacramento River flows would still constitute a large proportion (57% to
38 6%) of the total flows at Collinsville, Alternative 9 is not expected to significantly affect upstream
39 migration. This topic is discussed further in Impact AQUA-42 for Alternative 1A.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-42 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 9 could be significant because, when compared to the CEQA
4 baseline, the alternative could substantially reduce migration habitat and substantially interfere
5 with the movement of fish, contrary to the NEPA conclusion set forth above, which is directly related
6 to the inclusion of climate change effects in Alternative 9. Water temperatures in the Sacramento
7 River would be higher during a large portion of juvenile winter-run migration period. There would
8 be minimal effect on through-Delta migration and survival.

9 These results are primarily caused by four factors: differences in sea level rise, differences in climate
10 change, future water demands, and implementation of the alternative. The analysis described above
11 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
12 alternative from those of sea level rise, climate change and future water demands using the model
13 simulation results presented in this chapter. However, the increment of change attributable to the
14 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
15 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
16 implementation period, which does include future sea level rise, climate change, and water
17 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
18 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
19 effect of the alternative from those of sea level rise, climate change, and water demands.

20 The additional comparison of CALSIM flow and reservoir storage outputs between Existing
21 Conditions in the late long-term implementation period and Alternative 9 indicates that flows and
22 reservoir storage in the locations and during the months analyzed above would generally be similar
23 between Existing Conditions and Alternative 9. This indicates that the differences between Existing
24 Conditions and Alternative 9 found above would generally be due to climate change, sea level rise,
25 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9,
26 if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
27 therefore would not in itself result in a significant impact on migration habitat for winter-run
28 Chinook salmon. This impact is found to be less than significant and no mitigation is required.

29 **Restoration Measures (CM2, CM4–CM7, and CM10)**

30 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
31 differences in restoration-related fish effects are anticipated anywhere in the affected environment
32 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
33 restoration measures described for winter-run Chinook salmon under Alternative 1A (Impact
34 AQUA-43 through Impact AQUA-45) also appropriately characterize effects under Alternative 9.

35 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

36 **Impact AQUA-43: Effects of Construction of Restoration Measures on Chinook Salmon**
37 **(Winter-Run ESU)**

38 **Impact AQUA-44: Effects of Contaminants Associated with Restoration Measures on Chinook**
39 **Salmon (Winter-Run ESU)**

40 **Impact AQUA-45: Effects of Restored Habitat Conditions on Chinook Salmon (Winter-Run**
41 **ESU)**

1 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
2 winter-run Chinook salmon, and most would be at least slightly beneficial. Specifically for AQUA-44,
3 the effects of contaminants on winter-run Chinook salmon with respect to selenium, copper,
4 ammonia and pesticides would not be adverse. The effects of methylmercury on winter-run Chinook
5 salmon are uncertain.

6 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial,
7 or less than significant, and no mitigation is required.

8 **Other Conservation Measures (CM12–CM19 and CM21)**

9 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
10 differences in other conservation-related fish effects are anticipated anywhere in the affected
11 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
12 effects of other conservation measures described for winter-run Chinook salmon under Alternative
13 1A (Impact AQUA-46 through Impact AQUA-54) also appropriately characterize effects under
14 Alternative 9.

15 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

16 **Impact AQUA-46: Effects of Methylmercury Management on Chinook Salmon (Winter-Run**
17 **ESU) (CM12)**

18 **Impact AQUA-47: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
19 **(Winter-Run ESU) (CM13)**

20 **Impact AQUA-48: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Winter-**
21 **Run ESU) (CM14)**

22 **Impact AQUA-49: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
23 **(Winter-Run ESU) (CM15)**

24 **Impact AQUA-50: Effects of Nonphysical Fish Barriers on Chinook Salmon (Winter-Run ESU)**
25 **(CM16)**

26 **Impact AQUA-51: Effects of Illegal Harvest Reduction on Chinook Salmon (Winter-Run ESU)**
27 **(CM17)**

28 **Impact AQUA-52: Effects of Conservation Hatcheries on Chinook Salmon (Winter-Run ESU)**
29 **(CM18)**

30 **Impact AQUA-53: Effects of Urban Stormwater Treatment on Chinook Salmon (Winter-Run**
31 **ESU) (CM19)**

32 **Impact AQUA-54: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
33 **(Winter-Run ESU) (CM21)**

34 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
35 adverse effect, or beneficial effects on winter-run Chinook salmon for NEPA purposes, for the
36 reasons identified for Alternative 1A.

1 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
2 less than significant, or beneficial on winter-run Chinook salmon, for the reasons identified for
3 Alternative 1A, and no mitigation is required.

4 **Spring-Run Chinook Salmon**

5 **Construction and Maintenance of CM1**

6 **Impact AQUA-55: Effects of Construction of Water Conveyance Facilities on Chinook Salmon** 7 **(Spring-Run ESU)**

8 The construction-related effects of Alternative 9 would be identical for all four Chinook salmon ESUs
9 and would be the same as those described for winter-run Chinook salmon under Alternative 9,
10 Impact AQUA-37. This conclusion also applies to juvenile spring-run Chinook that would be present
11 in early June to August and would potentially be affected by construction activities.

12 **NEPA Effects:** As concluded under Alternative 9, Impact AQUA-37, environmental commitments and
13 mitigation measures would be available to avoid and minimize potential effects, and the effect would
14 not be adverse for Chinook salmon.

15 **CEQA Conclusion:** As described in Alternative 9, Impact AQUA-37, for winter-run Chinook salmon,
16 the impact of the construction of water conveyance facilities on Chinook salmon would be less than
17 significant except for construction noise associated with pile driving. There are more construction
18 sites where noise impacts would potentially occur under Alternative 9 than under Alternative 1A.
19 However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
20 reduce the noise impact on winter-run Chinook salmon to less than significant.

21 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 22 **of Pile Driving and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

24 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 25 **and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

27 **Impact AQUA-56: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon** 28 **(Spring-Run ESU)**

29 The maintenance-related effects of Alternative 9 would be identical for all four Chinook salmon
30 ESUs and would be the same as those described for winter-run Chinook salmon under Alternative 9,
31 Impact AQUA-38.

32 **NEPA Effects:** As concluded under Alternative 9, Impact AQUA-38 for winter-run Chinook salmon,
33 the effect would not be adverse for Chinook salmon.

34 **CEQA Conclusion:** As described in Alternative 1A, Impact AQUA-38, the impact of the maintenance
35 of water conveyance facilities on Chinook salmon would be less than significant and no mitigation
36 would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-57: Effects of Water Operations on Entrainment of Chinook Salmon (Spring-Run**
3 **ESU)**

4 ***Water Exports from SWP/CVP South Delta Facilities***

5 Alternative 9 would substantially reduce entrainment of spring-run Chinook salmon compared to
6 the NAA, due to screening of the DCC and Georgiana intakes. Furthermore the Old River channel
7 would no longer be subject to impacts from water exports at the SWP/CVP south Delta facilities
8 under Alternative 9, reducing the potential for entrainment loss. Limited numbers of spring-run
9 Chinook salmon juveniles would be entrained at the south Delta facilities by entering the water
10 conveyance corridor at the mouth of the Middle River.

11 ***Water Exports from SWP/CVP North Delta Intake Facilities***

12 Entrainment of spring-run Chinook salmon would be minimal because the north Delta intakes at
13 Georgiana Slough and DCC would be screened to exclude juvenile Chinook salmon. There would still
14 be a risk of injury from impingement associated with these north Delta intakes. Overall the impact
15 would be similar to those described for Alternative 1A, Impact AQUA-57.

16 ***Water Export with a Dual Conveyance for the SWP North Bay Aqueduct***

17 Entrainment to the NBA would be the same as described for Alternative 1A, Impact AQUA-57.

18 ***Delta Agricultural Diversions***

19 Since juvenile spring-run Chinook salmon would be prevented from entering the interior Delta via
20 state-of-the-art fish screens at Georgiana Slough and DCC, fewer fish would be exposed to
21 entrainment loss to agricultural diversions in the Delta.

22 ***Predation Associated with Entrainment***

23 The effects of predation associated with entrainment would be the same for all four ESUs. Please
24 refer to the discussion of predation for winter-run Chinook salmon under Alternative 9 (Impact
25 AQUA-39). As discussed for Impact AQUA-39, the effect on Chinook salmon would not be adverse.

26 ***NEPA Effects:*** Overall, the effects of entrainment and entrainment-related predation would be
27 beneficial for spring-run Chinook salmon.

28 ***CEQA Conclusion:*** Entrainment loss would be reduced at the south Delta facilities because the north
29 Delta intakes at the entrances to the DCC and Georgiana Slough would be screened, preventing
30 juvenile spring-run salmon migrating down the Sacramento River from entering the designated
31 water conveyance corridor. Furthermore the north Delta screens would prevent salmon from
32 entering the interior Delta, thus reducing entrainment risk to Delta agricultural diversions.
33 Entrainment to the NBA dual conveyance system would be the same as described for Alternative 1A.
34 Because south Delta entrainment would be reduced, pre-screen predation loss would also be
35 reduced. Predation loss at the north Delta intakes would be minor, representing about 0.2% of the
36 spring-run juvenile Chinook salmon population.

1 Overall, the impact of water operations on spring-run Chinook salmon would be beneficial
2 significant because of the reduction in entrainment and pre-screen predation loss at the south Delta
3 facilities. No mitigation would be required.

4 **Impact AQUA-58: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
5 **Chinook Salmon (Spring-Run ESU)**

6 In general, Alternative 9 would not affect spawning and egg incubation habitat for spring-run
7 Chinook salmon relative to the NAA.

8 ***Sacramento River***

9 Flows in the Sacramento River upstream of Red Bluff during the spring-run Chinook salmon
10 spawning and incubation period (September through January) under A9_LLT would generally be
11 similar to or greater than those under NAA, except during October (up to 13% lower) and dry and
12 critical years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model*
13 *Results utilized in the Fish Analysis*).

14 Shasta Reservoir storage volume at the end of September influences flows downstream of the dam
15 during the spring-run spawning and egg incubation period (September through January). Storage
16 volume at the end of September would be similar to storage under NAA in all water year types
17 (Table 11-9-16).

18 **Table 11-9-16. Difference and Percent Difference in September Water Storage Volume (thousand**
19 **acre-feet) in Shasta Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-537 (-16%)	-25 (-1%)
Above Normal	-568 (-18%)	47 (2%)
Below Normal	-334 (-12%)	20 (1%)
Dry	-537 (-22%)	-26 (-1%)
Critical	-407 (-34%)	-25 (-3%)

20
21 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
22 examined during the September through January spring-run Chinook salmon spawning period
23 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
24 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
25 temperature between NAA and Alternative 9 in any month or water year type throughout the period
26 at either location.

27 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
28 determined for each month (May through September At Bend Bridge and October through April at
29 Red Bluff) and year of the 82-year modeling period (Table 11-9-8). The combination of number of
30 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in
31 Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across
32 all months and all 82 modeled years are presented in Table 11-9-10 for Bend Bridge and in Table 11-
33 9-17 for Red Bluff. There would be no difference in levels of concern between NAA and Alternative 9
34 at Bend Bridge. At Red Bluff, there would be 4 (24%) more years and 3 (33%) fewer years with an
35 “orange” and “yellow” level of concern, respectively, under Alternative 9.

1 **Table 11-9-17. Differences between Baseline and Alternative 9 Scenarios in the Number of Years**
 2 **in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern,**
 3 **Sacramento River at Red Bluff, October through April**

Level of Concern ^a	EXISTING CONDITIONS vs. A9_LLTT	NAA vs. A9_LLTT
Red	36 (300%)	0 (0%)
Orange	11 (183%)	4 (24%)
Yellow	-4 (-31%)	-3 (-33%)
None	-43 (-84%)	-1 (-13%)

^a For definitions of levels of concern, see Table 11-9-9.

4

5 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge
 6 during May through September and at Red Bluff during October through April. At Bend Bridge, total
 7 degree-days under Alternative 9 would be up to 6% lower than those under NAA during May and
 8 September and up to 7% higher during June through August (Table 11-9-11). At Red Bluff, total
 9 degree-days under Alternative 9 would be similar to those under NAA during all months from
 10 October through April (Table 11-9-18).

1
2
3

Table 11-9-18. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River at Red Bluff, October through April

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LL1	NAA vs. A9_LL1
October	Wet	1,172 (456%)	3 (0%)
	Above Normal	545 (210%)	68 (9%)
	Below Normal	653 (312%)	-53 (-6%)
	Dry	1,086 (221%)	15 (1%)
	Critical	979 (163%)	56 (4%)
	All	4,435 (244%)	89 (1%)
November	Wet	87 (8,700%)	-3 (-3%)
	Above Normal	62 (NA)	1 (2%)
	Below Normal	36 (NA)	-12 (-25%)
	Dry	163 (2,038%)	12 (8%)
	Critical	112 (2,800%)	2 (2%)
	All	460 (3,538%)	0 (0%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	9 (NA)	0 (0%)
	Above Normal	5 (NA)	1 (25%)
	Below Normal	19 (211%)	-2 (-7%)
	Dry	64 (457%)	0 (0%)
	Critical	27 (2,700%)	0 (0%)
	All	124 (517%)	-1 (-1%)
April	Wet	265 (230%)	4 (1%)
	Above Normal	206 (147%)	-23 (-6%)
	Below Normal	253 (320%)	23 (7%)
	Dry	336 (181%)	16 (3%)
	Critical	153 (1,275%)	2 (1%)
	All	1,213 (228%)	22 (1%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
2 Sacramento River under A9_LLT would be similar to (<5% on an absolute scale) mortality under
3 NAA in all water years (Table 11-9-19).

4 **Table 11-9-19. Difference and Percent Difference in Percent Mortality of Spring-Run Chinook**
5 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	15 (149%)	0.4 (1%)
Above Normal	19 (146%)	-2 (-7%)
Below Normal	27 (227%)	-2 (-6%)
Dry	55 (277%)	-2 (-3%)
Critical	25 (34%)	3 (3%)
All	28 (125%)	-1 (-1%)

6

7 SacEFT predicts that there would be an 11% decrease in the percentage of years with good
8 spawning availability, measured as weighted usable area, there would be no difference between
9 A9_LLT and NAA (Table 11-9-20). SacEFT predicts that there would be no difference in the
10 percentage of years with good (lower) redd scour risk under A9_LLT relative to NAA. SacEFT
11 predicts no difference in the percentage of years with good (lower) egg incubation conditions under
12 A9_LLT relative to NAA. SacEFT predicts that there would be a 9% increase in the percentage of
13 years with good (lower) redd dewatering risk between A9_LLT, relative to NAA.

14 **Table 11-9-20. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
15 **for Spring-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-21 (-30%)	0 (0%)
Redd Scour Risk	0 (0%)	0 (0%)
Egg Incubation	-52 (-60%)	0 (0%)
Redd Dewatering Risk	-12 (-24%)	3 (9%)
Juvenile Rearing WUA	-2 (-9%)	-2 (-9%)
Juvenile Stranding Risk	-8 (-42%)	-3 (-21%)

WUA = Weighted Usable Area.

16

17 **Clear Creek**

18 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
19 (September through January) under A9_LLT would nearly always be similar to or greater than flows
20 under NAA throughout the spring-run spawning and egg incubation period, except in critical years
21 during September (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
23 comparing the magnitude of flow reduction each month over the incubation period compared to the
24 flow in September when spawning is assumed to occur. The greatest reduction in flows under
25 A9_LLT would be the same or of lower magnitude than that under NAA in all water year types (Table
26 11-9-21).

1 Water temperatures were not modeled in Clear Creek.

2 **Table 11-9-21. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
 3 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
 4 **January Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	66 (99%)	99 (99%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

5

6 ***Feather River***

7 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay)
 8 where spring-run Chinook primarily spawn during September through January (Appendix 11C,
 9 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would not differ from NAA
 10 because minimum Feather River flows are included in the FERC settlement agreement and would be
 11 met for all model scenarios.

12 Oroville Reservoir storage volume at the end of September influence flows downstream of the dam
 13 during the spring-run spawning and egg incubation period. Storage volume at the end of September
 14 would be similar to storage under NAA in all water year types. (Table 11-9-22). This indicates that
 15 the majority of reduction in storage volume would be due to climate change rather than Alternative
 16 9.

17 **Table 11-9-22. Difference and Percent Difference in September Water Storage Volume (thousand**
 18 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-1,017 (-35%)	-3 (-0.2%)
Above Normal	-816 (-34%)	-25 (-2%)
Below Normal	-605 (-30%)	4 (0.3%)
Dry	-337 (-25%)	16 (2%)
Critical	-202 (-21%)	-14 (-2%)

19

20 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
 21 comparing the magnitude of flow reduction each month over the egg incubation period compared to
 22 the flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
 23 during October through January were identical between A9_LLT and NAA (Appendix 11C, *CALSIM II*

1 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 9 on
2 redd dewatering in the Feather River low-flow channel.

3 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream
4 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water
5 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
6 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 9 in any
7 month or water year type throughout the period.

8 The percent of months exceeding the 56°F temperature threshold in the Feather River above
9 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table
10 11-9-23). The percent of months exceeding the threshold under Alternative 9 would generally be
11 lower (up to 11% lower on an absolute scale) than the percent under NAA during September
12 through November and similar during the other two months.

13 **Table 11-9-23. Differences between Baseline and Alternative 9 Scenarios in Percent of Months**
14 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
15 **River above Thermalito Afterbay Exceed the 56°F Threshold, September through January**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LL					
September	0 (0%)	0 (0%)	6 (7%)	21 (29%)	31 (76%)
October	54 (244%)	56 (750%)	43 (700%)	41 (1,650%)	35 (1,400%)
November	64 (2,600%)	56 (4,500%)	38 (3,100%)	30 (NA)	16 (NA)
December	2 (NA)	1 (NA)	1 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
NAA vs. A9_LL					
September	0 (0%)	-1 (-1%)	-1 (-1%)	-2 (-3%)	-11 (-13%)
October	-10 (-11%)	-2 (-4%)	-6 (-11%)	-6 (-13%)	-2 (-6%)
November	0 (0%)	-2 (-4%)	-10 (-20%)	-2 (-8%)	-9 (-35%)
December	-1 (-33%)	0 (0%)	0 (0%)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

16
17 Total degree-days exceeding 56°F were summed by month and water year type above Thermalito
18 Afterbay (low-flow channel) during September through January (Table 11-9-24). Total degree-
19 months would be similar between NAA and Alternative 9 during all months of the period.

1 **Table 11-9-24. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the Feather River above Thermalito Afterbay, September through January**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
September	Wet	21 (19%)	-4 (-3%)
	Above Normal	13 (30%)	3 (6%)
	Below Normal	29 (48%)	-2 (-2%)
	Dry	85 (123%)	-3 (-2%)
	Critical	63 (97%)	1 (1%)
	All	211 (61%)	-5 (-1%)
October	Wet	89 (1,780%)	-7 (-7%)
	Above Normal	37 (370%)	2 (4%)
	Below Normal	50 (714%)	-4 (-7%)
	Dry	80 (1,143%)	0 (0%)
	Critical	47 (588%)	6 (12%)
	All	303 (819%)	-3 (-1%)
November	Wet	59 (NA)	3 (5%)
	Above Normal	29 (967%)	4 (14%)
	Below Normal	32 (3,200%)	-2 (-6%)
	Dry	49 (NA)	-2 (-4%)
	Critical	31 (NA)	3 (11%)
	All	201 (5,025%)	7 (4%)
December	Wet	1 (NA)	0 (0%)
	Above Normal	2 (NA)	1 (100%)
	Below Normal	4 (NA)	1 (33%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	6 (NA)	1 (20%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Based on these results, it is concluded that the effect would not be adverse because
 6 habitat would not be substantially reduced. There would be negligible effects of Alternative 9 on
 7 reservoir storage, instream flows, and water temperatures in all rivers evaluated.

8 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of spawning
 9 and egg incubation habitat for spring-run Chinook salmon relative to Existing Conditions.

10 **Sacramento River**

11 Flows in the Sacramento River upstream of Red Bluff were examined during the spring-run Chinook
 12 salmon spawning and incubation period (September through January). Flows during September

1 would generally be greater than or similar to those under Existing Conditions, except in dry and
2 critical years during September (25% and 18% lower, respectively), above normal and critical years
3 during October (10% and 11% lower, respectively), and wet years during December (8% lower)
4 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

5 Shasta Reservoir storage volume at the end of September would be 12% to 34% lower under
6 A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-16).

7 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
8 examined during the September through January spring-run Chinook salmon spawning period
9 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
10 *utilized in the Fish Analysis*). At Keswick, temperatures under Alternative 9 during September and
11 October would be 6% greater than those under Existing Conditions, but not different in other
12 months during the period. At Red Bluff, temperatures under Alternative 9 during October would be
13 5% greater than those under Existing Conditions, but would not be different in other months during
14 the period.

15 The number of days on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was
16 determined for each month (May through September At Bend Bridge and October through April at
17 Red Bluff) and year of the 82-year modeling period (Table 11-9-8). The combination of number of
18 days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in
19 Table 11-9-9. Differences between baselines and Alternative 9 in the highest level of concern across
20 all months and all 82 modeled years are presented in Table 11-9-10 for Bend Bridge and in Table 11-
21 9-17 for Red Bluff. At Bend Bridge, there would be a 67% increase in the number of years with a
22 “red” level of concern under Alternative 9 relative to Existing Conditions. At Red Bluff, there would
23 be 300% and 183% increases in the number of years with “red” and “orange” levels of concern
24 under Alternative 9 relative to Existing Conditions.

25 Total degree-days exceeding 56°F were summed by month and water year type at Bend Bridge
26 during May through September and at Red Bluff during October through April. At Bend Bridge, total
27 degree-days under Alternative 9 would be up to 118% to 240% higher than those under Existing
28 Conditions depending on the month (Table 11-9-11). At Red Bluff, total degree-days under
29 Alternative 9 would be 228% to 3,538% higher than those under Existing Conditions during
30 October, November, March, and April, and similar during December through February (Table 11-9-
31 18).

32 The Reclamation egg mortality model predicts that spring-run Chinook salmon egg mortality in the
33 Sacramento River under A9_LLT would be 34% to 277% greater than mortality under Existing
34 Conditions, depending on water year type (Table 11-9-19).

35 SacEFT predicts that there would be a 30% decrease in the percentage of years with good spawning
36 availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table
37 11-9-20). SacEFT predicts that there would be no difference in the percentage of years with good
38 (lower) redd scour risk under A9_LLT relative to Existing Conditions. SacEFT predicts that there
39 would be a 60% decrease in the percentage of years with good (lower) egg incubation conditions
40 under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a 24% decrease
41 in the percentage of years with good (lower) redd dewatering risk under A9_LLT relative to Existing
42 Conditions. These results indicate that spawning and egg incubation conditions for spring-run
43 Chinook salmon under A9_LLT would be poor relative to Existing Conditions.

1 **Clear Creek**

2 Flows in Clear Creek during the spring-run Chinook salmon spawning and egg incubation period
3 (September through January) under A9_LLT would generally be similar to or greater than flows
4 under Existing Conditions, except in critical years during September and November (38% and 6%
5 lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

6 The potential risk of spring-run Chinook salmon redd dewatering in Clear Creek was evaluated by
7 comparing the magnitude of flow reduction each month over the incubation period compared to the
8 flow in September when spawning is assumed to occur. The greatest reduction in flows under
9 A9_LLT would be similar to or lower magnitude than that under Existing Conditions, except in above
10 normal water years (27 and 67 cfs lower, respectively) (Table 11-9-21).

11 Water temperatures were not modeled in Clear Creek.

12 **Feather River**

13 Flows in the Feather River low-flow channel under A9_LLT are not different from Existing
14 Conditions during the spring-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*). Flows in October through January (800 cfs) would be
16 equal to or greater than the spawning flows in September (773 cfs) for all model scenarios.

17 Oroville Reservoir storage volume at the end of September would be 21% to 35% lower under
18 A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-22).

19 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
20 comparing the magnitude of flow reduction each month over the incubation period compared to the
21 flow in September when spawning is assumed to occur. Minimum flows in the low-flow channel
22 during October through January were identical between A9_LLT and Existing Conditions (Appendix
23 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of
24 Alternative 9 on redd dewatering in the Feather River low-flow channel.

25 Mean monthly water temperatures were examined in the Feather River low-flow channel (upstream
26 of Thermalito Afterbay) during September through January (Appendix 11D, *Sacramento River Water*
27 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
28 Temperatures under Alternative 9 would be 7% to 10% greater than those under Existing
29 Conditions in all months during the period except September.

30 The percent of months exceeding the 56°F temperature threshold in the Feather River above
31 Thermalito Afterbay (low-flow channel) was evaluated during September through January (Table
32 11-9-23). The percent of months exceeding the threshold under Alternative 9 would be similar to or
33 up to 64% higher (absolute scale) than under Existing Conditions during September through
34 November. There would be almost no difference in the percent of months exceeding the threshold
35 between Existing Conditions and Alternative 9 during December and January.

36 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
37 Afterbay (low-flow channel) during September through January (Table 11-9-24). Total degree-
38 months exceeding the threshold under Alternative 9 would be 61% to 5,052% greater than those
39 under Existing Conditions during September through November. There would be essentially no
40 difference in total degree-months between Existing Conditions and Alternative 9 during December
41 and January.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce rearing habitat, contrary to the NEPA conclusion set forth
5 above. There would be increases in reservoir storage, instream flows, and water temperatures in the
6 Sacramento and Feather Rivers under Alternative 9 that would have substantial effects on spring-
7 run spawning and egg incubation conditions. SacEFT and the Reclamation egg mortality model
8 predict reductions in habitat conditions and survival under Alternative 9. Flow reductions in Clear
9 Creek under Alternative 9 would increase the risk of redd dewatering there.

10 These results are primarily caused by four factors: differences in sea level rise, differences in climate
11 change, future water demands, and implementation of the alternative. The analysis described above
12 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
13 alternative from those of sea level rise, climate change and future water demands using the model
14 simulation results presented in this chapter. However, the increment of change attributable to the
15 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
16 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
17 implementation period, which does include future sea level rise, climate change, and water
18 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
19 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
20 effect of the alternative from those of sea level rise, climate change, and water demands.

21 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
22 term implementation period and Alternative 9 indicates that flows and reservoir storage in the
23 locations and during the months analyzed above would generally be similar between Existing
24 Conditions during the LLT and Alternative 9. This indicates that the differences between Existing
25 Conditions and Alternative 9 found above would generally be due to climate change, sea level rise,
26 and future demand, and not the alternative. As a result, the CEQA conclusion regarding Alternative 9,
27 if adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
28 therefore would not in itself result in a significant impact on spawning and egg incubation habitat
29 for spring-run Chinook salmon. This impact is found to be less than significant and no mitigation is
30 required.

31 **Impact AQUA-59: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Spring-
32 Run ESU)**

33 In general, Alternative 9 would not affect the quantity and quality of rearing habitat for fry and
34 juvenile spring-run Chinook salmon relative to the NAA.

35 ***Sacramento River***

36 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
37 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
38 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LL
39 would generally be similar to or greater than those under NAA throughout the period.

40 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
41 examined during the November through March spring-run Chinook salmon juvenile rearing period
42 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*

1 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
2 temperature between NAA and Alternative 9 in any month or water year type throughout the period
3 at either location. As reported in Impact AQUA-40, May Shasta storage volume under A9_LLT would
4 be similar to storage under NAA for all water year types (Table 11-9-7).

5 As reported in Impact AQUA-58, September Shasta storage volume under A9_LLT would be similar
6 to storage under NAA in all water year types (Table 11-9-16).

7 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under
8 A9_LLT would be lower than that under NAA (9% lower) (Table 11-9-20). The percentage of years
9 with good (lower) juvenile stranding risk conditions under A9_LLT would be 21% lower than under
10 NAA. Both correspond to negligible absolute values; thus, there would be no effects on juvenile
11 rearing habitat predicted by SacEFT.

12 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A9_LLT would be
13 7% greater under A9_LLT than that under NAA.

14 **Clear Creek**

15 Flows in Clear Creek during the November through March rearing period under A9_LLT would
16 generally be similar to or greater than flows under NAA, except for a 6% decrease for below normal
17 years in March(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18 Water temperatures were not modeled in Clear Creek.

19 **Feather River**

20 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
21 channel) during November through June were reviewed to determine flow-related effects on larval
22 and juvenile spring-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
23 Analysis*). Relatively constant flows in the low-flow channel throughout this period under A9_LLT
24 would not differ from those under NAA. In the high-flow channel, flows under A9_LLT would be
25 mostly similar to or greater than flows under NAA during November through June, with some
26 exceptions (up to 22% lower).

27 May Oroville storage under A9_LLT would be similar to storage under NAA in all water year types,
28 indicating that the difference relative to NAA is primarily a result of climate change (Table 11-9-25).

29 As reported in Impact AQUA-58, September Oroville storage volume would be similar to storage
30 under NAA in all water year types (Table 11-9-22).

31 **Table 11-9-25. Difference and Percent Difference in May Water Storage Volume (thousand**
32 **acre-feet) in Oroville Reservoir for Model Scenarios**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-57 (-2%)	-11 (0%)
Above Normal	-184 (-5%)	-28 (-1%)
Below Normal	-380 (-12%)	-27 (-1%)
Dry	-560 (-20%)	-40 (-2%)
Critical	-351 (-19%)	-35 (-2%)

33

1 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at
 2 Thermalito Afterbay (high-flow channel) were evaluated during November through June (Appendix
 3 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
 4 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
 5 between NAA and Alternative 9 in any month or water year type throughout the period at either
 6 location.

7 The percent of months exceeding the 63°F temperature threshold in the Feather River above
 8 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-9-26).
 9 The percent of months exceeding the threshold under Alternative 9 would generally be similar to or
 10 lower (up to 16% lower on an absolute scale) than the percent under NAA.

11 **Table 11-9-26. Differences between Baseline and Alternative 9 Scenarios in Percent of Months**
 12 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
 13 **River above Thermalito Afterbay Exceed the 63°F Threshold, May through August**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LL1					
May	4 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
June	27 (49%)	35 (127%)	31 (625%)	12 (NA)	4 (NA)
July	0 (0%)	0 (0%)	1 (1%)	25 (34%)	44 (113%)
August	0 (0%)	12 (14%)	35 (60%)	44 (157%)	33 (338%)
NAA vs. A9_LL1					
May	-2 (-40%)	-2 (-100%)	-1 (-100%)	0 (NA)	0 (NA)
June	-6 (-7%)	-16 (-21%)	-11 (-24%)	-9 (-41%)	-1 (-25%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-10 (-11%)
August	0 (0%)	0 (0%)	-6 (-6%)	-9 (-11%)	-14 (-24%)

NA = could not be calculated because the denominator was 0.

14
 15 Total degree-months exceeding 63°F were summed by month and water year type above Thermalito
 16 Afterbay (low-flow channel) during May through August (Table 11-9-27). Total degree-months
 17 under Alternative 9 would be similar to or slightly lower than those under NAA depending on the
 18 month.

1 **Table 11-9-27. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 63°F in**
 3 **the Feather River above Thermalito Afterbay, May through August**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	0 (NA)	-1 (-100%)
	Above Normal	1 (NA)	0 (0%)
	Below Normal	0 (NA)	0 (NA)
	Dry	2 (NA)	0 (0%)
	Critical	3 (NA)	-1 (-25%)
	All	6 (NA)	-2 (-25%)
June	Wet	30 (200%)	1 (2%)
	Above Normal	17 (121%)	0 (0%)
	Below Normal	23 (177%)	1 (3%)
	Dry	31 (135%)	-2 (-4%)
	Critical	24 (400%)	-1 (-3%)
	All	124 (175%)	-2 (-1%)
July	Wet	42 (35%)	1 (1%)
	Above Normal	19 (43%)	-1 (-2%)
	Below Normal	26 (44%)	-2 (-2%)
	Dry	35 (49%)	-1 (-1%)
	Critical	34 (65%)	2 (2%)
	All	157 (45%)	0 (0%)
August	Wet	35 (39%)	2 (2%)
	Above Normal	18 (72%)	0 (0%)
	Below Normal	28 (74%)	-1 (-1%)
	Dry	50 (125%)	-3 (-3%)
	Critical	36 (86%)	-4 (-5%)
	All	167 (71%)	-6 (-2%)

NA = could not be calculated because the denominator was 0.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 habitat would not be substantially reduced. There would be negligible effects of Alternative 9 on
 7 reservoir storage, instream flows, and water temperatures in all rivers evaluated.

8 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of rearing
 9 habitat for spring-run Chinook salmon relative to Existing Conditions.

10 **Sacramento River**

11 Flows were evaluated during the November through March larval and juvenile spring-run Chinook
 12 salmon rearing period in the Sacramento River between Keswick Dam and just upstream of Red
 13 Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during December
 14 were generally lower by up to 15% under A9_LLT than under Existing Conditions. Flows under
 15 A9_LLT during the remaining 4 months of the rearing period would be generally similar to or up to
 16 28% greater than those under Existing Conditions, except in March of below normal years, when
 17 they were 20% lower.

1 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
2 examined during the November through March spring-run Chinook salmon juvenile rearing period
3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
4 *utilized in the Fish Analysis*). At both locations, there would be no differences (<5%) in mean
5 monthly water temperature between Existing Conditions and Alternative 9.

6 SacEFT predicts that the percentage of years with good juvenile rearing WUA conditions under
7 A9_LLT would be 9% lower than that under Existing Conditions (Table 11-9-20). The percentage of
8 years with good (lower) juvenile stranding risk conditions under A9_LLT would be 42% lower than
9 under Existing Conditions.

10 SALMOD predicts that spring-run smolt equivalent habitat-related mortality under A9_LLT would be
11 28% lower than under Existing Conditions.

12 **Clear Creek**

13 Flows in Clear Creek during the November through March rearing period under A9_LLT would
14 generally be similar to or greater than flows under Existing Conditions (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*).

16 Water temperatures were not model in Clear Creek.

17 **Feather River**

18 Relatively constant flows in the low-flow channel throughout this period under A9_LLT would not
19 differ from those under Existing Conditions. In the high-flow channel, flows under A9_LLT would
20 generally be lower (up to 55% lower) during October through February, and generally similar to or
21 greater than flows under Existing Conditions during the rest of the year, with some exceptions (up
22 to 56% lower).

23 May Oroville storage volume under A9_LLT would be similar to Existing Conditions in wet years and
24 5% to 20% lower than Existing Conditions in all other water year types (Table 11-9-25).

25 As reported in Impact AQUA-58, September Oroville storage volume would be 21% to 35% lower
26 under A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-22).

27 Mean monthly water temperatures in the Feather River both above (low-flow channel) and at
28 Thermalito Afterbay (high-flow channel) were evaluated during the November through June
29 juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
30 *Temperature Model Results utilized in the Fish Analysis*). Water temperature under Alternative 9
31 would be 5% to 11% greater than those under Existing Conditions during November through March,
32 but similar (<5% difference) during April through June.

33 The percent of months exceeding the 63°F temperature threshold in the Feather River above
34 Thermalito Afterbay (low-flow channel) was evaluated during May through August (Table 11-9-26).
35 The percent of months exceeding the threshold under Alternative 9 would be similar to those under
36 Existing Conditions during May, but up to 20% greater during June through August.

1 Total degree-months exceeding 63°F were summed by month and water year type above Thermalito
2 Afterbay (low-flow channel) during May through August (Table 11-9-27). Total degree-months
3 under Alternative 9 would be similar to those under Existing Conditions during May, but 45% to
4 175% higher during June through August.

5 **Summary of CEQA Conclusion**

6 Collectively, the results of the Impact AQUA-59 CEQA analysis indicate that the difference between
7 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
8 alternative could substantially reduce the amount of suitable habitat. Reservoir storage in the
9 Feather River and flows in the high-flow channel would be lower and water temperatures would be
10 higher under Alternative 9. Year-round flows and water temperatures in Clear Creek, the
11 Sacramento River, and the low-flow channel of the Feather River would be similar between Existing
12 Conditions and Alternative 9. However, juvenile stranding in the Sacramento River is predicted to be
13 higher under Alternative 9 by SacEFT.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate
15 change, future water demands, and implementation of the alternative. The analysis described above
16 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
17 alternative from those of sea level rise, climate change and future water demands using the model
18 simulation results presented in this chapter. However, the increment of change attributable to the
19 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
20 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
21 implementation period, which does include future sea level rise, climate change, and water
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
26 term implementation period and Alternative 9 indicates that flows in the locations and during the
27 months analyzed above would generally be similar between Existing Conditions during the LLT and
28 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
29 found above would generally be due to climate change, sea level rise, and future demand, and not
30 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
31 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
32 result in a significant impact on fry and juvenile rearing habitat for spring-run Chinook salmon. This
33 impact is found to be less than significant and no mitigation is required.

34 **Impact AQUA-60: Effects of Water Operations on Migration Conditions for Chinook Salmon** 35 **(Spring-Run ESU)**

36 **Upstream of the Delta**

37 In general, Alternative 9 would not affect migration conditions for spring-run Chinook salmon
38 relative to the NAA.

39 ***Sacramento River***

40 Flows in the Sacramento River upstream of Red Bluff were evaluated during the December through
41 May juvenile Chinook salmon spring-run migration period. Flows under A9_LL1T during December

1 through May would nearly always be similar to or greater than flows under NAA except in dry and
2 critical years during January (7% and 11% lower, respectively) (Appendix 11C, *CALSIM II Model*
3 *Results utilized in the Fish Analysis*).

4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
5 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
8 NAA and Alternative 9 in any month or water year type throughout the period.

9 Flows in the Sacramento River upstream of Red Bluff were evaluated during the April through
10 August adult spring-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A9_LLT during April through August would
12 nearly always be similar to or greater than flows under NAA except in above normal water years
13 during August (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

14 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
15 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,
16 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
17 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
18 NAA and Alternative 9 in any month or water year type throughout the period.

19 **Clear Creek**

20 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
21 migration period under A9_LLT would nearly always be similar to or greater than flows under NAA
22 except in below normal water years during March (6% lower) (Appendix 11C, *CALSIM II Model*
23 *Results utilized in the Fish Analysis*).

24 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
25 migration period under A9_LLT would always be similar to or greater than flows under NAA
26 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 Water temperatures were not modeled in Clear Creek.

28 **Feather River**

29 Flows in the Feather River at the confluence with the Sacramento River were examined during the
30 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
31 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during November under A9_LLT would
32 be similar to or greater than flows under NAA throughout the period, except during November in
33 above normal and critical years (6% lower for both), December in above normal years (5% lower),
34 and January in critical years (9% lower).

35 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
36 were examined during the November through May juvenile spring-run Chinook salmon migration
37 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
38 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
39 temperature between NAA and Alternative 9 in any month or water year type throughout the
40 period.

1 Flows in the Feather River at the confluence with the Sacramento River were examined during the
2 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
3 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLTT would generally be similar
4 to or greater than flows under NAA, except in dry and critical water years during July.

5 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
6 were examined during the April through August adult spring-run Chinook salmon upstream
7 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
8 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
9 mean monthly water temperature between NAA and Alternative 9 in any month or water year type
10 throughout the period.

11 **Through-Delta**

12 ***Juveniles***

13 As described above in Impact AQUA-42, fish screens at the DCC and Georgiana Slough would prevent
14 outmigrating spring-run juveniles straying from the Sacramento River into the interior Delta,
15 resulting in greater survival.

16 Mean monthly flows at Rio Vista under Alternative 9 during the outmigration period (November–
17 January peak, extending through April) averaged across all years would be similar (<7% difference)
18 to NAA, but reduced in drier water year types (4–28% less than NAA). Based on the DPM, through-
19 Delta survival by emigrating juvenile spring-run Chinook salmon under Alternative 9 would average
20 32% across all years, 26% in drier years, and 42.6% in wetter years. Under Alternative 9, juvenile
21 survival would be 2% greater (a 6–9% relative increase) than NAA (Table 11-9-28). Potential
22 predation losses at the fish screens at DCC and Georgiana Slough would be minor, as described
23 above in Impact AQUA-42. There is the risk of predatory fish aggregating at the fourteen new
24 operable barriers installed (locations described above) and preying on juvenile salmonids as they
25 migrate past. However, predators are already abundant in the south and central regions of the Delta,
26 so the effect of adding the new structures would have to be determined. Under Alternative 9,
27 increased flows in the Old River channel would increase salmon migration speed and reduce
28 exposure to many of these structures and any associated predators.

29 The effect on spring-run Chinook would not be adverse due to minor differences in modeled
30 survival.

1 **Table 11-9-28. Through-Delta Survival (%) of Emigrating Juvenile Spring-Run Chinook Salmon**
2 **under Alternative 9**

Month	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A9_LLT	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wetter Years	42.1	40.4	42.8	0.7 (2%)	2.4 (6%)
Drier Years	24.8	24.3	26.5	1.7 (7%)	2.2 (9%)
All Years	31.3	30.3	32.6	1.4 (4%)	2.3 (8%)

Note: Delta Passage Model results for survival to Chipps Island.
Wetter = Wet and Above Normal Water Years (6 years).
Drier = Below Normal, Dry and Critical Water Years (10 years).

3

4 **Adults**

5 During the adult spring-run migration, the proportion of Sacramento River flows in the Delta under
6 Alternative 9 would be similar to NAA. In June, the attraction flows would be similar compared to
7 NAA. Although the proportion of Sacramento River flows would be reduced during certain months
8 of the adult migration, Sacramento River flows would still represent 57–66% of Delta outflows.
9 Therefore, olfactory cues would still be strong for spring-run adult Chinook salmon. Flows at Rio
10 Vista under Alternative 9 would be increased (9–28%) relative to Alternative 1A. Rio Vista flows
11 under Alternative 1A were determined to not have an adverse effect on adult migration.

12 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
13 Alternative 9 does not have the potential to substantially interfere with the movement of fish.
14 Reservoir storage and flows in all rivers examined would be reduced infrequently such that the
15 reductions would not have a biologically meaningful effect on the spring-run population. Further,
16 water temperatures in these rivers would not differ substantially between NAA and Alternative 9.

17 **CEQA Conclusion:** In general, Alternative 9 would not affect migration conditions for spring-run
18 Chinook salmon relative to the Existing Conditions.

19 **Upstream of the Delta**

20 **Sacramento River**

21 Flows in the Sacramento River upstream of Red Bluff during December through May juvenile spring-
22 run Chinook salmon migration period under A9_LLT would nearly always be similar to or greater
23 than flows under Existing Conditions except in wet water years during December and May (8% and
24 20% lower, respectively) and in below normal water years during March (11% lower) (Appendix
25 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
27 December through May juvenile Chinook salmon spring-run emigration period (Appendix 11D,
28 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
29 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
30 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

1 Flows in the Sacramento River upstream of Red Bluff during the April through August adult spring-
2 run Chinook salmon upstream migration period under A9_LLT would generally be similar to or
3 greater than Existing Conditions except in wet years during May and August (20% and 7% lower,
4 respectively) and in critical years during July and August (9% and 13% lower, respectively).

5 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
6 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11D,
7 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
8 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
9 Existing Conditions and Alternative 9 during April through July. Mean monthly water temperatures
10 under Alternative 0 would be 6% greater relative to Existing Conditions during August.

11 **Clear Creek**

12 Flows in Clear Creek during the November through May juvenile Chinook salmon spring-run
13 migration period under A9_LLT would nearly always be similar to or greater than flows under
14 Existing Conditions except in critical years during November (6% lower) (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*).

16 Flows in Clear Creek during the April through August adult spring-run Chinook salmon upstream
17 migration period under A9_LLT would nearly always be similar to or greater than flows under
18 Existing Conditions except in critical water years during August (17% lower) (Appendix 11C,
19 *CALSIM II Model Results utilized in the Fish Analysis*).

20 Water temperatures were not modeled in Clear Creek.

21 **Feather River**

22 Flows were examined for the Feather River at the confluence with the Sacramento River during the
23 November through May juvenile Chinook salmon spring-run migration period (Appendix 11C,
24 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during March under A9_LLT would
25 generally be lower than flows under Existing Conditions by up to 15%. Flows during the rest of the
26 period would generally be similar to or greater than flows under Existing Conditions, with some
27 exceptions (up to 27% lower).

28 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
29 were examined during the November through May juvenile spring-run Chinook salmon migration
30 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
31 *Results utilized in the Fish Analysis*). Water temperatures under Alternative 9 would be 5% greater
32 than those under Existing Conditions in November and December, but similar during January
33 through May.

34 Flows were examined for the Feather River at the confluence with the Sacramento River during the
35 April through August adult spring-run Chinook salmon upstream migration period (Appendix 11C,
36 *CALSIM II Model Results utilized in the Fish Analysis*). Flows during April, May, and August under
37 A9_LLT would generally be similar to or greater than flows under Existing Conditions with some
38 exceptions, during which flows would be up to 32% lower. Flows during June and July under A9_LLT
39 would generally be lower by up to 35% than flows under Existing Conditions.

40 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
41 were examined during the April through August adult spring-run Chinook salmon upstream

1 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
2 *Temperature Model Results utilized in the Fish Analysis*). Water temperatures under Alternative 9
3 would be similar to those under Existing Conditions during all months of the migration period

4 **Through-Delta**

5 ***Juveniles***

6 Mean monthly Sacramento River flows at Rio Vista under Alternative 9 would be similar to Existing
7 Conditions in November to April (8% decreased to 6% increased). May flows would decrease on
8 average 23% across all water years, and decrease up to 32% in wet years. As described above,
9 Alternative 9 would result in a slight increase in through-Delta survival by emigrating juvenile
10 spring-run Chinook salmon across all years (1.4% increase, a 4% relative increase) compared to
11 Existing Conditions, mainly due to slight increase in drier years (1.7% increase). Furthermore,
12 screening of the DCC and Georgiana Slough would prevent Sacramento River basin juvenile salmon
13 from entering the interior Delta, thus improving migration survival. There is the risk of predatory
14 fish aggregating at the two new fish screens and the fourteen new operable barriers installed
15 (locations described above in Impact AQUA-42 for Alternative 9) and preying on juvenile salmonids
16 as they migrate past. However, predators are already abundant in the south and central regions of
17 the Delta, so the effect of adding the new structures would have to be determined. Under Alternative
18 9, increased flows in the Old River channel would increase salmon migration speed and reduce
19 exposure to many of these structures and any associated predators.

20 Overall the impact on outmigration for juvenile Chinook salmon would be less than significant
21 survival due to minor differences in survival across all water years and no mitigation would be
22 required.

23 ***Adults***

24 During the adult spring-run migration, the proportion of Sacramento River flows in the Delta would
25 be reduced in March–May (12–13% compared to Existing Conditions). However, olfactory cues
26 would remain strong as Sacramento River flows at Collinsville would still represent 57–66% of
27 Delta outflow. As discussed in Impact AQUA-42 for Alternative 1A, these incremental changes are
28 not expected to substantially affect adult migration. No mitigation would be required.

29 **Summary of CEQA Conclusion**

30 Collectively, these results indicate that the effect would be less than significant because Alternative 9
31 does not have the potential to substantially interfere with the movement of fish. Reservoir storage
32 and flows in all rivers examined would be reduced infrequently such that the reductions would not
33 have a biologically meaningful effect on the spring-run population. Further, water temperatures in
34 these rivers would not differ substantially between Existing Conditions and Alternative 9. Through-
35 Delta survival of migrating juveniles would be similar or slightly increased, and adult attraction
36 flows would not be substantially changed. Overall the effect is considered less than significant. No
37 mitigation is required.

38 **Restoration Measures (CM2, CM4–CM7, and CM10)**

39 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
40 differences in restoration-related fish effects are anticipated anywhere in the affected environment
41 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of

1 restoration measures described for spring-run Chinook salmon under Alternative 1A (Impact AQUA-
2 61 through Impact AQUA-63) also appropriately characterize effects under Alternative 9.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

4 **Impact AQUA-61: Effects of Construction of Restoration Measures on Chinook Salmon**
5 **(Spring-Run ESU)**

6 **Impact AQUA-62: Effects of Contaminants Associated with Restoration Measures on Chinook**
7 **Salmon (Spring-Run ESU)**

8 **Impact AQUA-63: Effects of Restored Habitat Conditions on Chinook Salmon (Spring-Run ESU)**

9 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
10 spring-run Chinook salmon, and most would be at least slightly beneficial. Specifically for AQUA-62,
11 the effects of contaminants on spring-run Chinook salmon with respect to selenium, copper,
12 ammonia and pesticides would not be adverse. The effects of methylmercury on spring-run Chinook
13 salmon are uncertain.

14 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial,
15 or less than significant, and no mitigation is required.

16 **Other Conservation Measures (CM12–CM19 and CM21)**

17 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
18 differences in other conservation-related fish effects are anticipated anywhere in the affected
19 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
20 effects of other conservation measures described for spring-run Chinook salmon under Alternative
21 1A (Impact AQUA-64 through Impact AQUA-72) also appropriately characterize effects under
22 Alternative 9.

23 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

24 **Impact AQUA-64: Effects of Methylmercury Management on Chinook Salmon (Spring-Run**
25 **ESU) (CM12)**

26 **Impact AQUA-65: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon**
27 **(Spring-Run ESU) (CM13)**

28 **Impact AQUA-66: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Spring-**
29 **Run ESU) (CM14)**

30 **Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon**
31 **(Spring-Run ESU) (CM15)**

32 **Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU)**
33 **(CM16)**

34 **Impact AQUA-69: Effects of Illegal Harvest Reduction on Chinook Salmon (Spring-Run ESU)**
35 **(CM17)**

1 **Impact AQUA-70: Effects of Conservation Hatcheries on Chinook Salmon (Spring-Run ESU)**
2 **(CM18)**

3 **Impact AQUA-71: Effects of Urban Stormwater Treatment on Chinook Salmon (Spring-Run**
4 **ESU) (CM19)**

5 **Impact AQUA-72: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon**
6 **(Spring-Run ESU) (CM21)**

7 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
8 adverse effect, or beneficial effects on spring-run Chinook salmon for NEPA purposes, for the
9 reasons identified for Alternative 1A.

10 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
11 less than significant, or beneficial on spring-run Chinook salmon, for the reasons identified for
12 Alternative 1A, and no mitigation is required.

13 **Fall-/Late Fall–Run Chinook Salmon**

14 **Construction and Maintenance of CM1**

15 The construction- and maintenance-related effects of Alternative 9 would be identical for all four
16 Chinook salmon ESUs. Accordingly, for a discussion of the impacts listed below, please refer to the
17 discussion of these effects for winter-run Chinook (Impact AQUA-37 through Impact AQUA-42).

18 **Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon**
19 **(Fall-/Late Fall–Run ESU)**

20 The construction-related effects of Alternative 9 would be identical for all four Chinook salmon ESUs
21 and would be the same as those described for winter-run Chinook salmon under Alternative 9,
22 Impact AQUA-37.

23 *NEPA Effects:* As concluded under Alternative 9, Impact AQUA-37, environmental commitments and
24 mitigation measures would be available to avoid and minimize potential effects, and the effect would
25 not be adverse for Chinook salmon.

26 *CEQA Conclusion:* As described in Alternative 9, Impact AQUA-37, for winter-run Chinook salmon,
27 the impact of the construction of water conveyance facilities on Chinook salmon would be less than
28 significant except for construction noise associated with pile driving. There are more construction
29 sites where noise impacts would potentially occur under Alternative 9 than under Alternative 1A.
30 However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
31 reduce the noise impact on Chinook salmon to less than significant.

32 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
33 **of Pile Driving and Other Construction-Related Underwater Noise**

34 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

35 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
36 **and Other Construction-Related Underwater Noise**

37 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

1 **Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon**
2 **(Fall-/Late Fall-Run ESU)**

3 The maintenance-related effects of Alternative 9 would be identical for all four Chinook salmon
4 ESUs and would be the same as those described for winter-run Chinook salmon.

5 **NEPA Effects:** As concluded under Alternative 9, Impact AQUA-38 for winter-run Chinook salmon,
6 the effect would not be adverse for Chinook salmon.

7 **CEQA Conclusion:** As described in Alternative 9, Impact AQUA-38, the impact of the maintenance of
8 water conveyance facilities on Chinook salmon would be less than significant and no mitigation
9 would be required.

10 **Water Operations of CM1**

11 **Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late**
12 **Fall-Run ESU)**

13 Alternative 9 would substantially reduce entrainment losses of juvenile fall-run and late fall-run
14 Chinook salmon compared to baseline conditions due to screening which would exclude juvenile
15 Chinook salmon. San Joaquin River basin fall-run Chinook salmon juveniles would benefit from
16 isolating the fish migration corridor through Old River from the water conveyance corridor via the
17 Middle River. Rerouting Mokelumne River fall-run Chinook salmon juveniles through Lost Slough
18 and into the Sacramento River near Walnut Grove would reduce their potential to enter the water
19 conveyance channel at the mouth at the Middle River on the San Joaquin River and thus decrease
20 entrainment loss at the south Delta export facilities.

21 **Water Exports from SWP/CVP North Delta Intake Facilities**

22 Entrainment of fall-run Chinook salmon would be minimal because the north Delta intakes at
23 Georgiana Slough and DCC would be screened to exclude juvenile Chinook salmon. There would still
24 be a risk of injury from impingement associated with these north Delta intakes. Overall the impact
25 would be similar to those described for Alternative 1A, Impact AQUA-75.

26 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

27 Entrainment to the NBA would be the same as described for Alternative 1A, Impact AQUA-75. Since
28 Sacramento River basin juvenile fall-run Chinook salmon would be prevented from entering the
29 interior Delta via state-of-the-art fish screens at Georgiana Slough and DCC, fewer fish would be
30 exposed to entrainment loss to agricultural diversions in the Delta.

31 **Predation Associated with Entrainment**

32 The effects of predation associated with entrainment would be the same for all four ESUs. Please
33 refer to the discussion of predation in Alternative 1A, Impact AQUA-39 for winter-run Chinook
34 salmon. As discussed for Impact AQUA-39, the effect on Chinook salmon would not be adverse.

35 **NEPA Effects:** Overall, the effects of entrainment and entrainment-related predation would be
36 beneficial for fall- or late-fall run Chinook salmon.

1 **CEQA Conclusion:** The impact and conclusion would be the same as discussed immediately above
2 because entrainment would be substantially reduced. Thus the impact would be beneficial and no
3 mitigation would be required.

4 **Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
5 **Chinook Salmon (Fall-/Late Fall-Run ESU)**

6 In general, Alternative 9 would not affect the quantity and quality of spawning and egg incubation
7 habitat for fall-/late fall-run Chinook salmon relative to the NAA.

8 **Sacramento River**

9 *Fall-Run*

10 Sacramento River flows upstream of Red Bluff were examined for the October through January fall-
11 run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
12 *utilized in the Fish Analysis*). Flows under A9_LLTT would generally be greater than or similar to NAA
13 throughout the period, except during October (up to 13% lower) and in dry and critical years during
14 January (7% and 11% lower, respectively).

15 Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning
16 and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir
17 storage would be similar to storage under NAA in all water year types (Table 11-9-16).

18 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
19 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
20 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
21 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
22 between NAA and Alternative 9 in any month or water year type throughout the period.

23 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
24 increments was determined for each month during October through April and year of the 82-year
25 modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F
26 threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between
27 baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled
28 years are presented in Table 11-9-17. There would be 3 (33%) fewer years with a “yellow” level of
29 concern under Alternative 9 relative to NAA.

30 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
31 October through April. Total degree-days under Alternative 9 would be similar to those under NAA
32 throughout the period (Table 11-9-18).

33 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
34 Sacramento River under A9_LLTT would be lower than or similar to mortality under NAA in all water
35 year types (Table 11-9-29). These results indicate that climate change would increase fall-run
36 Chinook salmon egg mortality, but Alternative 9 would have negligible effects.

1 **Table 11-9-29. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
2 **Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	9 (97%)	-0.2 (-1%)
Above Normal	10 (95%)	-1 (-3%)
Below Normal	11 (102%)	-0.3 (-1%)
Dry	17 (114%)	0 (0%)
Critical	10 (34%)	0.3 (1%)
All	11 (82%)	-0.2 (-1%)

3
4 SacEFT predicts that there would be a 20% increase in the percentage of years with good spawning
5 availability for fall-run Chinook salmon, measured as weighted usable area, under A9_LLT relative to
6 NAA (Table 11-9-30). SacEFT predicts that there would be a 12% reduction in the percentage of
7 years with good (lower) redd scour risk under A9_LLT relative to NAA. SacEFT predicts that there
8 would be a negligible difference between A9_LLT and NAA. SacEFT predicts that there would be
9 negligible changes in the percentage of years with good (lower) redd dewatering risk under A9_LLT
10 relative to NAA.

11 **Table 11-9-30. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
12 **for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-6 (-13%)	7 (20%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-23 (-24%)	2 (3%)
Redd Dewatering Risk	1 (4%)	1 (4%)
Juvenile Rearing WUA	7 (21%)	0 (0%)
Juvenile Stranding Risk	-11 (-33%)	2 (10%)

WUA = Weighted Usable Area.

13
14 *Late Fall-Run*

15 Sacramento River flows upstream of Red Bluff were examined for the February through May late
16 fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model*
17 *Results utilized in the Fish Analysis*). Flows under A9_LLT would be greater than or similar to flows
18 under NAA throughout the period.

19 Shasta Reservoir storage at the end of September would affect flows during the late fall-run
20 spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta
21 Reservoir storage under A9_LLT would be similar to storage under NAA in all water year types
22 (Table 11-9-16).

23 The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the
24 Sacramento River under A9_LLT would be similar to mortality under NAA in all water
25 years, including below normal water years in which, although there would be a 5% relative increase,
26 the absolute increase would be <1% of the late fall-run population (Table 11-9-31).

1 **Table 11-9-31. Difference and Percent Difference in Percent Mortality of Late Fall–Run Chinook**
2 **Salmon Eggs in the Sacramento River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	4 (206%)	-0.05 (-1%)
Above Normal	4 (162%)	-1 (-9%)
Below Normal	4 (290%)	0.3 (5%)
Dry	5 (188%)	0.2 (3%)
Critical	3 (151%)	0.1 (2%)
All	4 (197%)	0 (0%)

3
4 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
5 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix
6 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
7 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
8 between NAA and Alternative 9 in any month or water year type throughout the period.

9 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
10 increments was determined for each month during October through April and year of the 82-year
11 modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F
12 threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between
13 baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled
14 years are presented in Table 11-9-17. There would be 6 (14%) and 4 (50%) fewer years with a “red”
15 and “yellow” level of concern, respectively, under Alternative 9 relative to NAA.

16 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
17 October through April. Total degree-days under Alternative 9 would be similar to those under NAA
18 during all months of the period (Table 11-9-18).

19 SacEFT predicts a negligible difference under A9_LLT relative to NAA in the percentage of years with
20 good spawning availability for late fall–run Chinook salmon, measured as weighted usable area,
21 (Table 11-9-32). SacEFT predicts that there would be no difference in the percentage of years with
22 good egg incubation conditions between A9_LLT and NAA. SacEFT predicts that there would be 5%
23 more years with good conditions relative to NAA.

24 **Table 11-9-32. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
25 **for Late Fall–Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Spawning WUA	-3 (-6%)	1 (2%)
Redd Scour Risk	-6 (-7%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-2 (-3%)	3 (5%)
Juvenile Rearing WUA	12 (27%)	-6 (-10%)
Juvenile Stranding Risk	-26 (-36%)	0 (0%)

WUA = Weighted Usable Area.

26

1 **Clear Creek**

2 No water temperature modeling was conducted in Clear Creek.

3 **Fall-Run**

4 Clear Creek flows below Whiskeytown Reservoir were examined for the September through
5 February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
6 *Model Results utilized in the Fish Analysis*). Flows under A9_LLT would always be similar to or
7 greater than flows under NAA throughout the period.

8 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
9 flow reduction each month over the incubation period compared to the flow in September when
10 spawning is assumed to occur. The magnitude of the greatest monthly reduction in Clear Creek
11 flows during September through February under A9_LLT would be similar to or lower than the
12 reduction under NAA for all water year types (Table 11-9-33).

13 **Table 11-9-33. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
14 **in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through**
15 **February Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	0 (NA)	0 (NA)
Above Normal	-27 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	66 (99%)	99 (99%)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

16

17 **Feather River**

18 **Fall-Run**

19 Flows in the Feather River in the low-flow and high-flow channels were examined for the October
20 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C,
21 *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A9_LLT
22 would be identical to those under NAA. Flows in the high-flow channel under A9_LLT would
23 generally be lower than those under NAA during October (up to 14% lower), and generally similar
24 to or greater than flows under NAA during the rest of the period, except for above normal water
25 years during November and December (10% and 9% lower, respectively) and in critical water years
26 during November and January (6% and 22% lower, respectively).

27 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
28 comparing the magnitude of flow reduction each month over the incubation period compared to the
29 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during
30 November through January were identical between A9_LLT and NAA (Appendix 11C, *CALSIM II*

1 *Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 9 on
2 redd dewatering in the Feather River low-flow channel.

3 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow
4 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October
5 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,
6 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
7 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
8 NAA and Alternative 9 in any month or water year type throughout the period at either location.

9 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley
10 was evaluated during October through April (Table 11-9-34). The percent of months exceeding the
11 threshold under Alternative 9 would similar to or up to 10% lower (absolute scale) than the percent
12 under NAA.

13 **Table 11-9-34. Differences between Baseline and Alternative 9 Scenarios in Percent of Months**
14 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
15 **River at Gridley Exceed the 56°F Threshold, October through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LL1					
October	2 (3%)	12 (14%)	21 (29%)	43 (106%)	58 (313%)
November	52 (1,400%)	36 (2,900%)	25 (NA)	12 (NA)	4 (NA)
December	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	2 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	27 (367%)	16 (433%)	7 (600%)	6 (NA)	4 (NA)
April	12 (18%)	17 (30%)	35 (112%)	32 (186%)	20 (178%)
NAA vs. A9_LL1					
October	0 (0%)	-1 (-1%)	-2 (-3%)	-5 (-6%)	-1 (-2%)
November	-6 (-10%)	-4 (-9%)	-7 (-23%)	-6 (-33%)	-2 (-40%)
December	0 (0%)	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-1 (-33%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-22%)	-9 (-30%)	-2 (-22%)	-1 (-17%)	0 (0%)
April	-7 (-8%)	-6 (-8%)	-7 (-10%)	-10 (-17%)	-7 (-19%)
NA = could not be calculated because the denominator was 0.					

16
17 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during
18 October through April (Table 11-9-35). Total degree-months would be similar between NAA and
19 Alternative 9 for all months of the period.

1
2
3

Table 11-9-35. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at Gridley, October through April

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
October	Wet	100 (137%)	-2 (-1%)
	Above Normal	37 (84%)	1 (1%)
	Below Normal	48 (87%)	-1 (-1%)
	Dry	72 (136%)	1 (1%)
	Critical	46 (112%)	2 (2%)
	All	304 (114%)	2 (0.4%)
November	Wet	38 (NA)	1 (3%)
	Above Normal	22 (1,100%)	3 (14%)
	Below Normal	22 (2,200%)	1 (5%)
	Dry	28 (NA)	-3 (-10%)
	Critical	20 (2,000%)	2 (11%)
	All	131 (3,275%)	5 (4%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	-1 (-50%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	1 (NA)	-1 (-50%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	2 (NA)	0 (0%)
	All	3 (NA)	0 (0%)
March	Wet	5 (NA)	0 (0%)
	Above Normal	3 (300%)	1 (33%)
	Below Normal	19 (1,900%)	-2 (-9%)
	Dry	23 (575%)	0 (0%)
	Critical	17 (425%)	0 (0%)
	All	67 (670%)	-1 (-1%)
April	Wet	36 (257%)	-2 (-4%)
	Above Normal	25 (109%)	-2 (-4%)
	Below Normal	23 (58%)	-2 (-3%)
	Dry	41 (84%)	0 (0%)
	Critical	30 (103%)	-1 (-2%)
	All	154 (99%)	-8 (-3%)

NA = could not be calculated because the denominator was 0.

4

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
2 Feather River under A9_LLТ would be similar to mortality under NAA in all water years (Table 11-9-
3 36).

4 **Table 11-9-36. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
5 **Eggs in the Feather River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
Wet	20 (1,436%)	1 (4%)
Above Normal	12 (1,094%)	0 (0%)
Below Normal	13 (736%)	0 (0%)
Dry	19 (875%)	1 (3%)
Critical	24 (492%)	1 (2%)
All	18 (858%)	0 (2%)

6

7 ***American River***

8 *Fall-Run*

9 Flows in the American River at the confluence with the Sacramento River were examined during the
10 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A9_LLТ would generally be similar to or
12 greater than flows under NAA, except for during the month of October (up to 18% lower), above
13 normal water years during November (5% lower) and dry water years during January (5% lower).

14 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
15 during the October through January fall-run Chinook salmon spawning and egg incubation period
16 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
17 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
18 temperature between NAA and Alternative 9 in any month or water year type throughout the
19 period.

20 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
21 Avenue Bridge was evaluated during November through April (Table 11-9-37). The percent of
22 months exceeding the threshold under Alternative 9 would similar to or up to 10% lower (absolute
23 scale) than the percent under NAA.

1 **Table 11-9-37. Differences between Baseline and Alternative 9 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**
 3 **River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LL1					
November	47 (103%)	52 (191%)	53 (391%)	47 (1,900%)	33 (2,700%)
December	1 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	2 (NA)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
March	27 (220%)	15 (200%)	11 (450%)	9 (700%)	5 (NA)
April	25 (35%)	25 (40%)	26 (57%)	30 (92%)	25 (91%)
NAA vs. A9_LL1					
November	0 (0%)	-6 (-7%)	-7 (-10%)	-7 (-13%)	-6 (-15%)
December	0 (0%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	-1 (-33%)	0 (0%)	0 (NA)	0 (NA)	0 (NA)
March	-10 (-20%)	-10 (-31%)	-2 (-15%)	-2 (-20%)	0 (0%)
April	-1 (-1%)	-6 (-7%)	-9 (-11%)	-10 (-14%)	-5 (-9%)

NA = could not be calculated because the denominator was 0.

4
 5 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
 6 Avenue Bridge during November through April (Table 11-9-38). Total degree-months would be
 7 similar between NAA and Alternative 9 for all months.

1 **Table 11-9-38. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the American River at the Watt Avenue Bridge, November through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
November	Wet	82 (328%)	0 (0%)
	Above Normal	32 (291%)	-4 (-9%)
	Below Normal	45 (563%)	2 (4%)
	Dry	53 (408%)	2 (3%)
	Critical	38 (238%)	0 (0%)
	All	251 (344%)	1 (0%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	2 (NA)	0 (0%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	4 (NA)	0 (0%)
	All	4 (NA)	0 (0%)
March	Wet	10 (500%)	-2 (-14%)
	Above Normal	9 (NA)	0 (0%)
	Below Normal	11 (367%)	0 (0%)
	Dry	24 (600%)	-1 (-3%)
	Critical	19 (190%)	-1 (-3%)
	All	73 (384%)	-4 (-4%)
April	Wet	57 (204%)	-1 (-1%)
	Above Normal	33 (150%)	-1 (-2%)
	Below Normal	39 (108%)	-2 (-3%)
	Dry	43 (57%)	-2 (-2%)
	Critical	36 (61%)	1 (1%)
	All	208 (94%)	-5 (-1%)

NA = could not be calculated because the denominator was 0.

4
 5 The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by
 6 comparing the magnitude of flow reduction each month over the incubation period compared to the
 7 flow in October when spawning is assumed to occur. The greatest monthly reduction in American
 8 River flows during November through January under A9_LLТ would be 7% to 9% greater in

1 magnitude than under NAA in dry and critical water years and lower in magnitude in other water
2 years (Table 11-9-39).

3 **Table 11-9-39. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change)**
4 **in Instream Flow in the American River at Nimbus Dam during the October through January**
5 **Spawning and Egg Incubation Period^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-16 (-73%)	9 (19%)
Above Normal	15 (50%)	25 (63%)
Below Normal	-11 (-59%)	16 (34%)
Dry	-1 (-2%)	-3 (-7%)
Critical	8 (15%)	-4 (-9%)

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

6
7 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
8 American River under A9_LLT would be similar to mortality under NAA in all water years (Table 11-
9 9-40).

10 **Table 11-9-40. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon**
11 **Eggs in the American River (Egg Mortality Model)**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	24 (159%)	0.4 (1%)
Above Normal	23 (219%)	1 (2%)
Below Normal	23 (184%)	1 (2%)
Dry	17 (103%)	1 (2%)
Critical	10 (47%)	0 (0%)
All	20 (132%)	0.4 (1%)

12
13 ***Stanislaus River***

14 ***Fall-Run***

15 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
16 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
17 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT would be similar to
18 flows under NAA throughout the period.

19 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 9
20 throughout the October through January period (Appendix 11D, Sacramento River Water Quality
21 Model and Reclamation Temperature Model Results utilized in the Fish Analysis).

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
3 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
4 *utilized in the Fish Analysis*). Flows under A9_LLТ would be similar to flows under NAA throughout
5 the period.

6 Water temperature modeling was not conducted in the San Joaquin River.

7 **Mokelumne River**

8 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
9 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
10 *utilized in the Fish Analysis*). Flows under A9_LLТ would be similar to flows under NAA throughout
11 the period.

12 Water temperature modeling was not conducted in the Mokelumne River.

13 **NEPA Effects:** Collectively, it is concluded that the effect would not be adverse because habitat
14 conditions are not substantially reduced. There are no reductions in flows under Alternative 9 or
15 increases in temperatures that would translate into adverse biological effects on fall-run Chinook
16 salmon.

17 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of spawning
18 and egg incubation habitat for fall-/late fall-run Chinook salmon relative to Existing Conditions.

19 **Sacramento River**

20 *Fall-Run*

21 Flows in the Sacramento River upstream of Red Bluff were examined during the October through
22 January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
23 *Model Results utilized in the Fish Analysis*). Flows under A9_LLТ would generally be greater than or
24 similar to Existing Conditions throughout the period, except in above normal and critical water
25 years during October (10% and 11% lower, respectively) and in wet years during December (8%
26 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 Storage volume at the end of September would be 12% to 34% lower under A9_LLТ relative to
28 Existing Conditions (Table 11-9-16).

29 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
30 October through January fall-run Chinook salmon spawning and egg incubation period (Appendix
31 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
32 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
33 between Existing Conditions and Alternative 9 during the period, except during October, in which
34 temperatures would be 5% higher under Alternative 9.

35 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
36 increments was determined for each month during October through April and year of the 82-year
37 modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F
38 threshold were further assigned a "level of concern", as defined in Table 11-9-9. Differences between
39 baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled

1 years are presented in Table 11-9-17. There would be 300% and 183% increases in the number of
2 years with “red” and “orange” levels of concern under Alternative 9 relative to Existing Conditions.

3 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
4 October through April. Total degree-days under Alternative 9 would be 228% to 3,538% higher than
5 those under Existing Conditions during October, November, March, and April, and similar during
6 December through February (Table 11-9-18). The Reclamation egg mortality model predicts that fall-
7 run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be 34% to 114%
8 greater than mortality under Existing Conditions, which is a 9% to 17% increase on an absolute
9 scale (Table 11-9-29).

10 SacEFT predicts that there would be a 13% decrease in the percentage of years with good spawning
11 availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table
12 11-9-30). SacEFT predicts that there would be a 5% reduction in the percentage of years with good
13 (lower) redd scour risk under A9_LLT relative to Existing Conditions. SacEFT predicts that there
14 would be a 24% decrease in the percentage of years with good (lower) egg incubation conditions
15 under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a 4% increase in
16 the percentage of years with good (lower) redd dewatering risk under A9_LLT relative to Existing
17 Conditions.

18 *Late Fall-Run*

19 Flows in the Sacramento River upstream of Red Bluff were examined during the February through
20 May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*
21 *Model Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be greater than or
22 similar to flows under Existing Conditions, except in below normal years during March (11% lower)
23 and wet years during May (20% lower).

24 Storage volume at the end of September would be 12% to 34% lower under A9_LLT relative to
25 Existing Conditions (Table 11-9-16).

26 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
27 February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix
28 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
29 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
30 between Existing Conditions and Alternative 9 in any month or water year type throughout the
31 period.

32 The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F
33 increments was determined for each month during October through April and year of the 82-year
34 modeling period (Table 11-9-8). The combination of number of days and degrees above the 56°F
35 threshold were further assigned a “level of concern”, as defined in Table 11-9-9. Differences between
36 baselines and Alternative 9 in the highest level of concern across all months and all 82 modeled
37 years are presented in Table 11-9-17. There would be 300% and 183% increases in the number of
38 years with “red” and “orange” levels of concern under Alternative 9 relative to Existing Conditions.

39 Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during
40 October through April. Total degree-days under Alternative 9 would be 228% to 3,538% higher than
41 those under Existing Conditions during October, November, March, and April, and similar during
42 December through February (Table 11-9-18). The Reclamation egg mortality model predicts that late
43 fall–run Chinook salmon egg mortality in the Sacramento River under A9_LLT would be 151% to

1 290% greater than mortality under Existing Conditions (Table 11-9-31). However, absolute
2 differences in the percent of the late-fall population subject to mortality would be negligible in all
3 but dry years, in which there is a 5% increase.

4 SacEFT predicts that there would be a 6% decrease in the percentage of years with good spawning
5 availability, measured as weighted usable area, under A9_LLT relative to Existing Conditions (Table
6 11-9-32). SacEFT predicts that there would be a 7% decrease in the percentage of years with good
7 (lower) redd scour risk under A9_LLT relative to Existing Conditions. SacEFT predicts that there
8 would be no difference in the percentage of years with good (lower) egg incubation conditions
9 under A9_LLT relative to Existing Conditions. SacEFT predicts that there would be a negligible
10 difference in the percentage of years with good (lower) redd dewatering risk between A9_LLT and
11 Existing Conditions.

12 **Clear Creek**

13 No water temperature modeling was conducted in Clear Creek.

14 *Fall-Run*

15 Flows in Clear Creek below Whiskeytown Reservoir under A9_LLT during the September through
16 February fall-run spawning and egg incubation period would nearly always be similar to or greater
17 than flows under Existing Conditions, except in critical water years during November (6% lower).

18 The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of
19 flow reduction each month over the incubation period compared to the flow in September when
20 spawning occurred. The greatest monthly reduction in Clear Creek flows during September through
21 February under A9_LLT would be similar to or of lower magnitude than those under Existing
22 Conditions in wet, below normal, and critical water year types and 27% and 67% lower than
23 Existing Conditions in above normal and dry water year types, respectively (Table 11-9-33).

24 **Feather River**

25 *Fall-Run*

26 Flows in the low-flow channel during October through January under A9_LLT would be identical to
27 those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
28 Flows in the high-flow channel under A9_LLT would generally be lower by up to 43% than flows
29 under Existing Conditions throughout the period.

30 The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by
31 comparing the magnitude of flow reduction each month over the incubation period compared to the
32 flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were
33 identical between A9_LLT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in*
34 *the Fish Analysis*). Therefore, there would be no effect of Alternative 9 on redd dewatering in the
35 Feather River low-flow channel.

36 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
37 Feather River under A9_LLT would be 492% to 1,436% greater than mortality under Existing
38 Conditions (Table 11-9-36).

39 Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow
40 channel) and below Thermalito Afterbay (high-flow channel) were examined during the October

1 through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D,
2 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
3 *Fish Analysis*). Mean monthly water temperatures under Alternative 9 relative to Existing Conditions
4 would be 7% to 10% higher in the low-flow channel and 6% to 8% higher in the high-flow channel,
5 depending on month.

6 The percent of months exceeding the 56°F temperature threshold in the Feather River at Gridley
7 was evaluated during October through April (Table 11-9-34). The percent of months exceeding the
8 threshold under Alternative 9 would similar to or up to 58% higher (absolute scale) than the
9 percent under Existing Conditions during all months except December through February, during
10 which there would be no difference in the percent of months exceeding the threshold.

11 Total degree-months exceeding 56°F were summed by month and water year type at Gridley during
12 October through April (Table 11-9-35). Total degree-months under Alternative 9 would be 99% to
13 3,275% higher than total degree-months under Existing Conditions, except during December
14 through February, when there would be no differences.

15 **American River**

16 *Fall-Run*

17 Flows in the American River at the confluence with the Sacramento River were examined during the
18 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
19 *Model Results utilized in the Fish Analysis*). Flows under A9_LL1T would generally be lower than flows
20 under Existing Conditions throughout the period (up to 28% lower).

21 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
22 during the October through January fall-run Chinook salmon spawning and egg incubation period
23 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
24 *utilized in the Fish Analysis*). Mean monthly temperatures under Alternative 9 would be 5% to 12%
25 greater than those under Existing Conditions depending on month.

26 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
27 Avenue Bridge was evaluated during November through April (Table 11-9-37). The percent of
28 months exceeding the threshold under Alternative 9 would be up to 52% greater (absolute scale)
29 than the percent under Existing Conditions during November, March, and April and similar to the
30 percent under Existing Conditions during December through February.

31 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
32 Avenue Bridge during November through April (Table 11-9-38). Total degree-months under
33 Alternative 9 would be 94% to 384% greater than total degree-months under Existing Conditions
34 during November, March and April and similar to total degree months under Existing Conditions
35 during December through February. The potential risk of redd dewatering in the American River at
36 Nimbus Dam was evaluated by comparing the magnitude of flow reduction each month over the
37 incubation period compared to the flow in October when spawning is assumed to occur. The
38 greatest monthly reduction in American River flows during October through January under A9_LL1T
39 would be of lower magnitude in all water year types other than above normal years, in which the
40 magnitude of the greatest monthly reduction would be 50% greater under A9_LL1T than under
41 Existing Conditions.

1 The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the
2 American River under A9_LLТ would be 47% to 219% greater than mortality under Existing
3 Conditions, which would be 10% to 24% higher on an absolute scale (Table 11-9-40).

4 **Stanislaus River**

5 *Fall-Run*

6 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
7 October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II*
8 *Model Results utilized in the Fish Analysis*). Flows under A9_LLТ would generally be lower by up to
9 16% than those under Existing Conditions throughout the period.

10 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were
11 examined during the October through January fall-run spawning and egg incubation period
12 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
13 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would not be
14 different from those under Existing Conditions during October, but 6% higher during November
15 through January.

16 **San Joaquin River**

17 Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run
18 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
19 *utilized in the Fish Analysis*). Flows under A9_LLТ would be up to 8% lower than Existing Conditions
20 in most water years during October, similar to Existing Conditions in November and December
21 (each month with one water year greater than 5% lower), and up to 11% higher than Existing
22 Conditions during January.

23 Water temperature modeling was not conducted in the San Joaquin River.

24 **Mokelumne River**

25 Flows in the Mokelumne River at the Delta were examined for the October through January fall-run
26 Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results*
27 *utilized in the Fish Analysis*). Flows under A9_LLТ would be up to 14% lower than flows under
28 Existing Conditions during October and November, up to 15% greater than flows under Existing
29 Conditions during December, and similar to flows under Existing Conditions during January.

30 Water temperature modeling was not conducted in the Mokelumne River.

31 **Summary of CEQA Conclusion**

32 Collectively, the results of the Impact AQUA-76 CEQA analysis indicate that the difference between
33 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
34 alternative could substantially reduce the amount of suitable habitat for fish, contrary to the NEPA
35 conclusion set forth above. There would be flow reductions and water temperature increases under
36 Alternative 9 in the Sacramento, Feather and American Rivers that would affect the fall-run
37 population. Further, the Reclamation egg mortality model and SacEFT predict moderate to
38 substantial negative effects of Alternative 9 on fall-run Chinook salmon.

1 These results are primarily caused by four factors: differences in sea level rise, differences in climate
2 change, future water demands, and implementation of the alternative. The analysis described above
3 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
4 alternative from those of sea level rise, climate change and future water demands using the model
5 simulation results presented in this chapter. However, the increment of change attributable to the
6 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
7 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
8 implementation period, which does include future sea level rise, climate change, and water
9 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
10 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
11 effect of the alternative from those of sea level rise, climate change, and water demands.

12 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
13 term implementation period and Alternative 9 indicates that flows in the locations and during the
14 months analyzed above would generally be similar between Existing Conditions during the LLT and
15 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
16 found above would generally be due to climate change, sea level rise, and future demand, and not
17 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
18 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
19 result in a significant impact on spawning habitat for fall-/late fall-run Chinook salmon. This impact
20 is found to be less than significant and no mitigation is required.

21 **Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon** 22 **(Fall-/Late Fall-Run ESU)**

23 In general, Alternative 9 would not affect the quantity and quality of larval and juvenile rearing
24 habitat for fall-/late fall-run Chinook salmon relative to the NAA.

25 ***Sacramento River***

26 *Fall-Run*

27 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
28 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*). Flows in the Sacramento River upstream of Red Bluff under A9_LL T would generally be
30 greater than or similar to flows under NAA, except in dry and critical water years during January
31 (7% and 11% lower, respectively).

32 Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and
33 juvenile rearing period. As reported in Impact AQUA-156, end of September Shasta Reservoir
34 storage would be similar to storage under NAA in all water year types (Table 11-9-16).

35 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
36 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
37 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
38 There would be no differences (<5%) in mean monthly water temperature between NAA and
39 Alternative 9 in any month or water year type throughout the period.

40 SacEFT predicts that the percentage of years with good juvenile rearing availability for fall-run
41 Chinook salmon, measured as weighted usable area, under A9_LL T would be identical to the
42 percentage of years under NAA (Table 11-9-30). SacEFT predicts that there would be a 10%

1 increase in the percentage of years with “good” (lower) juvenile stranding risk under A9_LLT
2 relative to NAA.

3 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A9_LLT would be
4 similar to mortality under NAA.

5 *Late Fall-Run*

6 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run
7 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
8 *Analysis*). Flows throughout the year under A9_LLT would be generally similar to or greater than
9 those under NAA, except during October (up to 13% lower) and exceptions in some water years
10 during the rest of the period (up to 21% lower).

11 Shasta Reservoir storage at the end of September and May would affect flows during the late fall–
12 run larval and juvenile rearing period. As reported in Impact AQUA-58, end of September Shasta
13 Reservoir storage would be similar to storage under NAA in all water year types (Table 11-9-16).

14 As reported in Impact AQUA-40, Shasta storage at the end of May under A9_LLT would be similar to
15 storage under NAA in all water year types (Table 11-9-7).

16 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
17 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
18 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
19 There would be no differences (<5%) in mean monthly water temperature between NAA and
20 Alternative 9 in any month or water year type throughout the period. SacEFT predicts that there
21 would be a 10% decrease in the percentage of years with good juvenile rearing availability for late
22 fall–run Chinook salmon, measured as weighted usable area, under A9_LLT relative to NAA (Table
23 11-9-32). SacEFT predicts that there would be no change relative to NAA.

24 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A9_LLT would
25 be similar to mortality under NAA.

26 **Clear Creek**

27 No water temperature modeling was conducted in Clear Creek.

28 *Fall-Run*

29 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall–
30 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
31 *Analysis*). Flows under A9_LLT would nearly always be similar to or greater than flows under NAA,
32 except in below normal water years during March (6% lower).

33 **Feather River**

34 *Fall-Run*

35 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
36 channel) during December through June were reviewed to determine flow-related effects on larval
37 and juvenile fall–run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
38 *Analysis*). Relatively constant flows in the low-flow channel throughout this period under A9_LLT
39 would not differ from those under NAA. In the high-flow channel, flows under A9_LLT would be

1 mostly similar to or greater than flows under NAA during December through June with some
2 exceptions during which flows would be up to 22% lower under A9_LLТ.

3 As reported in Impact AQUA-59, May Oroville storage volume under A9_LLТ would be similar to
4 storage under NAA, indicating that the difference relative to NAA is primarily a result of climate
5 change (Table 11-9-25).

6 As reported in Impact AQUA-58, September Oroville storage volume would be similar to that under
7 NAA in all water year types (Table 11-9-22).

8 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
9 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run
10 Chinook salmon juvenile rearing period (Appendix 11D, Sacramento River Water Quality Model and
11 Reclamation Temperature Model Results utilized in the Fish Analysis). There would be no
12 differences (<5%) in mean monthly water temperature between NAA and Alternative 9 in any
13 month or water year type throughout the period at either location.

14 **American River**

15 *Fall-Run*

16 Flows in the American River at the confluence with the Sacramento River were examined for the
17 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
18 *Results utilized in the Fish Analysis*). Flows under A9_LLТ would nearly always be similar to or
19 greater than flows under NAA except in dry years during January and critical years during April (5%
20 lower for both).

21 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined
22 during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D,
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
25 NAA and Alternative 9 in any month or water year type throughout the period.

26 **Stanislaus River**

27 *Fall-Run*

28 Flows in the Stanislaus River at the confluence with the Sacramento River for Alternative 9 are not
29 different from those under NAA, for the January through May fall-run Chinook salmon juvenile
30 rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA
32 and Alternative 9 throughout the January through May fall-run rearing period (Appendix 11D,
33 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
34 *Fish Analysis*).

35 **San Joaquin River**

36 Flows in the San Joaquin River at Vernalis for Alternative 9 are not different from those under NAA,
37 for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II*
38 *Model Results utilized in the Fish Analysis*).

39 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 **Mokelumne River**

3 Flows in the Mokelumne River at the Delta for Alternative 9 are not different from those under NAA,
4 for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II*
5 *Model Results utilized in the Fish Analysis*).

6 Water temperature modeling was not conducted in the Mokelumne River.

7 **NEPA Effects:** Taken together, these results indicate that the effect would not be adverse because it
8 does not have the potential to substantially reduce the amount of suitable habitat for fish. Changes
9 in flow rates and water temperatures are generally small and infrequent under Alternative 9.
10 Therefore, there would be no biologically meaningful effects to fall-run Chinook salmon.

11 **CEQA Conclusion:** In general, the quantity and quality of larval and juvenile rearing habitat for fall-
12 /late fall-run Chinook salmon would not be affected by Alternative 9, relative to the CEQA baseline.

13 **Sacramento River**

14 *Fall-Run*

15 Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run
16 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
17 *Analysis*). Flows under A9_LLTP would almost always be greater than or similar to flows under
18 Existing Conditions, except in below normal water years during March (11% lower) and wet water
19 years during May (20% lower).

20 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 34%
21 lower under A9_LLTP relative to Existing Conditions, depending on water year type (Table 11-9-16).

22 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
23 January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
24 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
25 There would be no differences (<5%) in mean monthly water temperature between Existing
26 Conditions and Alternative 9 in any month or water year type throughout the period.

27 SacEFT predicts that there would be a 21% increase in the percentage of years with good juvenile
28 rearing availability for fall-run Chinook salmon, measured as weighted usable area, under A9_LLTP
29 relative to Existing Conditions (Table 11-9-30). SacEFT predicts that there would be a 33%
30 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A9_LLTP
31 relative to Existing Conditions.

32 SALMOD predicts that fall-run smolt equivalent habitat-related mortality under A9_LLTP would be
33 7% lower than mortality under Existing Conditions.

34 *Late Fall-Run*

35 Sacramento River flows upstream of Red Bluff were examined for the March through July late fall-
36 run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the*
37 *Fish Analysis*). Flows during the period would generally be similar to or greater than those under
38 Existing Conditions, except in wet water years during May (20% lower).

1 Year-round Sacramento River flows upstream of Red Bluff were examined for the late fall–run
2 Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
3 *Analysis*). Flows throughout the period under A9_LLT were generally similar to or greater than those
4 under Existing Conditions, with some exceptions (up to 25% lower).

5 As reported in Impact AQUA-58, end of September Shasta Reservoir storage would be 12% to 34%
6 lower under A9_LLT relative to Existing Conditions, depending on water year type (Table 11-9-16).

7 As reported in Impact AQUA-40, end of May Shasta storage under A9_LLT would be similar to
8 Existing Conditions in wet and above normal water years, but lower by 6% to 24% in all other water
9 years (Table 11-9-7).

10 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
11 March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*
12 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
13 There would be no differences (<5%) in mean monthly water temperature between Existing
14 Conditions and Alternative 9 in any month or water year type throughout the period.

15 SacEFT predicts that there would be a 27% increase in the percentage of years with good juvenile
16 rearing availability for late fall–run Chinook salmon, measured as weighted usable area, under
17 A9_LLT relative to Existing Conditions (Table 11-9-32). SacEFT predicts that there would be a 36%
18 reduction in the percentage of years with “good” (lower) juvenile stranding risk under A9_LLT
19 relative to Existing Conditions.

20 SALMOD predicts that late fall–run smolt equivalent habitat-related mortality under A9_LLT would
21 be 6% higher than mortality under Existing Conditions.

22 **Clear Creek**

23 No temperature modeling was conducted in Clear Creek.

24 *Fall-Run*

25 Flows in Clear Creek below Whiskeytown Reservoir were examined the January through May fall-
26 run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
27 *Analysis*). Flows under A9_LLT would be similar to or greater than flows under Existing Conditions
28 for the entire period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

29 **Feather River**

30 *Fall-Run*

31 Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow
32 channel) during December through June were reviewed to determine flow-related effects on larval
33 and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
34 *Analysis*). Relatively constant flows in the low-flow channel throughout the period under A9_LLT
35 would not differ from those under Existing Conditions. In the high-flow channel, flows under A9_LLT
36 would be mostly lower (up to 55%) during December through February and generally similar to or
37 greater than flows under Existing Conditions during the rest of the period, except in below normal
38 and dry years during March (39% and 18% lower, respectively) and wet years during May and June
39 (35% and 21% lower, respectively).

1 As reported under Impact AQUA-59, May Oroville storage volume under A9_LLT would be lower
2 than Existing Conditions by 5% to 20% depending on water year type, except in wet years, in which
3 storage would be similar to Existing Conditions (Table 11-9-25).

4 As reported in Impact AQUA-58, September Oroville storage volume would be 21% to 35% lower
5 under A9_LLT relative to Existing Conditions depending on water year type (Table 11-9-22).

6 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
7 Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run
8 Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and*
9 *Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean
10 monthly water temperatures under Alternative 9 would be 5% to 10% higher than those under
11 Existing Conditions during December through March, but not different from those under Existing
12 Conditions during April through June. In the high-flow channel, mean monthly water temperatures
13 under Alternative 9 would be 5% to 8% higher than those under Existing Conditions during
14 December through February, but not different from those under Existing Conditions during March
15 through June.

16 **American River**

17 *Fall-Run*

18 Flows in the American River at the confluence with the Sacramento River were examined for the
19 January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model*
20 *Results utilized in the Fish Analysis*). Flows under A9_LLT would generally be lower during January
21 and May (up to 26% lower) and similar to or greater than flows under Existing Conditions during
22 the rest of the period, except in critical years during February (16% lower) and above normal years
23 during April (9% lower).

24 **Stanislaus River**

25 *Fall-Run*

26 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 9 would be
27 up to 36% lower than Existing Conditions in January through May fall-run larval and juvenile
28 rearing period in most water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
29 *Analysis*).

30 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
31 River were examined during the January through May fall-run Chinook salmon juvenile rearing
32 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
33 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would
34 be 6% higher than those under Existing Conditions in all months during the period.

35 **San Joaquin River**

36 Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run
37 Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in*
38 *the Fish Analysis*). Flows under A9_LLT would generally be similar to flows under Existing
39 Conditions during January and February and lower by up to 15% during March through May.

40 Water temperature modeling was not conducted in the San Joaquin River.

1 **Mokelumne River**

2 Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook
3 salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A9_LLТ would be similar to flows under Existing Conditions during January
5 through March and lower by up to 18% than flows under Existing Conditions during April and May.

6 Water temperature modeling was not conducted in the Mokelumne River.

7 **Summary of CEQA Conclusion**

8 Collectively, the results of the Impact AQUA-77 CEQA analysis indicate that the difference between
9 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
10 alternative could substantially reduce the amount of suitable habitat for fish, contrary to the NEPA
11 conclusion set forth above. Flow reductions in the Feather, American, and Stanislaus Rivers and
12 temperature increases in the Sacramento, Feather, and American Rivers would be sufficiently high
13 and frequent to cause biologically meaningful effects to fall-run Chinook salmon. Reductions in flows
14 and temperature increases in these rivers can alter the quantity and quality of habitat for rearing
15 larval and juvenile fall-run.

16 These results are primarily caused by four factors: differences in sea level rise, differences in climate
17 change, future water demands, and implementation of the alternative. The analysis described above
18 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
19 alternative from those of sea level rise, climate change and future water demands using the model
20 simulation results presented in this chapter. However, the increment of change attributable to the
21 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
22 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLТ
23 implementation period, which does include future sea level rise, climate change, and water
24 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
25 the LLТ, both of which include sea level rise, climate change, and future water demands, isolates the
26 effect of the alternative from those of sea level rise, climate change, and water demands.

27 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
28 term implementation period and Alternative 9 indicates that flows in the locations and during the
29 months analyzed above would generally be similar between Existing Conditions during the LLТ and
30 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
31 found above would generally be due to climate change, sea level rise, and future demand, and not
32 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
33 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
34 result in a significant impact on rearing habitat for fall-/late fall-run Chinook salmon. This impact is
35 found to be less than significant and no mitigation is required.

36 **Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon**
37 **(Fall-/Late Fall-Run ESU)**

38 In general, Alternative 9 would not affect migration conditions for fall-/late fall-run Chinook salmon
39 relative to the NAA.

1 **Upstream of the Delta**

2 ***Sacramento River***

3 ***Fall-Run***

4 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February
5 through May under A9_LLT would be similar to or greater than flows under NAA throughout the
6 February through May juvenile fall-run migration period regardless of water year type Appendix
7 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
9 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,
10 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
11 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
12 NAA and Alternative 9 in any month or water year type throughout the period.

13 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon
14 upstream migration period (September through October) under A9_LLT would always be similar to
15 or greater than those under NAA during September, but flows would generally be lower during
16 October (up to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
18 September through October adult fall-run Chinook salmon upstream migration period (Appendix
19 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
20 *the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature
21 between NAA and Alternative 9 in any month or water year type throughout the period.

22 ***Late Fall-Run***

23 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January
24 through March) under A9_LLT would generally be similar to or greater than flows under NAA,
25 except in dry and critical years during January compared to NAA (7% and 11% lower, respectively)
26 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

27 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
28 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,
29 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
30 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
31 NAA and Alternative 9 in any month or water year type throughout the period.

32 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon
33 upstream migration period (December through February) under A9_LLT would almost always be
34 similar to or greater than those under NAA, except in dry and critical years during January (11%
35 lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

36 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
37 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,
38 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
39 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
40 NAA and Alternative 9 in any month or water year type throughout the period.

1 **Clear Creek**

2 Water temperature modeling was not conducted in Clear Creek.

3 *Fall-Run*

4 Flows in the Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run
5 migrants during February through May. Flows under A9_LLT would nearly always be similar to or
6 greater than those under NAA, except in below normal years during March (6% lower).

7 Flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon
8 upstream migration period (September through October) under A9_LLT would generally be similar
9 to or greater than those under NAA, except in critical years during September (13% lower)
10 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 **Feather River**

12 *Fall-Run*

13 Flows in the Feather River at the confluence with the Sacramento River were examined during the
14 fall-run juvenile migration period (February through May). Flows under A9_LLT would nearly
15 always be similar to or greater than flows under NAA (Appendix 11C, *CALSIM II Model Results*
16 *utilized in the Fish Analysis*).

17 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
18 were examined during the February through May juvenile fall-run Chinook salmon migration period
19 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
20 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
21 temperature between NAA and Alternative 9 in any month or water year type throughout the
22 period.

23 Flows in the Feather River at the confluence with the Sacramento River were examined during the
24 September through October fall-run Chinook salmon adult migration period. Flows during
25 September under A9_LLT would generally be similar to or greater than flows under NAA. Flows
26 during October would generally be lower than those under NAA by up to 17% (Appendix 11C,
27 *CALSIM II Model Results utilized in the Fish Analysis*).

28 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
29 were examined during the September through October fall-run Chinook salmon adult upstream
30 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
31 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
32 mean monthly water temperature between NAA and Alternative 9 in any month or water year type
33 throughout the period.

34 **American River**

35 *Fall-Run*

36 Flows in the American River at the confluence with the Sacramento River were examined during the
37 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
38 *Model Results utilized in the Fish Analysis*). Flows under A9_LLT would nearly always be similar to or
39 greater than flows under NAA, except in critical years during April (5% lower). Mean monthly water
40 temperatures in the American River at the confluence with the Sacramento River were examined

1 during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,
2 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
3 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
4 NAA and Alternative 9 in any month or water year type throughout the period.

5 Flows in the American River at the confluence with the Sacramento River were examined during the
6 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
7 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLTP during September would
8 be similar to or greater than flows under NAA. Flows during October compared to NAA would be
9 generally lower during October (up to 18% lower) although 12% higher in dry years.

10 Mean monthly water temperatures in the American River at the confluence with the Sacramento
11 River were examined during the September and October adult fall-run Chinook salmon upstream
12 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
13 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
14 mean monthly water temperature between NAA and Alternative 9 in any month or water year type
15 throughout the period.

16 **Stanislaus River**

17 *Fall-Run*

18 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
19 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*
20 *Model Results utilized in the Fish Analysis*). Flows under A9_LLTP would be similar to those under NAA
21 in all months and water year types throughout the period.

22 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
23 River were examined during the February through March juvenile fall-run Chinook salmon
24 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
25 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
26 mean monthly water temperature between NAA and Alternative 9 in any month or water year type
27 throughout the period.

28 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
29 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
30 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLTP would be similar to those
31 under NAA in all months and water year types throughout the period.

32 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
33 River were examined during the September and October adult fall-run Chinook salmon upstream
34 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
35 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
36 mean monthly water temperature between NAA and Alternative 9 in any month or water year type
37 throughout the period.

38 **San Joaquin River**

39 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
40 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*

1 *Analysis*). Flows under A9_LLТ would be similar to those under NAA in all months and water year
2 types throughout the period.

3 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
4 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
5 *in the Fish Analysis*). Flows under A9_LLТ would be similar to those under NAA in all months and
6 water year types throughout the period.

7 Water temperature modeling was not conducted in the San Joaquin River.

8 **Mokelumne River**

9 Flows in the Mokelumne River at the Delta were examined during the February through May
10 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized*
11 *in the Fish Analysis*). Flows under A9_LLТ would be similar to those under NAA in all months and water
12 year types throughout the period.

13 Flows in the Mokelumne River at the Delta were examined during the September and October adult
14 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
15 *in the Fish Analysis*). Flows under A9_LLТ would be similar to those under NAA in all months and
16 water year types throughout the period. Flows under A9_LLТ would be similar to those under NAA
17 in all months and water year types throughout the period.

18 Water temperature modeling was not conducted in the Mokelumne River.

19 **Through-Delta**

20 **Sacramento River**

21 *Fall-Run*

22 *Juveniles*

23 Fall-run Chinook salmon juveniles typically migrate out as young-of-the-year fish, smaller than the
24 other runs. During the fall-run juvenile Chinook salmon outmigration (February–May), Sacramento
25 River flows at Rio Vista would generally be similar to NAA, although slightly decreased in April (6%
26 less) and May (7% less) when averaged across water year types. Screening of the DCC and
27 Georgiana Slough would prevent downstream migrating juveniles from entering the interior delta,
28 thereby improving migration success. Based on DPM modeling, through-Delta survival by
29 Sacramento River juvenile fall-run Chinook salmon under Alternative 9 would be 28% averaged
30 across years, an increase of 3.4% (14% relative increase) compared to NAA, with similar increases
31 in both wetter and drier water year types (Table 11-9-41).

1 **Table 11-9-41. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under**
2 **Alternative 9**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A9	EXISTING CONDITIONS vs. A9	NAA vs. A9
Sacramento River					
Wetter Years	34.5	31.1	35.0	0.5 (1%)	3.9 (13%)
Drier Years	20.6	20.8	23.9	3.3 (16%)	3.1 (15%)
All Years	25.8	24.7	28.1	2.3 (9%)	3.4 (14%)
Mokelumne River					
Wetter Years	17.2	15.7	14.6	-2.6 (-15%)	-1.2 (-7%)
Drier Years	15.6	15.9	15.2	-0.4 (-3%)	-0.8 (-5%)
All Years	16.2	15.9	14.9	-1.3 (-8%)	-0.9 (-6%)
San Joaquin River^a					

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

^a DPM results are anomalous for Alternative 9 San Joaquin River juveniles.

3

4 Predation losses of Sacramento juvenile fall-run Chinook associated with the Georgiana Slough and
5 DCC fish screens or with the fourteen operable barriers around the Delta are expected to be
6 minimal, as discussed above for Impact-AQUA-42. Overall, Alternative 9 would not have an adverse
7 effect on Sacramento River fall-run Chinook salmon survival due to expected slight increase in
8 through-Delta survival.

9 *Adults*

10 During the adult fall-run migration through the Delta from September-December, flows at Rio Vista
11 During the adult fall-run migration through the Delta from September-December, the proportion of
12 Sacramento River flows in the Delta decreased 5% to 9% compared to NAA (Table 11-9-15). The
13 reductions are small compared with the change in dilution (>20%) reported to cause a significant
14 change in migration by Fretwell (1989). Sacramento River flows would still represent 57% to 60%
15 of Delta outflows and would provide strong olfactory cues for adults from the Sacramento River.
16 Therefore the impact on adult fall-run upstream migration under Alternative 9 would not be
17 adverse.

18 *Late Fall Run*

19 *Juveniles*

20 During the late fall-run juvenile Chinook salmon outmigration through the Delta (October to
21 February), average flows at Rio Vista under Alternative 9 would be similar to NAA (<5% difference)
22 in November to February, and reduced 17% in October. Fish screens at the DCC and Georgiana
23 Slough would prevent late fall-run juveniles from leaving the Sacramento River and entering the
24 interior Delta. Migration routes through the interior Delta are associated with reduced survival for
25 tagged smolts (Perry et al. 2010). Based on the DPM, through-Delta survival by emigrating juvenile

1 spring-run Chinook salmon under Alternative 9 would average 28.2% across all years, which is 5.3%
2 greater (23% relative increase) compared to NAA (Table 11-9-42). Potential predation losses at the
3 fish screens at DCC and Georgiana Slough and at the fourteen operation barriers would be minor, as
4 described above in Impact AQUA-42.

5 In conclusion, the effect of Alternative 9 on migration success for late-fall juvenile salmon would not
6 be adverse.

7 **Table 11-9-42. Through-Delta Survival (%) of Emigrating Juvenile Late Fall–Run Chinook Salmon**
8 **under Alternative 9**

Year Type	Percentage Survival			Difference in Percentage Survival (Relative Difference)	
	EXISTING CONDITIONS	NAA	A9	EXISTING CONDITIONS vs. A9_LL1	NAA vs. A9
Wetter Years	28.8	27.3	33.3	4.6 (16%)	6.0 (22%)
Drier Years	18.8	20.2	25.2	6.4 (34%)	5.0 (25%)
All Years	22.5	22.9	28.2	5.7 (25%)	5.3 (23%)

Note: Delta Passage Model results for survival to Chipps Island.

Wetter = Wet and above normal water years (6 years).

Drier = Below normal, dry and critical water years (10 years).

9

10 *Adults*

11 The adult late fall–run migration is from November through March, peaking in January through
12 March. The proportion of Sacramento River water in the Delta would be reduced 7–10% relative to
13 NAA throughout the adult late fall–run migration period. As discussed in further detail in Impact
14 AQUA-42 for Alternative 1A, the proportion of Sacramento River flows in the Delta would still
15 represent 57–66% of Delta outflows, thus providing strong olfactory cues.

16 San Joaquin River

17 *Fall-Run*

18 *Juveniles*

19 Outmigration conditions for San Joaquin River basin fall-run Chinook salmon would be improved
20 relative to NAA. Flows in the Old River fish migration corridor would be isolated from the San
21 Joaquin River downstream of Old River and the Middle River water conveyance corridor eliminating
22 SWP/CVP entrainment risk for San Joaquin River basin outmigrating juvenile salmon. The greater
23 flows through the Old River compared to the NAA would increase outmigration speed, thus
24 improving through-Delta migration survival.

25 Juvenile salmon outmigrating via the Old River fish migration corridor would have a simplified
26 pathway for outmigration. Alternative migration routes into the interior Delta are minimized with
27 Alternative 9 since fish can't move down the San Joaquin River, or into Middle River from Old River
28 into the central Delta. Alternative 9 delivers outmigrating fall-run Chinook salmon to the western
29 Delta near Frank's Tract where the fish would then use Rock, Sandmound, Taylor or Dutch slough,
30 Franks Tract of False River to reach the San Joaquin River. The mouth of Old River would be gated
31 off under Alternative 9.

1 Although the Delta Passage Model is used to estimate through-Delta survival for most Chinook
2 salmon runs, it can be problematic applying the DPM to San Joaquin River salmon for certain
3 Alternatives and operations scenarios with highly reduced south Delta exports (such as Alternatives
4 6A, 7, 8 and 9). These issues are discussed further in Impact AQUA-78 under Alternative 6A. A
5 qualitative assessment is more appropriate given this modeling limitation. Under Alternative 9,
6 survival of juvenile fall-run Chinook salmon would be expected to be similar or greater compared to
7 NAA, given the elimination of south Delta exports that could entrain juveniles and the improved
8 migration corridor from the San Joaquin River.

9 Overall there would be a low risk of entrainment at the south Delta under Alternative 9 which would
10 substantially improve migration conditions for San Joaquin River basin Chinook salmon juveniles.
11 The effect would not be adverse.

12 *Adults*

13 The San Joaquin River basin fall-run Chinook salmon adult migration would be affected by the
14 change in operations under Alternative 9. Chinook salmon would generally be attracted to migrate
15 upstream through False River into the Old River fish migration corridor, because most of San
16 Joaquin River basin flows would be diverted into the Old River corridor under Alternative 9
17 increasing olfactory cues. The proportion of San Joaquin River basin water at Collinsville would be
18 increased relative to NAA, mainly due to the reduction in Sacramento River water. Thus the
19 olfactory cues for the San Joaquin basin would be strengthened under Alternative 9. For adult
20 Chinook salmon that do not migrate upstream along False River, they would migrate further
21 upstream into the San Joaquin River, where they could become stranded in the channel between
22 Stockton and Old River. They could potentially migrate into the Middle River water conveyance
23 pathway. Chinook salmon adults that migrate into the Middle River would be subject to entrainment
24 at the SWP/CVP south Delta facilities and would be returned to Old River. Overall there would be a
25 beneficial impact on the species because the majority of Chinook salmon would likely migrate
26 upstream along the Old River migration corridor which would be isolated from entrainment effects
27 at the south Delta export facilities.

28 **NEPA Effects:** The results of the Impact AQUA-78 NEPA analysis indicate no differences between
29 NAA and Alternative 9 effects related to location. Through-Delta conditions on the Sacramento River
30 would not substantially affect migration conditions relative to NAA. Similarly, through-Delta
31 conditions on the San Joaquin River and upstream of the Delta conditions relative to NAA would not
32 substantially affect migration. Collectively, these results indicate that the effect is not adverse in
33 these locations because it does not have the potential to substantially reduce migration habitat or
34 substantially interfere with the movement of fish. Flows and water temperatures during juvenile
35 and adult fall-/late fall-run Chinook salmon migration periods would be similar between Alternative
36 9 and the NEPA point of comparison in all evaluated upstream rivers, through Delta on the
37 Sacramento River and through Delta on the San Joaquin River.

38 **CEQA Conclusion:**

39 **Upstream of the Delta**

40 In general, Alternative 9 would not reduce migration conditions for fall-/late fall-run Chinook
41 salmon relative to Existing Conditions.

1 **Sacramento River**

2 *Fall-Run*

3 Flows in the Sacramento River upstream of Red Bluff for juvenile fall-run migrants during February
4 through May under A9_LLTT would nearly always be similar to or greater than those under Existing
5 Conditions, except in below normal water years during March (11% lower) and wet water years
6 during May (20% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

7 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
8 February through May juvenile fall-run Chinook salmon migration period (Appendix 11D,
9 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
10 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
11 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

12 Flows in the Sacramento River upstream of Red Bluff during the adult fall-run Chinook salmon
13 upstream migration period (September through October) under A9_LLTT would generally be similar
14 to or greater than those under Existing Conditions except in dry and critical years during September
15 (25% and 18% lower, respectively) and above normal and critical years during October (10% and
16 11% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
18 September through October adult fall-run Chinook salmon upstream migration period (Appendix
19 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
20 *the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be unchanged
21 (<5%) and 5% greater than those under Existing Conditions during September and October,
22 respectively.

23 *Late Fall-Run*

24 Flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January
25 through March) under A9_LLTT would nearly always be similar to or greater than flows under
26 Existing Conditions, except in below normal water years during March (11% lower) (Appendix 11C,
27 *CALSIM II Model Results utilized in the Fish Analysis*).

28 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
29 January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D,
30 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
31 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
32 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

33 Flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon
34 upstream migration period (December through February) under A9_LLTT would generally be similar
35 to or greater than those under Existing Conditions, except in wet years during December (8% lower)
36 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

37 Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the
38 December through February adult late fall-run Chinook salmon migration period (Appendix 11D,
39 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
40 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
41 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

1 **Clear Creek**

2 Water temperature modeling was not conducted in Clear Creek.

3 *Fall-Run*

4 Flows in Clear Creek below Whiskeytown Reservoir were examined during the juvenile fall-run
5 Chinook salmon upstream migration period (February through May). Flows under A9_LLT would be
6 similar to or greater than those under Existing Conditions throughout the period (Appendix 11C,
7 *CALSIM II Model Results utilized in the Fish Analysis*).

8 Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run
9 Chinook salmon upstream migration period (September through October). Flows under A9_LLT
10 would nearly always be similar to or greater than those under Existing Conditions, except in critical
11 years during September (38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
12 *Analysis*).

13 **Feather River**

14 *Fall-Run*

15 Flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile
16 migration period (February through May) under A9_LLT would generally be lower than flows under
17 Existing Conditions during March (up to 15% lower) but similar to or greater than flows under
18 Existing Conditions during the rest of the period, with some exceptions (up to 27% lower)
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
21 were examined during the February through May juvenile fall-run Chinook salmon migration period
22 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
23 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
24 temperature between Existing Conditions and Alternative 9 in any month or water year type
25 throughout the period. Flows in the Feather River at the confluence with the Sacramento River
26 during the September through October fall-run Chinook salmon adult migration period under
27 A9_LLT would generally be similar to or greater than flows under Existing Conditions during
28 September, except in dry and critical years (33% and 8% lower, respectively), and generally lower
29 during October (up to 23% lower).

30 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
31 were examined during the September through October fall-run Chinook salmon adult upstream
32 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
33 *Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in
34 mean monthly water temperature between Existing Conditions and Alternative 9 in September and
35 a 5% increase in October.

36 **American River**

37 *Fall-Run*

38 Flows in the American River at the confluence with the Sacramento River were examined during the
39 February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II*
40 *Model Results utilized in the Fish Analysis*). Flows under A9_LLT during February through April

1 would generally be similar to or greater than flows under Existing Conditions, except in critical
2 years during February (16% lower) and above normal years during April (9% lower). Flows under
3 A9_LLTT during May would be generally lower by up to 36% than flows under Existing Conditions.

4 Mean monthly water temperatures in the American River at the confluence with the Sacramento
5 River were examined during the February through May juvenile fall-run Chinook salmon migration
6 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
7 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would
8 be 5% to 7% higher than under Existing Conditions in all months except April, in which there would
9 be no difference. Flows in the American River at the confluence with the Sacramento River were
10 examined during the September and October adult fall-run Chinook salmon upstream migration
11 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLTT
12 would generally be lower than those under Existing Conditions throughout the period by up to 52%.

13 Mean monthly water temperatures in the American River at the confluence with the Sacramento
14 River were examined during the September and October adult fall-run Chinook salmon upstream
15 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
16 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under
17 Alternative 9 would be 5% and 11% higher than those under Existing Conditions during September
18 and October, respectively.

19 **Stanislaus River**

20 *Fall-Run*

21 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
22 February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II*
23 *Model Results utilized in the Fish Analysis*). Flows under A9_LLTT throughout this period would
24 generally be lower than Existing Conditions (up to 36% lower), except for March in wet water years
25 (7% greater).

26 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
27 River were examined during the February through May juvenile fall-run Chinook salmon migration
28 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
29 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would
30 be 6% higher than those under Existing Conditions in every month of the period.

31 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
32 September and October adult fall-run Chinook salmon upstream migration period (Appendix 11C,
33 *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLTT would generally be similar
34 to flows under Existing Conditions during September, except in wet and above normal years (17%
35 and 6% lower, respectively). During October, flows would be 6% to 11% lower depending on water
36 year type.

37 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
38 River were examined during the September and October adult fall-run Chinook salmon upstream
39 migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation*
40 *Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures under
41 Alternative 9 would be 6% higher than those under Existing Conditions during September but there
42 would be no difference in mean monthly water temperatures between Alternative 9 and Existing
43 Conditions during October.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile
3 Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Mean monthly flows under A9_LLT would be similar to Existing Conditions but drier water
5 years would be up to 16% lower than those under Existing Conditions.

6 Flows in the San Joaquin River at Vernalis were examined during the September and October adult
7 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
8 *in the Fish Analysis*). Flows under A9_LLT would be lower than Existing Conditions by up to 11%
9 during both months.

10 Water temperature modeling was not conducted in the San Joaquin River.

11 **Mokelumne River**

12 Flows in the Mokelumne River at the Delta were examined during the February through May
13 juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in*
14 *the Fish Analysis*). Flows under A9_LLT would be similar to those under Existing Conditions during
15 February and March, but up to 18% lower than flows under Existing Conditions during April and
16 May.

17 Flows in the Mokelumne River at the Delta were examined during the September and October adult
18 fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized*
19 *in the Fish Analysis*). Flows under A9_LLT would be up to 29% lower than those under NAA
20 depending on water year type.

21 Water temperature modeling was not conducted in the Mokelumne River.

22 **Through-Delta**

23 Sacramento River flows at Rio Vista under Alternative 9 would generally be similar to Existing
24 Conditions. The only exception is in May and June when flows would be reduced by 23% and 13%,
25 respectively, relative to Existing Conditions. The reduction in flows in May would affect the tail end
26 of the juvenile fall-run and late fall-run outmigration periods. Furthermore, screening of the DCC
27 and Georgiana Slough would prevent Sacramento River basin juvenile salmon from entering the
28 interior Delta, thus improving migration survival. Based on DPM modeling, through-Delta survival of
29 Sacramento River fall-run smolts would increase 2.3% (9% relative increase) compared to Existing
30 Conditions. Survival of Mokelumne River fall-run Chinook salmon juveniles would decrease 1.3%
31 (8% relative increase) under Alternative 9. Predation losses associated with the Georgiana Slough
32 and DCC fish screens or with the fourteen operable barriers around the Delta are expected to be
33 minimal, as discussed above for Impact-AQUA-42. For fall-run Chinook salmon from the San Joaquin
34 River basin, outmigration success would be improved as flows would be increased in the Old River
35 fish migration corridor thus reducing transit times for juvenile salmon. Survival rates for San
36 Joaquin River basin salmon would also be improved because the Old River fish migration corridor
37 would be isolated from the south Delta export facilities.

38 Overall the impact on Chinook salmon would not be negative because flow conditions for juveniles
39 outmigrating from the Sacramento River and San Joaquin River basins based on the overall flows at
40 Rio Vista and the lack of entrainment for San Joaquin basin fall-run Chinook salmon. Increased flows
41 in the Old River fish migration corridor would reduce transit times for juvenile San Joaquin River

1 basin Chinook salmon thus improving outmigration success. The impact on adults is unknown for
2 San Joaquin River basin fish because of modification under Alternative 9.

3 Attraction flows from the Sacramento River would be similar (less than 4%) during fall-run adult
4 migration (September to November) and reduced 8% to 12% during late fall-run migration
5 (December to February) compared to Existing Conditions. The proportion of San Joaquin River flows
6 at Collinsville would be increased relative to Existing Conditions, thus strengthening olfactory cues
7 under Alternative 9. Overall the impact would be less than significant, no mitigation would be
8 required.

9 ***Summary of CEQA Conclusion***

10 The results of the Impact AQUA-78 CEQA analysis indicate differences between the CEQA baseline
11 and Alternative 9 depending on location. Through Delta conditions on the Sacramento River and on
12 the San Joaquin River would not substantially impact migration conditions relative to Existing
13 Conditions. Upstream of the Delta conditions relative to Existing Conditions would be reduced
14 although the impacts are related to climate change.

15 In the Delta on the Sacramento River, under Alternative 9 flows and olfactory cues would be similar
16 to Existing Conditions for Sacramento River Chinook salmon migration periods. Additionally,
17 screening of the DCC and Georgiana Slough would prevent Sacramento River basin juvenile salmon
18 from entering the interior Delta, thereby improving migration survival. Therefore, it is concluded
19 that the through-delta impact on the Sacramento River is less than significant and no mitigation is
20 required.

21 In the Delta on the San Joaquin River there would be increased proportions of San Joaquin River
22 flows at Collinsville which would strengthen olfactory cues relative to Existing Conditions. Also,
23 increased flows in the Old River migration corridor would reduce transit times and improve
24 outmigration success. Alternative 9 would be less than significant for fall-run Chinook salmon and
25 no mitigation is required.

26 For upstream of the Delta, collectively, the results of the Impact AQUA-78 CEQA analysis indicate
27 that the difference between the CEQA baseline and Alternative 9 could be significant because, under
28 the CEQA baseline, the alternative could substantially reduce migration habitat and substantially
29 interfere with the movement of fish, contrary to the NEPA conclusion set forth above. Flows under
30 Alternative 9 in the Stanislaus and Mokelumne Rivers would generally be lower than flows under
31 Existing Conditions. These flow reductions would reduce the ability of fall-run Chinook salmon adult
32 migrants to sense olfactory cues from their natal spawning grounds, potentially delaying or
33 preventing them from reaching these spawning grounds. Further, increases in temperatures in the
34 Feather and Stanislaus River for one of the two month adult upstream migration period under
35 Alternative 9 would have negative impacts. Flows and temperatures in other rivers would be
36 variably similar to, negative or slightly positive depending on river, month and water year type.

37 These negative results are primarily caused by four factors: differences in sea level rise, differences
38 in climate change, future water demands, and implementation of the alternative. The analysis
39 described above comparing Existing Conditions to Alternative 9 does not partition the effect of
40 implementation of the alternative from those of sea level rise, climate change and future water
41 demands using the model simulation results presented in this chapter. However, the increment of
42 change attributable to the alternative is well informed by the results from the NEPA analysis, which
43 found this effect to be not adverse. In addition, CALSIM modeling has been conducted for Existing

1 Conditions in the LLT implementation period, which does include future sea level rise, climate
2 change, and water demands. Therefore, the comparison of results between the alternative and
3 Existing Conditions in the LLT, both of which include sea level rise, climate change, and future water
4 demands, isolates the effect of the alternative from those of sea level rise, climate change, and water
5 demands.

6 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
7 term implementation period and Alternative 9 indicates that flows in the locations and during the
8 months analyzed above would generally be similar between Existing Conditions during the LLT and
9 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
10 found above would generally be due to climate change, sea level rise, and future demand, and not
11 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
12 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
13 result in a significant impact on migration habitat for fall-/late fall-run Chinook salmon. This impact
14 is found to be less than significant and no mitigation is required.

15 **Restoration Measures (CM2, CM4–CM7, and CM10)**

16 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
17 differences in restoration-related fish effects are anticipated anywhere in the affected environment
18 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
19 restoration measures described for fall- and late fall–run Chinook salmon under Alternative 1A
20 (Impact AQUA-79 through Impact AQUA-81) also appropriately characterize effects under
21 Alternative 9.

22 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

23 **Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon** 24 **(Fall-/Late Fall–Run ESU)**

25 **Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook** 26 **Salmon (Fall-/Late Fall–Run ESU)**

27 **Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–** 28 **Run ESU)**

29 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
30 fall-/late fall–run Chinook salmon, and most would be at least slightly beneficial. Specifically for
31 AQUA-80, the effects of contaminants on fall- and late fall-run Chinook salmon with respect to
32 selenium, copper, ammonia and pesticides would not be adverse. The effects of methylmercury on
33 fall- and late fall-run Chinook salmon are uncertain.

34 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial,
35 or less than significant, and no mitigation is required.

36 **Other Conservation Measures (CM12–CM19 and CM21)**

37 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
38 differences in other conservation-related fish effects are anticipated anywhere in the affected
39 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
40 effects of other conservation measures described for fall- and late fall–run Chinook salmon under

1 Alternative 1A (Impact AQUA-82 through Impact AQUA-90) also appropriately characterize effects
2 under Alternative 9.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

4 **Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall-
5 Run ESU) (CM12)**

6 **Impact AQUA-83: Effects of Invasive Aquatic Vegetation Management on Chinook Salmon
7 (Fall-/Late Fall-Run ESU) (CM13)**

8 **Impact AQUA-84: Effects of Dissolved Oxygen Level Management on Chinook Salmon (Fall-
9 /Late Fall-Run ESU) (CM14)**

10 **Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon
11 (Fall-/Late Fall-Run ESU) (CM15)**

12 **Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall-
13 Run ESU) (CM16)**

14 **Impact AQUA-87: Effects of Illegal Harvest Reduction on Chinook Salmon (Fall-/Late Fall-Run
15 ESU) (CM17)**

16 **Impact AQUA-88: Effects of Conservation Hatcheries on Chinook Salmon (Fall-/Late Fall-Run
17 ESU) (CM18)**

18 **Impact AQUA-89: Effects of Urban Stormwater Treatment on Chinook Salmon (Fall-/Late
19 Fall-Run ESU) (CM19)**

20 **Impact AQUA-90: Effects of Removal/Relocation of Nonproject Diversions on Chinook Salmon
21 (Fall-/Late Fall-Run ESU) (CM21)**

22 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
23 adverse effect, or beneficial effects on fall- and late fall-run Chinook salmon for NEPA purposes, for
24 the reasons identified for Alternative 1A.

25 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
26 less than significant, or beneficial on fall- and late fall-run Chinook salmon, for the reasons identified
27 for Alternative 1A, and no mitigation is required.

28 **Steelhead**

29 **Construction and Maintenance of CM1**

30 Potential impacts from Alternative 9 construction are expected to be as described for Chinook
31 salmon, under Alternative 9 above (see Impact AQUA-37). Steelhead could be present in the vicinity
32 of the Alternative 9 facilities and barge landings during in-water construction. The potential for
33 exposure of steelhead to construction-related activities is expected to be low due to the limited time
34 required for installation of each individual cofferdam and barge landing. Adult and juvenile
35 steelhead could be present at the Alternative 9 in-water construction areas in July to October (see

1 Table 11-6). Appendix A of the BDCP details the temporal and spatial distribution of various life
2 history stages for steelhead.

3 **Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead**

4 The potential effects of construction of water conveyance facilities on steelhead would be similar to
5 but greater than those described under Impact AQUA-91 under Alternative 1A, except the number of
6 construction sites would have a temporary and permanent in-water footprint of 31.4 acres (Table
7 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would
8 total 56.9 acres (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank
9 protection under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A
10 (Table 11-5). The effects related to temporary increases in turbidity, accidental spills, underwater
11 noise, in-water work activities, and disturbance of contaminated sediments would be similar to
12 Alternative 1A and the same environmental commitments and mitigation measures (described
13 under Impact AQUA-1 for delta smelt and in Appendix 3B, *Environmental Commitments*) would be
14 available to avoid and minimize potential effects.

15 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-91, the effect would not be adverse for
16 steelhead.

17 **CEQA Conclusion:** Although Alternative 9 affects a larger in-water area than Alternative 1A, as
18 described in Impact AQUA-91, the impact of construction of the water conveyance facilities on
19 steelhead would be less than significant except for construction noise associated with pile driving.
20 The number of sites where noise impacts would potentially occur are greater under Alternative 9
21 because it has more construction sites than Alternative 1A. However, implementation of Mitigation
22 Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce that noise impact to less than
23 significant.

24 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 25 **of Pile Driving and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

27 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 28 **and Other Construction-Related Underwater Noise**

29 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

30 **Impact AQUA-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead**

31 Although the facilities involved in maintenance activities under Alternative 9 (screen and gates)
32 would differ from the intakes of Alternative 1A, the same types of effects resulting from
33 maintenance activities would apply. Consequently, the potential effects of the maintenance of water
34 conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A
35 (see Impact AQUA-92).

36 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-92, the impact would not be adverse for
37 steelhead.

38 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
39 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects

1 resulting from maintenance activities would apply. Consequently, as described under Alternative 1A,
2 Impact AQUA-92 for steelhead, the impact of the maintenance of water conveyance facilities on
3 steelhead would be less than significant and no mitigation would be required.

4 **Water Operations of CM1**

5 **Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead**

6 The potential effects would be the same as those discussed for entrainment of winter-run Chinook
7 under Alternative 9 (see Impact AQUA-39).

8 **NEPA Effects:** As concluded for Alternative 9, Impact AQUA-39, the effects would be beneficial for
9 steelhead.

10 **CEQA Conclusion:** As described in Impact AQUA-39 for winter-run Chinook under Alternative 9, the
11 impact of Alternative 9 operations of water conveyance facilities on steelhead would be less than
12 significant. Overall the impact of water operations on steelhead would be beneficial to the species.
13 No mitigation would be required.

14 **Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for 15 Steelhead**

16 In general, Alternative 9 would have negligible effects on spawning and egg incubation habitat for
17 steelhead relative to the NAA.

18 **Sacramento River**

19 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
20 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
21 and egg incubation period of January through April (Appendix 11C, *CALSIM II Model Results utilized
22 in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
23 incubation, and rapid reductions in flow can expose redds leading to mortality. Flows under A9_LL
24 throughout the period would generally be similar to those under NAA except during January in dry
25 and critical water years (7% and 11% lower, respectively) and during February during below
26 normal water years (6% higher).

27 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were
28 examined during the January through April primary steelhead spawning and egg incubation period
29 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results
30 utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
31 temperature between NAA and Alternative 9 in any month or water year type throughout the period
32 at either location

33 SacEFT predicts that there would be negligible effects (<5% difference) under Alternative 9 relative
34 to NAA in the percentage of years with good spawning availability (measured as weighted usable
35 area), percentage of years with good (lower) redd scour risk and redd dewatering risk, and
36 percentage of years with good (lower) egg incubation conditions (Table 11-9-43). These results
37 indicate that there would be negligible effects of Alternative 9 on these parameters relative to NAA.

1 **Table 11-9-43. Difference and Percent Difference in Percentage of Years with “Good” Conditions**
2 **for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)**

Metric	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Spawning WUA	1 (2%)	-2 (-4%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-1 (-2%)	2 (4%)
Juvenile Rearing WUA	2 (5%)	-2 (-4%)
Juvenile Stranding Risk	-14 (-41%)	0 (0%)

WUA = Weighted Usable Area.

3
4 Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg
5 incubation habitat in the Sacramento River would be negligible.

6 **Clear Creek**

7 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
8 (January through April). Flows under A9_LLT would generally be similar to flows under NAA
9 throughout the period, except in critical years during January (6% higher) and below normal years
10 during March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
12 monthly flow reduction would be identical between NAA and A9_LLT for all water year types except
13 for a reduction in above normal years which would be a relatively isolated, small event (Table 11-9-
14 44).

15 No water temperature modeling was conducted for Clear Creek.

16 Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg
17 incubation habitat in Clear Creek would be negligible.

18 **Table 11-9-44. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow**
19 **under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg**
20 **Incubation Period^a**

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wet	-25 (-38%)	0 (0%)
Above Normal	-31 (NA)	-31 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in the month when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

21

Feather River

Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under A9_LLT would not differ from NAA because minimum Feather River flows are included in the FERC settlement agreement and would be met for all model scenarios (California Department of Water Resources 2006). Flows under A9_LLT at Thermalito Afterbay would generally be similar to flows under NAA, except lower in critical years during January (22% lower), below normal years during February (6% lower), and dry years during March (7% lower) and higher in below normal and dry years during April (14% and 19% higher, respectively).

Oroville Reservoir storage volume at the end of May and end of September influences flows downstream of the dam during the steelhead spawning and egg incubation period. May Oroville storage under A9_LLT would be similar to storage under NAA in all water year types (Table 11-9-45). Storage volume at the end of September under A9_LLT would be similar to storage under NAA in all water year types (Table 11-9-46).

Table 11-9-45. May Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wet	-57 (-2%)	-11 (0%)
Above Normal	-184 (-5%)	-28 (-1%)
Below Normal	-380 (-12%)	-27 (-1%)
Dry	-560 (-20%)	-40 (-2%)
Critical	-351 (-19%)	-35 (-2%)

Table 11-9-46. September Water Storage Volume (thousand acre-feet) in Oroville Reservoir for Model Scenarios

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wet	-1,017 (-35%)	-3 (0%)
Above Normal	-816 (-34%)	-25 (-2%)
Below Normal	-605 (-30%)	4 (0%)
Dry	-337 (-25%)	16 (2%)
Critical	-202 (-21%)	-14 (-2%)

Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 9 in any month or water year type throughout the period at either location.

1 The percent of months exceeding the 56°F temperature threshold in the Feather River above
 2 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-9-
 3 47). The percent of months exceeding the threshold under Alternative 9 would generally be similar
 4 to or lower (up to 11% lower on an absolute scale) than the percent under NAA depending on
 5 month and degrees above the threshold.

6 **Table 11-9-47. Differences between Baseline and Alternative 9 Scenarios in Percent of Months**
 7 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
 8 **River above Thermalito Afterbay Exceed the 56°F Threshold, January through April**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LL1					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	7 (600%)	1 (NA)	1 (NA)	1 (NA)	0 (NA)
April	33 (386%)	16 (325%)	11 (NA)	2 (NA)	1 (NA)
NAA vs. A9_LL1					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-1 (-13%)	-1 (-50%)	0 (0%)	0 (0%)	-1 (-100%)
April	-11 (-21%)	-11 (-35%)	-6 (-36%)	-4 (-60%)	0 (0%)
NA = could not be calculated because the denominator was 0.					

9

10 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
 11 Afterbay (low-flow channel) during January through April (Table 11-9-48). Total degree-months
 12 would be similar between NAA and Alternative 9 in all months.

1 **Table 11-9-48. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in**
 3 **the Feather River above Thermalito Afterbay, January through April**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	0 (0%)
	Dry	2 (NA)	0 (0%)
	Critical	8 (800%)	0 (0%)
	All	12 (1,200%)	0 (0%)
April	Wet	4 (NA)	1 (33%)
	Above Normal	11 (550%)	0 (0%)
	Below Normal	15 (375%)	-1 (-5%)
	Dry	24 (480%)	-2 (-6%)
	Critical	21 (NA)	-2 (-9%)
	All	74 (673%)	-5 (-6%)

NA = could not be calculated because the denominator was 0.

4

5 **American River**

6 Flows in the American River at the confluence with the Sacramento River were examined for the
 7 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
 8 *Model Results utilized in the Fish Analysis*). Flows under A9_LLТ would generally be similar to flows
 9 under NAA during the period except in dry and critical years during March and April (5% lower for
 10 each) and during dry water years during February and April (8% and 12% higher, respectively)
 11 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated
 13 during the January through April steelhead spawning and egg incubation period ((Appendix 11D,
 14 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
 15 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
 16 NAA and Alternative 9 in any month or water year type throughout the period.

17 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
 18 Avenue Bridge was evaluated during November through April (Table 11-9-37). Steelhead spawn and

1 eggs incubate in the American River between January and April. During this period, the percent of
2 months exceeding the threshold under Alternative 9 would similar to or up to 10% lower (absolute
3 scale) than the percent under NAA.

4 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
5 Avenue Bridge during November through April (Table 11-9-38). During the January through April
6 steelhead spawning and egg incubation period, total degree-months would be similar between NAA
7 and Alternative 9.

8 Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg
9 incubation habitat in the American River would be negligible.

10 **Stanislaus River**

11 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
12 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
13 *Model Results utilized in the Fish Analysis*). Flows under A9_LL1T throughout this period would
14 generally be identical to flows under NAA.

15 Water temperatures throughout the Stanislaus River would be similar under NAA and Alternative 9
16 throughout the January through April steelhead spawning and egg incubation period (Appendix
17 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in*
18 *the Fish Analysis*).

19 **San Joaquin River**

20 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

21 **Mokelumne River**

22 Flows in the Mokelumne River at the Delta were examined during the January through April
23 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
24 *Fish Analysis*). Flows under A9_LL1T throughout this period would generally be identical to flows
25 under NAA.

26 Water temperature modeling was not conducted in the Mokelumne River.

27 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
28 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
29 as a result of egg mortality. Reservoir storage, instream flows, and water temperatures would not be
30 substantially changed by Alternative 9 in any waterway evaluated.

31 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of steelhead
32 spawning habitat relative to Existing Conditions.

33 **Sacramento River**

34 Flows in the Sacramento River between Keswick and upstream of Red Bluff Diversion Dam, where
35 the majority of steelhead spawning occurs, were examined during the primary steelhead spawning
36 and egg incubation period of January through April. (Appendix 11C, *CALSIM II Model Results utilized*
37 *in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg
38 incubation, and rapid reductions in flow can expose redds, leading to mortality. At Keswick, flows
39 under A9_LL1T would be mixed in January and February with individual water years similar to, lower

1 than, or higher than Existing Conditions (up to 20% lower in below normal years during March or
2 up to 13% higher in wet years during January). Flows would be similar to or lower than Existing
3 Conditions during March and April (up 20% lower). Upstream of Red Bluff Diversion Dam, flows
4 would generally be similar to those at Keswick except there would be fewer water years with lower
5 flows.

6 Mean monthly water temperatures in the Sacramento River at Keswick and Red Bluff were
7 examined during the January through April primary steelhead spawning and egg incubation period
8 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
9 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
10 temperature between Existing Conditions and Alternative 9 in any month or water year type
11 throughout the period at either location.

12 SacEFT predicts negligible change (0% difference) in spawning habitat, egg incubation, redd
13 dewatering and redd scour risk for Alternative 9 compared to Existing Conditions (Table 11-9-43).

14 **Clear Creek**

15 Flows in Clear Creek were examined during the steelhead spawning and egg incubation period
16 (January through April). Flows under A9_LLT would be similar to or greater than flows under
17 Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the*
18 *Fish Analysis*).

19 Results of the flow analyses for the risk of redd dewatering for Clear Creek indicate that the greatest
20 monthly flow reduction would be identical between Existing Conditions and A9_LLT for all water
21 year types except wet, in which the greatest reduction would be 38% lower (worse) under A9_LLT
22 than under Existing Conditions (Table 11-9-44).

23 No water temperature modeling was conducted in Clear Creek.

24 Overall, these results indicate that the effects of Alternative 9 on steelhead spawning and egg
25 incubation habitat in Clear Creek would be negligible.

26 **Feather River**

27 Flows were examined in the Feather River low-flow channel (upstream of Thermalito Afterbay) and
28 high-flow channel (at Thermalito Afterbay) during the steelhead spawning and egg incubation
29 period (January through April) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
30 Flows in the low-flow channel under A9_LLT would not differ from Existing Conditions because
31 minimum Feather River flows are included in the FERC settlement agreement and would be met for
32 all model scenarios (California Department of Water Resources 2006). Flows under A9_LLT at
33 Thermalito Afterbay would be variable depending on the specific month and water year type. There
34 would be primarily decreases in mean monthly flows in January and February (-11% to -39% and -
35 6% to -55%, respectively) for all but wet water years, which would increase by 7% and 18%,
36 respectively. March would experience substantial decreases (-18% to -39%) in drier water year
37 types that could significantly affect spawning conditions, and increases in wetter water year types
38 (12% to 13%). April would experience primarily higher flows (5% to 14%) in the drier water years.

39 Oroville Reservoir storage volume at the end of September and end of May influences flows
40 downstream of the dam during the steelhead spawning and egg incubation period. Oroville
41 Reservoir storage volume at the end of September would be 21% to 35% lower under A9_LLT

1 relative to Existing Conditions depending on water year (Table 11-9-46). May Oroville storage
2 volume under A9_LL1T would be lower than Existing Conditions by 2% to 19% depending on water
3 year type (Table 11-9-45).

4 Mean monthly water temperatures in the Feather River low-flow channel (upstream of Thermalito
5 Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January
6 through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River*
7 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the
8 low-flow channel, mean monthly water temperatures under Alternative 9 would be 5% to 7%
9 greater than those under Existing Conditions during January through March and similar to
10 temperatures under Existing Conditions during April. In the high-flow channel, mean monthly water
11 temperatures under Alternative 9 would be 6% greater than those under Existing Conditions during
12 January and February and similar to temperatures under Existing Conditions during March and
13 April.

14 The percent of months exceeding the 56°F temperature threshold in the Feather River above
15 Thermalito Afterbay (low-flow channel) was evaluated during January through April (Table 11-9-
16 47). The percent of months exceeding the threshold under Alternative 9 would be similar to the
17 percent under Existing Conditions during January and February and similar to or up to 33% greater
18 (absolute scale) than the percent under Existing Conditions depending on month and degrees above
19 the threshold.

20 Total degree-months exceeding 56°F were summed by month and water year type above Thermalito
21 Afterbay (low-flow channel) during January through April (Table 11-9-48). Total degree-months
22 would be similar between Existing Conditions and Alternative 9 during January and February and
23 673% to 1,200% higher under Alternative 9 compared to Existing Conditions during March and
24 April.

25 **American River**

26 Flows in the American River at the confluence with the Sacramento River were examined for the
27 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
28 *Model Results utilized in the Fish Analysis*). Flows under A9_LL1T would generally be lower than flows
29 under Existing Conditions during January (up to 28% lower), generally greater than flows under
30 Existing Conditions during February and March (up to 27% higher), and similar to Existing
31 Conditions during April except for lower flows in above normal years (9% lower) and higher flows
32 in dry years (12% higher).

33 Mean monthly water temperatures in the American River at the Watt Avenue Bridge were evaluated
34 during the January through April steelhead spawning and egg incubation period (Appendix 11D,
35 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
36 *Fish Analysis*). Mean monthly water temperature under Alternative 9 would be 5% to 7% higher
37 than those under Existing Conditions during January through March, and temperatures would not
38 differ between Alternative 9 and Existing Conditions during April.

39 The percent of months exceeding the 56°F temperature threshold in the American River at the Watt
40 Avenue Bridge was evaluated during November through April (Table 11-9-37). Steelhead spawn and
41 eggs incubate in the American River between January and April. During January and February, the
42 percent of month exceeding the threshold under Existing Conditions and Alternative 9 would be

1 similar. During March and April, the percent of months exceeding the threshold under Alternative 9
2 would be up to 30% greater (absolute scale) than the percent under Existing Conditions.

3 Total degree-months exceeding 56°F were summed by month and water year type at the Watt
4 Avenue Bridge during November through April (Table 11-9-38). During the January and February,
5 there would be no difference in total degree-months above the threshold between Existing
6 Conditions and Alternative 9. During March and April, total degree-months under Alternative 9
7 would be 384% and 94% greater, respectively than those under Existing Conditions.

8 ***Stanislaus River***

9 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the
10 January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A9_LLТ throughout this period would be up
12 to 36% lower flows under Existing Conditions in all months with few exceptions.

13 Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was
14 evaluated during the January through April steelhead spawning and egg incubation period
15 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
16 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6%
17 higher than those under Existing Conditions in all months.

18 ***San Joaquin River***

19 The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

20 ***Mokelumne River***

21 Flows in the Mokelumne River at the Delta were examined during the January through April
22 steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the*
23 *Fish Analysis*). Flows under A9_LLТ would generally be similar to flows under Existing Conditions
24 during January through March and up to 14% lower during April.

25 Water temperature modeling was not conducted in the Mokelumne River.

26 **Summary of CEQA Conclusion**

27 Collectively, the results of the Impact AQUA-94 CEQA analysis indicate that the difference between
28 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
29 alternative could substantially reduce suitable spawning habitat and substantially reduce the
30 number of fish as a result of egg mortality, contrary to the NEPA conclusion set forth above.
31 Alternative 9 would reduce instream flows in the Stanislaus and Mokelumne Rivers and would
32 increase water temperatures in the Feather, American, and Stanislaus Rivers.

33 These results are primarily caused by four factors: differences in sea level rise, differences in climate
34 change, future water demands, and implementation of the alternative. The analysis described above
35 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
36 alternative from those of sea level rise, climate change and future water demands using the model
37 simulation results presented in this chapter. However, the increment of change attributable to the
38 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
39 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLТ
40 implementation period, which does include future sea level rise, climate change, and water

1 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
2 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
3 effect of the alternative from those of sea level rise, climate change, and water demands.

4 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
5 term implementation period and Alternative 9 indicates that flows in the locations and during the
6 months analyzed above would generally be similar between Existing Conditions during the LLT and
7 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
8 found above would generally be due to climate change, sea level rise, and future demand, and not
9 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
10 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
11 result in a significant impact on spawning habitat for steelhead. This impact is found to be less than
12 significant and no mitigation is required.

13 **Impact AQUA-95: Effects of Water Operations on Rearing Habitat for Steelhead**

14 In general, Alternative 9 would not affect steelhead rearing habitat relative to the NAA.

15 ***Sacramento River***

16 Juvenile steelhead rear within the Sacramento River for 1 to 2 years before migrating downstream
17 to the ocean. Lower flows can reduce the instream area available for rearing and rapid reductions in
18 flow can strand fry or juveniles leading to mortality. Year-round Sacramento River flows within the
19 reach where the majority of steelhead spawning and juvenile rearing occurs (Keswick Dam to
20 upstream of RBDD) were evaluated (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
21 *Analysis*). Flows would generally be similar to or greater (up to 18%) than flows under NAA during
22 February through September, November, and December, and lower than flows under NAA (up to
23 13% lower) during January and October.

24 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
25 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*
26 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There
27 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 9
28 in any month or water year type throughout the period at either location.

29 SacEFT predicts that the percentage of years with good juvenile steelhead rearing WUA conditions
30 under A9_LLTT would be 4% less than under NAA (Table 11-9-43). The percentage of years with
31 good (lower) juvenile stranding risk conditions under A9_LLTT would be the same as under NAA.
32 These results indicate that Alternative 9 would cause a minimal decrease in rearing habitat
33 conditions and no increase in juvenile mortality risk resulting from stranding in the Sacramento
34 River.

35 Overall in the Sacramento River, Alternative 9 would have negligible effects on juvenile steelhead
36 rearing conditions in the Sacramento River.

37 ***Clear Creek***

38 Flows in Clear Creek below Whiskeytown during the year-round steelhead rearing period under
39 A9_LLTT would generally be similar to or sometimes greater than flows under NAA, except for below
40 normal years in March and critical years in September in which flows would be 6% and 13% lower,
41 respectively (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

1 Water temperatures were not modeled in Clear Creek.

2 It was assumed that habitat for juvenile steelhead rearing would be constrained by the month
3 having the lowest instream flows. Juvenile rearing habitat is assumed to increase as instream flows
4 increase, and therefore the lowest monthly instream flow was used as an index of habitat
5 constraints for juvenile rearing. Results of the analysis indicate that juvenile steelhead rearing
6 habitat, based on minimum instream flows, is comparable for Alternative 9 relative to NAA in all
7 water years except in critical years when they would be 10% higher (Table 11-9-49).

8 Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-
9 1A-4). The current Clear Creek management regime uses flows slightly lower than those
10 recommended by Denton. Results from a new IFIM study on Clear Creek are currently being
11 analyzed. Depending on results of this study the flow regime could be adjusted in the future. We
12 expect that the modeled flows will be suitable for the existing steelhead populations in Clear Creek.
13 No change in effect on steelhead in Clear Creek is anticipated.

14 Overall, these results indicate that Alternative 9 would not affect juvenile rearing conditions in Clear
15 Creek.

16 **Table 11-9-49. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during**
17 **the Year-Round Juvenile Steelhead Rearing Period**

Water Year Type	A9_LLT vs. EXISTING CONDITIONS	A9_LLT vs. NAA
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	0 (0%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	-7 (-8%)	7 (10%)

Note: Minimum flows occurred between October and March.

18

19 ***Feather River***

20 Year-round flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay
21 (high-flow channel) were reviewed to determine flow-related effects on steelhead juvenile rearing
22 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The low-flow channel is
23 the primary reach of the Feather River utilized by steelhead spawning and rearing (Cavallo et al.
24 2003). Relatively constant flows in the low flow channel throughout the year under A9_LLT would
25 not differ from those under NAA. In the high flow channel, flows under A9_LLT would be mostly
26 lower (up to 14%) during July and October, mostly greater (up to 42%) than flows under NAA
27 during April and May, similar to or slightly lower than flows under NAA in January, February, March,
28 and September, and mixed in November and December.

29 May Oroville storage under A9_LLT would be similar to that under NAA (Table 11-9-45). September
30 Oroville storage volume would be similar to that under NAA (Table 11-9-46).

31 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
32 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile
33 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*
34 *Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly

1 water temperature between NAA and Alternative 9 in any month or water year type throughout the
2 period at either location.

3 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in
4 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and
5 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-
6 flow channel, the percent of months exceeding the threshold under Alternative 9 would generally be
7 similar to or lower (up to 16% lower on an absolute scale) than the percent under NAA (Table 11-9-
8 26). At Gridley, the percent of months exceeding the threshold under Alternative 9 would similar to
9 or up to 10% lower (absolute scale) than the percent under NAA (Table 11-9-34).

10 Total degree-months exceeding 63°F were summed by month and water year type in the Feather
11 River above Thermalito Afterbay (low-flow channel) during May through August and total degree-
12 months exceeding 56°F at Gridley during October through April. In the low-flow channel, total
13 degree-months under Alternative 9 would be similar to or lower than those under NAA depending
14 on the month (Table 11-9-27). At Gridley, total degree-months would be similar between NAA and
15 Alternative 9 for all months of the rearing period (Table 11-9-35).

16 Overall in the Feather River, project-related effects of Alternative 9 would generally result in
17 negligible effects on steelhead rearing habitat.

18 **American River**

19 Flows in the American River at the confluence with the Sacramento River were examined for the
20 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish
21 Analysis*). Flows under A9_LL1T would generally be similar to flows under NAA during March and
22 June, similar to or greater than flows under NAA during February, May, September, November, and
23 December, lower than flows under NAA during July, and October, and mixed in January, April, and
24 August with higher flows in dry years and lower flows in critical years.

25 Mean monthly water temperatures in the American River at the confluence with the Sacramento
26 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period
27 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results
28 utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
29 temperature between NAA and Alternative 9 in any month or water year type throughout the
30 period.

31 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt
32 Avenue Bridge was evaluated during May through October (Table 11-9-50). During May, June,
33 September, and October, the percent of months exceeding the threshold under Alternative 9 would
34 similar to or up to 17% lower (absolute scale) than the percent under NAA. During July and August,
35 the percent of months exceeding the threshold would be similar between NAA and Alternative 9.

1 **Table 11-9-50. Differences between Baseline and Alternative 9 Scenarios in Percent of Months**
 2 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American**
 3 **River at the Watt Avenue Bridge Exceed the 65°F Threshold, May through October**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LL1					
May	33 (169%)	28 (192%)	19 (167%)	12 (200%)	5 (100%)
June	33 (52%)	38 (72%)	30 (73%)	23 (76%)	20 (94%)
July	0 (0%)	1 (1%)	32 (51%)	40 (110%)	40 (229%)
August	0 (0%)	2 (3%)	19 (23%)	49 (103%)	56 (180%)
September	14 (16%)	37 (70%)	43 (135%)	46 (285%)	40 (533%)
October	68 (1,375%)	46 (1,850%)	35 (NA)	21 (NA)	9 (NA)
NAA vs. A9_LL1					
May	-11 (-17%)	-6 (-13%)	-10 (-25%)	-14 (-42%)	-7 (-43%)
June	-1 (-1%)	0 (0%)	-11 (-14%)	-11 (-17%)	-7 (-15%)
July	0 (0%)	0 (0%)	-2 (-3%)	4 (5%)	1 (2%)
August	0 (0%)	0 (0%)	0 (0%)	1 (1%)	-4 (-4%)
September	-1 (-1%)	-7 (-8%)	-10 (-12%)	-12 (-17%)	-14 (-22%)
October	-7 (-9%)	-17 (-26%)	-11 (-24%)	-9 (-29%)	-2 (-22%)

NA = could not be calculated because the denominator was 0.

4
 5 Total degree-months exceeding 65°F were summed by month and water year type at the Watt
 6 Avenue Bridge during May through October (Table 11-9-51). During May, June, and August through
 7 October, total degree-months would be similar between NAA and Alternative 9 or up to 14% lower
 8 under Alternative 9. During July, there would be a 9% increase in total degree-months exceeding the
 9 threshold.

1 **Table 11-9-51. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 65°F in**
 3 **the American River at the Watt Avenue Bridge, May through October**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
May	Wet	19 (317%)	-2 (-7%)
	Above Normal	25 (NA)	-2 (-7%)
	Below Normal	16 (533%)	-7 (-27%)
	Dry	21 (95%)	-13 (-23%)
	Critical	30 (158%)	-2 (-4%)
	All	111 (222%)	-26 (-14%)
June	Wet	61 (359%)	-7 (-8%)
	Above Normal	28 (117%)	-4 (-7%)
	Below Normal	40 (138%)	2 (3%)
	Dry	42 (62%)	2 (2%)
	Critical	48 (96%)	-2 (-2%)
	All	219 (116%)	-9 (-2%)
July	Wet	57 (73%)	8 (6%)
	Above Normal	13 (48%)	7 (21%)
	Below Normal	34 (100%)	13 (24%)
	Dry	64 (103%)	13 (12%)
	Critical	46 (57%)	0 (0%)
	All	213 (76%)	40 (9%)
August	Wet	107 (135%)	-1 (-1%)
	Above Normal	29 (71%)	-4 (-5%)
	Below Normal	34 (61%)	-3 (-3%)
	Dry	84 (124%)	3 (2%)
	Critical	66 (84%)	2 (1%)
	All	320 (99%)	-3 (0%)
September	Wet	67 (279%)	-7 (-7%)
	Above Normal	34 (213%)	-2 (-4%)
	Below Normal	40 (143%)	-7 (-9%)
	Dry	81 (193%)	-5 (-4%)
	Critical	53 (108%)	0 (0%)
	All	275 (173%)	-21 (-5%)
October	Wet	54 (5,400%)	0 (0%)
	Above Normal	27 (NA)	1 (4%)
	Below Normal	35 (NA)	-4 (-10%)
	Dry	35 (NA)	-2 (-5%)
	Critical	25 (500%)	-5 (-14%)
	All	176 (2,933%)	-10 (-5%)

NA = could not be calculated because the denominator was 0.

1 **Stanislaus River**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
3 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A9_LLТ would be similar to flows under NAA throughout the period.

5 Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA and
6 Alternative 9 throughout the year-round period (Appendix 11D, Sacramento River Water Quality
7 Model and Reclamation Temperature Model Results utilized in the Fish Analysis).

8 **San Joaquin River**

9 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing
10 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLТ
11 would be similar to flows under NAA throughout the period.

12 **Mokelumne River**

13 Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing
14 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLТ
15 would be similar to flows under NAA throughout the period.

16 Water temperature modeling was not conducted in the Mokelumne River.

17 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
18 would not substantially reduce rearing habitat or substantially reduce the number of fish. Effects of
19 Alternative 9 on flow would result primarily in negligible effects on mean monthly flow in all rivers
20 analyzed, with relatively infrequent increases in flow (to 42%) that would have beneficial effects on
21 rearing conditions, and isolated decreases in flow (to -26%) that would not be of the persistence and
22 magnitude to have biologically meaningful negative effects on rearing conditions. Alternative 9
23 would have negligible effects (<5%), small negative effects (to -10%), or positive/beneficial effects
24 on rearing conditions evaluated with SacEFT and minimum instream flows. Alternative 9 would
25 have negligible effects on critical water temperatures in all location evaluated.

26 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of rearing
27 habitat for steelhead relative to the CEQA baseline.

28 **Sacramento River**

29 Year-round Sacramento River flows within the reach where the majority of steelhead spawning and
30 juvenile rearing occurs (Keswick Dam to upstream of RBDD) were evaluated (Appendix 11C, *CALSIM*
31 *II Model Results utilized in the Fish Analysis*). Flows during January, February, April, May, June, and
32 November under A9_LLТ would generally be similar to or greater than those under Existing
33 Conditions. Flows during March, July, August, September, October and December would generally be
34 similar to or lower under A9_LLТ than under Existing Conditions.

35 Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were
36 examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River*
37 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At
38 both locations, mean monthly water temperatures under Alternative 9 would generally be similar to
39 those under Existing Conditions, except during August through September, in each of which there
40 would be a 6% higher temperatures under Alternative 9.

1 SacEFT predicts that there would be a small improvement (5%) in the percentage of years with good
2 rearing habitat availability, measured as weighted usable area, under A9_LLT relative to Existing
3 Conditions (Table 11-9-43). SacEFT predicts that there would be a substantial reduction (-41%) in
4 the number of years with good (lower) juvenile stranding risk under A9_LLT relative to Existing
5 Conditions.

6 Collectively, these impacts would have biologically meaningful effects on juvenile rearing success in
7 the Sacramento River.

8 **Clear Creek**

9 No temperature modeling was conducted in Clear Creek.

10 Flows in Clear Creek during the year-round rearing period under A9_LLT would generally be similar
11 to or greater than flows under Existing Conditions, except for critical years in August, September
12 and November in which flows would be 6% to 38% lower (Appendix 11C, *CALSIM II Model Results*
13 *utilized in the Fish Analysis*).

14 Juvenile rearing habitat is assumed to increase in Clear Creek as instream flows increase, and
15 therefore the use of the lowest monthly instream flow as an index of habitat constraints for juvenile
16 rearing was selected for use in this analysis. Results of the analysis of minimum monthly instream
17 flows affecting juvenile rearing habitat are shown in Table 11-9-49. Results indicate that Alternative
18 9 would have no effect on juvenile rearing habitat, based on minimum instream flows, compared to
19 Existing Conditions in all water years except for that they would be 8% lower in critical water years.

20 Overall, Alternative 9 would have primarily negligible effects on mean monthly flow in Clear Creek.

21 **Feather River**

22 The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and
23 rearing (Cavallo et al. 2003). There would be no change in flows for Alternative 9 relative to Existing
24 Conditions in the low-flow channel during the year-round steelhead juvenile rearing period
25 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the high flow channel (at
26 Thermalito Afterbay), flows under A9_LLT would be mostly lower (up to 55% lower) during
27 January, February, October, November and December, mostly similar to or higher (up to 205%
28 higher) in April, May, June, and August, and mixed with some water years higher and some lower in
29 March and September.

30 Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at
31 Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile
32 rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature*
33 *Model Results utilized in the Fish Analysis*). In the low-flow channel, mean monthly water
34 temperatures under Alternative 9 would be similar to those under Existing Conditions between
35 April and September, but would be 5% to 10% higher between October and March. In the high-flow
36 channel, mean monthly water temperatures under Alternative 9 would be similar to those under
37 Existing Conditions between March through September, but would be 6% to 8% in the remaining
38 five months.

39 An additional analysis evaluated the percent of months exceeding a 63°F temperature threshold in
40 the Feather River above Thermalito Afterbay (low-flow channel) (May through August) and
41 exceeding a 56°F threshold at Gridley (October through April) for each model scenario. In the low-

1 flow channel, the percent of months exceeding the threshold under Alternative 9 would generally be
2 similar to the percent under Existing Conditions during May, and similar or up to 44% (absolute
3 scale) higher than the percent under Existing Conditions during June through August (Table 11-9-
4 26). At Gridley, the percent of months exceeding the threshold under Alternative 9 would similar to
5 the percent under Existing Conditions during December through February, but similar to or up to
6 58% greater (absolute scale) than the percent under Existing Conditions in the remaining 4 months
7 (Table 11-9-34).

8 Total degree-months exceeding 63°F were summed by month and water year type in the Feather
9 River above Thermalito Afterbay (low-flow channel) during May through August and total degree-
10 months exceeding 56°F at Gridley during October through April. In the low-flow channel, total
11 degree-months under Alternative 9 would be similar to those under Existing Conditions during May
12 and 45% to 175% higher during June through August (Table 11-9-27). At Gridley, total degree-
13 months under Alternative 9 would be similar to those under Existing Conditions during December
14 through and February and 99% to 3,275% greater than those under Existing Conditions in the
15 remaining months of the period (Table 11-9-35).

16 Overall in the Feather River, Alternative 9 would affect juvenile rearing habitat in the Feather River
17 low-flow channel and high-flow channel due to increased exposures to critical water temperatures,
18 as well as due to persistent reductions in mean monthly flow (to -55%) below Thermalito Afterbay
19 for much of the year, particularly in drier water years.

20 **American River**

21 Flows in the American River at the confluence with the Sacramento River were examined for the
22 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
23 *Analysis*). Flows under A9_LL1T would be generally lower than flows under Existing Conditions (up to
24 52% lower) during January and May through December, generally higher flows in February and
25 March (up to 27% higher).

26 Mean monthly water temperatures in the American River at the confluence with the Sacramento
27 River and the Watt Avenue Bridge were examined during the year-round steelhead rearing period
28 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
29 *utilized in the Fish Analysis*). Mean monthly water temperatures would be 5% to 12% higher during
30 January through March, May, and August through December and similar in the remaining 3 months.

31 The percent of months exceeding a 65°F temperature threshold in the American River at the Watt
32 Avenue Bridge was evaluated during May through October (Table 11-9-50). The percent of months
33 under Alternative 9 would be up to 68 (absolute scale) higher than those under Existing Conditions
34 except in July and August for the >1 degree category.

35 Total degree-months exceeding 65°F were summed by month and water year type at the Watt
36 Avenue Bridge during May through October (Table 11-9-51). Total degree-months under Alternative
37 9 would be 76% to 2,933% higher than those under Existing Conditions.

38 Overall in the American River, Alternative 9 would substantially reduce flows and increased water
39 temperatures for most of the year depending on water year type.

1 **Stanislaus River**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the
3 year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*). Flows under A9_LLTP would be similar to flows under Existing Conditions during June and
5 July and up to 36% lower than flows under Existing Conditions during the remaining 9 months.

6 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
7 River were evaluated during the year-round juvenile steelhead rearing period (Appendix 11D,
8 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
9 *Fish Analysis*). Mean monthly water temperatures under Alternatives 9 would be 6% greater than
10 those under Existing Conditions during January through May, August, September, November, and
11 December and would be similar to those under Existing Conditions in the remaining 3 months.

12 **San Joaquin River**

13 Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing
14 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLTP
15 would be up to 6% higher than Existing Conditions during January, generally similar to Existing
16 Conditions during February except for being lower in two water years, lower in most water years
17 than Existing Conditions during March through October (up to 38% lower), and similar to Existing
18 Conditions during November and December.

19 Water temperature modeling was not conducted in the San Joaquin River.

20 **Mokelumne River**

21 Flows in the Mokelumne River for Alternative 9 are generally lower than Existing Conditions in all
22 months except that they are similar in March (although lower in dry water years), and generally
23 higher in January, February and December (up to 18% higher depending on water year).

24 Water temperature modeling was not conducted in the Mokelumne River.

25 **Summary of CEQA Conclusion**

26 Collectively, the results of the Impact AQUA-95 CEQA analysis indicate that the difference between
27 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
28 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
29 a result of juvenile mortality, contrary to the NEPA conclusion set forth above. Alternative 9 would
30 cause reduced juvenile steelhead rearing habitat conditions in the Sacramento, Feather, American,
31 Stanislaus, and Mokelumne rivers based on persistent, small to substantial reductions in mean
32 monthly flows and increased water temperatures throughout much of the year. Effects of
33 Alternative 9 would not have biologically meaningful negative effects on juvenile rearing conditions
34 in Clear Creek.

35 These results are primarily caused by four factors: differences in sea level rise, differences in climate
36 change, future water demands, and implementation of the alternative. The analysis described above
37 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
38 alternative from those of sea level rise, climate change and future water demands using the model
39 simulation results presented in this chapter. However, the increment of change attributable to the
40 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
41 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT

1 implementation period, which does include future sea level rise, climate change, and water
2 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
3 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
4 effect of the alternative from those of sea level rise, climate change, and water demands.

5 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
6 term implementation period and Alternative 9 indicates that flows in the locations and during the
7 months analyzed above would generally be similar between Existing Conditions during the LLT and
8 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
9 found above would generally be due to climate change, sea level rise, and future demand, and not
10 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
11 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
12 result in a significant impact on rearing habitat for steelhead. This impact is found to be less than
13 significant and no mitigation is required.

14 **Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead**

15 **Upstream of the Delta**

16 In general, Alternative 9 would not negatively affect the quantity and quality of migration habitat for
17 steelhead relative to the NEPA point of comparison.

18 ***Sacramento River***

19 *Juveniles*

20 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
21 May juvenile steelhead migration period. Flows under A9_LLTT would be higher than NAA in some
22 water years during February, April, May, August, November and December (up to 18% higher),
23 similar to NAA during March, June, July, and September, and lower than NAA (up to 13% lower)
24 during January and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
26 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento
27 River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
28 There would be no differences (<5%) in mean monthly water temperature between NAA and
29 Alternative 9 in any month or water year type throughout the period.

30 *Adults*

31 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
32 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in
33 the Fish Analysis*). Flows under A9_LLTT would be higher than NAA in some water years during
34 February, November and December (up to 8% higher), similar to NAA during March and September,
35 and lower than NAA (up to 13% lower) during January and October.

36 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
37 during the September through March steelhead adult upstream migration period (Appendix 11D,
38 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the
39 Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
40 NAA and Alternative 9 in any month or water year type throughout the period.

1 **Kelts**

2 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
3 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
4 *Fish Analysis*). Flows during March would be similar to NAA and flows during April would be up to
5 7% higher than NAA. Mean monthly water temperatures in the Sacramento River upstream of Red
6 Bluff were evaluated during the March through April steelhead kelt downstream migration period
7 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
8 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
9 temperature between NAA and Alternative 9 in any month or water year type throughout the
10 period.

11 Overall in the Sacramento River, project-related effects of Alternative 9 on mean monthly flow
12 would not affect juvenile, adult, or kelt steelhead migration based on a prevalence of negligible
13 effects with a few, isolated, small increases in flow (to 18%) that would have beneficial effects and
14 decreases (to -13%) that would not have biologically meaningful effects on migration conditions.

15 **Clear Creek**

16 Water temperatures were not modeled in Clear Creek.

17 **Juveniles**

18 Flows in Clear Creek during the October through May juvenile Chinook steelhead migration period
19 under A9_LLT would generally be similar to or greater than flows under NAA except in below
20 normal years in March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
21 *Analysis*).

22 **Adults**

23 Flows in Clear Creek during the September through March adult steelhead migration period under
24 A9_LLT would generally be similar to or greater than flows under NAA except in critical years in
25 September (13% lower) and below normal years in March (6% lower) (Appendix 11C, *CALSIM II*
26 *Model Results utilized in the Fish Analysis*).

27 **Kelts**

28 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
29 under A9_LLT would generally be similar to flows under NAA except in below normal years in
30 March (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

31 Overall, in Clear Creek these results indicate that Alternative 9 on flows would not affect juvenile,
32 adult, or kelt steelhead migration.

33 **Feather River**

34 **Juveniles**

35 Flows in the Feather River at the confluence with the Sacramento River were examined during the
36 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
37 *utilized in the Fish Analysis*). Flows under A9_LLT would generally be similar to or greater than flows

1 under NAA during December, February, March, April and May, and lower than flows under NAA
2 during October, November and January.

3 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
4 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,
5 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
6 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
7 NAA and Alternative 9 in any month or water year type throughout the period.

8 **Adults**

9 Flows in the Feather River at the confluence with the Sacramento River were examined during the
10 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A9_LLTP would generally be similar to or
12 greater than flows under NAA during September, December, February and March, and lower than
13 flows under NAA during October, November and January.

14 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
15 were evaluated during the September through March steelhead adult upstream migration period
16 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
17 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
18 temperature between NAA and Alternative 9 in any month or water year type throughout the
19 period.

20 **Kelts**

21 Flows in the Feather River at the confluence with the Sacramento River were examined during the
22 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
23 *Results utilized in the Fish Analysis*). Flows under A9_LLTP would be similar to those under NAA in
24 March and April.

25 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
26 were evaluated during the March through April steelhead kelt downstream migration period
27 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
28 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
29 temperature between NAA and Alternative 9 in any month or water year type throughout the
30 period. Overall in the Feather River, the effects of Alternative 9 on flow would not have biologically
31 meaningful effects on juvenile, adult or kelt steelhead migration.

32 **American River**

33 **Juveniles**

34 Flows in the American River at the confluence with the Sacramento River were evaluated during the
35 October through May juvenile steelhead migration period. Flows under A9_LLTP would be lower than
36 under NAA during October (15% lower in below normal years although 12% higher in dry years),
37 similar to or lower during January (5% lower in dry years), similar to or higher than flows under
38 NAA during November, December, February, March, and May, and mixed in April (12% higher in dry
39 years and 5% lower in critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
40 *Analysis*).

1 Mean monthly water temperatures in the American River at the confluence with the Sacramento
2 River were evaluated during the October through May juvenile steelhead migration period
3 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
4 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
5 temperature between NAA and Alternative 9 in any month or water year type throughout the
6 period.

7 *Adults*

8 Flows in the American River at the confluence with the Sacramento River were evaluated during the
9 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
10 *Model Results utilized in the Fish Analysis*). Flows under A9_LLTP would be lower than under NAA
11 during October (15% lower in below normal years although 12% higher in dry years), similar to or
12 lower during January (5% lower in dry years), similar to or higher than flows under NAA during
13 September, November, December, February, and March (Appendix 11C, *CALSIM II Model Results*
14 *utilized in the Fish Analysis*).

15 Mean monthly water temperatures in the American River at the confluence with the Sacramento
16 River were evaluated during the September through March steelhead adult upstream migration
17 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
18 *Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
19 temperature between NAA and Alternative 9 in any month or water year type throughout the
20 period.

21 *Kelts*

22 Flows in the American River at the confluence with the Sacramento River were evaluated for the
23 March and April kelt migration period. Flows under A9_LLTP would be similar to NAA during March
24 (up to 17% lower in critical years), and mixed in April (12% higher in dry years and 5% lower in
25 critical years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 Overall in the American River, the effects of Alternative 9 on flow would not have biologically
27 meaningful effects on juvenile, adult or kelt steelhead migration.

28 Mean monthly water temperatures in the American River at the confluence with the Sacramento
29 River were evaluated during the March through April steelhead kelt downstream migration period
30 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
31 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
32 temperature between NAA and Alternative 9 in any month or water year type throughout the
33 period.

34 ***Stanislaus River***

35 Flows in the Stanislaus River at the confluence with the San Joaquin River for Alternative 9 are not
36 different from flows under NAA for any month. Therefore, there would be no effect of Alternative 9
37 on juvenile, adult, or kelt migration in the Stanislaus River.

38 Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San
39 Joaquin River for Alternative 9 are not different from flows under NAA for any month. Therefore,
40 there would be no effect of Alternative 9 on juvenile, adult, or kelt migration in the Stanislaus River.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis for Alternative 9 are not different from flows under NAA
3 for any month. Therefore, there would be no effect of Alternative 9 on juvenile, adult, or kelt
4 migration in the San Joaquin River.

5 Water temperature modeling was not conducted in the San Joaquin River.

6 **Mokelumne River**

7 Flows in the Mokelumne River at the Delta for Alternative 9 are not different from flows under NAA
8 for any month. Therefore, there would be no effect of Alternative 9 on juvenile, adult, or kelt
9 migration in the Mokelumne River.

10 Water temperature modeling was not conducted in the Mokelumne River.

11 **Through-Delta**

12 **Sacramento River**

13 *Juveniles*

14 Under Alternative 9, Sacramento River flows at Rio Vista during the juvenile steelhead migration
15 period (October–May) would be similar to NAA (<7% difference) (Appendix 11C, *CALSIM II Model*
16 *Results utilized in the Fish Analysis*). Little difference in flows would occur under Alternative 9 in May
17 and June, compared to NAA. Based on DPM modeling for Chinook salmon, through-Delta survival of
18 steelhead is expected to increase as a result of fish screens at the mouth of the DCC and Georgiana
19 Slough which would prevent juveniles from entering the interior Delta where survival rates are
20 lower than for the Sacramento River mainstem. The effect on Sacramento River basin juvenile
21 steelhead outmigration success would be similar to NAA, and thus there is not a substantial effect.

22 *Adults*

23 The proportion of January-March Sacramento River flows in the Delta under Alternative 9 would be
24 reduced 9% to 10% compared to NAA (Table 11-9-15). The proportion of Sacramento River flows
25 would represent 57–66% of Delta outflows over the course of the entire adult steelhead migration.
26 Therefore olfactory cues would be strong during the entire migration period. The impact on adult
27 steelhead would not be substantial.

28 **San Joaquin River**

29 *Juveniles*

30 Migration conditions for San Joaquin River basin steelhead juveniles would overall be improved
31 under Alternative 9 compared to NAA conditions. The Old River fish migration corridor would be
32 isolated from the Middle River water conveyance corridor, thereby reducing entrainment losses of
33 juvenile steelhead. There would be increased flows in the fish migration corridor as more San
34 Joaquin River flows are diverted into the Old River; the increase in flows would reduce steelhead
35 transit times through the Delta and thus increase survival rates. There would be a predation risk for
36 juvenile steelhead as they travel through Frank's Tract to the False River, however there are several
37 other routes to the San Joaquin River that would not require passing through Frank's Tract. Overall,
38 the amount of predator-dense habitat to transit would be reduced for San Joaquin River fish.

1 *Adults*

2 Little information apparently currently exists as to the importance of Plan Area flows on the straying
3 of adult San Joaquin River region steelhead, in contrast to San Joaquin River fall-run Chinook salmon
4 (Marston et al. 2012). Although information specific to steelhead is not available, for this analysis of
5 effects, it was assumed with moderate certainty that the attribute of Plan Area flows (including
6 olfactory cues associated with such flows) is of high importance to adult San Joaquin River region
7 steelhead adults as well.

8 Upstream migration of San Joaquin River basin steelhead adults would be slightly affected by the
9 change in operations under Alternative 9. The proportion of San Joaquin River-origin water in the
10 flows at Collinsville would be 0.1% to 8.9% during the migration period, compared to 0.3% to 2.6%
11 under NAA (Table 11-9-15). This change would increase olfactory cues from San Joaquin River basin
12 relative to NAA. Steelhead would generally be attracted to migrate upstream of False River into the
13 Old River fish migration corridor, because most of San Joaquin River basin flows would be routed
14 into the Old River corridor under Alternative 9 increasing olfactory cues. For adult steelhead that do
15 not migrate upstream of False River, they would migrate further upstream in the San Joaquin River
16 and potentially into the Middle River water conveyance pathway or into the San Joaquin River past
17 Stockton up to the barrier at Old River where passage would be available. Steelhead that migrate
18 into the Middle River would be subject to entrainment at the SWP/CVP south Delta facilities. Overall
19 there would be a beneficial impact on the species because the majority of steelhead adults would
20 likely migrate upstream the Old River migration corridor which would be isolated from confounding
21 flow cues and entrainment effects at the south Delta export facilities.

22 **NEPA Effects:** Collectively, these results indicate that there would be no substantial negative effects
23 through Delta on the Sacramento River, through Delta on the San Joaquin River or upstream of the
24 Delta.

25 There would be no negative effects on through-Delta survival or migration. The effect of Alternative
26 9 on Sacramento River basin juvenile steelhead outmigration success would be similar to NAA
27 conditions. The effects would not be adverse.

28 Through Delta San Joaquin River basin conditions for juveniles would be improved because of the
29 Old River fish migration corridor reducing entrainment losses and increased flows reducing transit
30 times and increasing survival. Through Delta San Joaquin River adult fish would also experience
31 increased olfactory cues, generally improved migration routes, and reduced entrainment at the
32 south Delta facilities resulting in an overall beneficial effect on the species.

33 Upstream of the Delta these results indicate that the effect would not be adverse because it would
34 not substantially affect migration habitat or substantially interfere with the movement of fish. Flows
35 under Alternative 9 in each waterway examined would not be reduced enough or in high enough
36 frequency relative to the NAA to affect steelhead migration. Effects on flow in all rivers analyzed
37 consist primarily of negligible effects ($\leq 5\%$), with relatively infrequent small to moderate increases
38 in flow (to 30%) that would have beneficial effects on migration conditions, and small and/or
39 infrequent moderate decreases in flow (to -28%) that would not affect migration conditions. Effects
40 of Alternative 9 on water temperature would also be negligible in all locations analyzed.

41 **CEQA Conclusion:** In general, the quantity and quality of steelhead migration habitat would not be
42 negatively affected by Alternative 9 water operations relative to the CEQA baseline, upstream of the
43 Delta, through Delta on the Sacramento River and through Delta on the San Joaquin River.

1 **Upstream of the Delta**

2 ***Sacramento River***

3 *Juveniles*

4 Flows in the Sacramento River upstream of Red Bluff were evaluated during the October through
5 May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
6 *Analysis*). Flows under A9_LLТ would be generally similar to or greater than Existing Conditions
7 during November through February, April and May, and lower flows in March and October.

8 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
9 during the October through May juvenile steelhead migration period (Appendix 11D, *Sacramento*
10 *River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).
11 There would be no differences (<5%) in mean monthly water temperature between Existing
12 Conditions and Alternative 9 in all months but October, in which the temperature under Alternative
13 9 would be 5% greater than that under Existing Conditions.

14 *Adults*

15 Flows in the Sacramento River upstream of Red Bluff were evaluated during the September through
16 March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in*
17 *the Fish Analysis*). Flows under A9_LLТ would be generally similar to or greater than Existing
18 Conditions during November through February, April and May, and lower flows than Existing
19 Conditions in March and October, and mixed flows in September (higher in wet and above normal
20 years and lower in dry and critical years).

21 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
22 during the September through March steelhead adult upstream migration period (Appendix 11D,
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
24 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
25 Existing Conditions and Alternative 9 in all months except October, in which the temperature under
26 Alternative 9 would be 5% greater than that under Existing Conditions.

27 *Kelts*

28 Flows in the Sacramento River upstream of Red Bluff were evaluated during the March and April
29 steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*
30 *Fish Analysis*). Flows under A9_LLТ would generally be similar to those under Existing Conditions
31 during March and April except in below normal water years during March (11% lower) and critical
32 water years during April (20% lower).

33 Mean monthly water temperatures in the Sacramento River upstream of Red Bluff were evaluated
34 during the March through April steelhead kelt downstream migration period (Appendix 11D,
35 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
36 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
37 Existing Conditions and Alternative 9 in any month or water year type throughout the period.

38 Overall in the Sacramento River, project-related effects of Alternative 9 on mean monthly flow
39 would not affect juvenile, adult, or kelt steelhead migration based on a prevalence of negligible

1 effects with a few, isolated, small increases in flow that would have beneficial effects and decreases
2 that would not have biologically meaningful effects on migration conditions.

3 **Clear Creek**

4 Water temperatures were not modeled in Clear Creek.

5 Flows in Clear Creek during the October through May juvenile steelhead migration period under
6 A9_LLT would generally be similar to or greater than flows under Existing Conditions (up to 54%
7 greater) except in critical years during November (6% lower) (Appendix 11C, *CALSIM II Model*
8 *Results utilized in the Fish Analysis*).

9 **Adults**

10 Flows in Clear Creek during the September through March adult steelhead migration period under
11 A9_LLT would generally be similar to flows under Existing Conditions (up to 54% greater) except in
12 critical years during September and November (38% and 6% lower, respectively) (Appendix 11C,
13 *CALSIM II Model Results utilized in the Fish Analysis*).

14 **Kelt**

15 Flows in Clear Creek during the March through April steelhead kelt downstream migration period
16 under A9_LLT would generally be similar to or greater than flows under Existing Conditions with
17 10% higher flows in critical years during both months (Appendix 11C, *CALSIM II Model Results*
18 *utilized in the Fish Analysis*).

19 Overall in Clear Creek, the impacts of Alternative 9 on flows would not affect juvenile, adult, or kelt
20 steelhead migration.

21 **Feather River**

22 **Juveniles**

23 Flows in the Feather River at the confluence with the Sacramento River were examined during the
24 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
25 *utilized in the Fish Analysis*). Flows under A9_LLT would generally be lower than flows under
26 Existing Conditions during October, November, January and March (except for some wet and above
27 normal water years with higher flows), similar to Existing Conditions in April, and mixed higher and
28 lower flows during December, February, March and May depending on water year type.

29 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
30 were evaluated during the October through May juvenile steelhead migration period (Appendix 11D,
31 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
32 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
33 Existing Conditions and Alternative 9 in all months except October, November and December, in
34 which temperatures under Alternative 9 would be 5% greater than temperatures under Existing
35 Conditions.

36 **Adults**

37 Flows in the Feather River at the confluence with the Sacramento River were examined during the
38 September through March adult steelhead upstream migration period (Appendix 11C, *CALSIM II*

1 *Model Results utilized in the Fish Analysis*). Flows under A9_LLТ would generally be lower than flows
2 under Existing Conditions during October, November, and January (except for some wet and above
3 normal water years with higher flows), and mixed higher and lower flows during September,
4 December, February, and March depending on water year type.

5 Mean monthly water temperatures in the Feather River at the confluence with the Sacramento River
6 were evaluated during the September through March steelhead adult upstream migration period
7 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
8 *utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water
9 temperature between Existing Conditions and Alternative 9 in all months except October, November
10 and December, in which temperatures under Alternative 9 would be 5% greater than temperatures
11 under Existing Conditions.

12 ***Kelt***

13 Flows in the Feather River at the confluence with the Sacramento River were examined during the
14 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
15 *Results utilized in the Fish Analysis*). Flows under A9_LLТ compared to Existing Conditions would be
16 mixed during March (higher flows in wet and above normal years and lower flows in below normal,
17 dry, and critical years) and similar to or slightly greater than Existing Conditions during April (7%
18 higher during dry water years). Mean monthly water temperatures in the Feather River at the
19 confluence with the Sacramento River were evaluated during the March through April steelhead kelt
20 downstream migration period (Appendix 11D, *Sacramento River Water Quality Model and*
21 *Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences
22 (<5%) in mean monthly water temperature between Existing Conditions and Alternative 9 in any
23 month or water year type throughout the period.

24 Overall in the Feather River, the impact of Alternative 9 on flows would affect juvenile, adult, and
25 kelt migration conditions due to a prevalence of lower flows and higher temperatures.

26 ***American River***

27 ***Juveniles***

28 Flows in the American River at the confluence with the Sacramento River were evaluated during the
29 October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results*
30 *utilized in the Fish Analysis*). Flows under A9_LLТ would generally be lower during October,
31 November, December, January, and May (up to 36% lower). Flows during February and March
32 would generally be higher (up to 27%) except that February flows would be 16% lower in critical
33 water years. Flows in January and April would be mixed with both higher and lower flows than
34 under Existing Conditions depending on individual water year types.

35 Mean monthly water temperatures in the American River at the confluence with the Sacramento
36 River were evaluated during the October through May juvenile steelhead migration period
37 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
38 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 5% to
39 11% higher than those under Existing Conditions in all months during the period except December
40 and April, in which there would be no difference in water temperatures between Existing Conditions
41 and Alternative 9.

1 **Adults**

2 Flows in the American River at the confluence with the Sacramento River were evaluated during the
3 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
4 *Model Results utilized in the Fish Analysis*). Flows under A9_LLTP would generally be lower during
5 September, October, November, December, January, and May (up to 40% lower). Flows during
6 February and March would generally be higher (up to 27%) except that February flows would be
7 16% lower in critical water years. Flows in January would be mixed with both higher and lower
8 flows than under Existing Conditions depending on individual water year types.

9 Mean monthly water temperatures in the American River at the confluence with the Sacramento
10 River were evaluated during the September through March steelhead adult upstream migration
11 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
12 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would
13 be 5% to 11% higher than those under Existing Conditions in all months during the period except
14 December, in which there would be no difference in water temperatures between Existing
15 Conditions and Alternative 9.

16 **Kelt**

17 Flows in the American River at the confluence with the Sacramento River were evaluated for the
18 March and April kelt migration period. Flows during March would generally be higher (up to 14%)
19 than under Existing Conditions. Flows during April would be mixed with both higher and lower
20 flows depending on water year type than under Existing Conditions. Mean monthly water
21 temperatures in the American River at the confluence with the Sacramento River were evaluated
22 during the March through April steelhead kelt downstream migration period (Appendix 11D,
23 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
24 *Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 5% higher than
25 those under Existing Conditions in March but temperatures would be similar between Existing
26 Conditions and Alternative 9 during April.

27 Overall in the American River, the impacts of Alternative 9 on flows would affect juvenile, adult and
28 kelt steelhead migration in drier water years.

29 **Stanislaus River**

30 **Juveniles**

31 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
32 October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II*
33 *Model Results utilized in the Fish Analysis*). Mean monthly flows under A9_LLTP would be 7% to 18%
34 lower than flows under Existing Conditions depending on month.

35 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
36 River were evaluated during the October through May steelhead juvenile downstream migration
37 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
38 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would
39 be 6% higher than those under Existing Conditions in all months during the period except October,
40 in which temperature would be similar between Existing Conditions and Alternative 9.

1 **Adults**

2 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
3 September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II*
4 *Model Results utilized in the Fish Analysis*). Mean monthly flows under A9_LLT would be 7% to 18%
5 lower than flows under Existing Conditions depending on month.

6 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
7 River were evaluated during the September through March steelhead adult upstream migration
8 period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model*
9 *Results utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would
10 be 6% higher than those under Existing Conditions in all months during the period except October,
11 in which temperature would be similar between Existing Conditions and Alternative 9.

12 **Kelt**

13 Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the
14 March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model*
15 *Results utilized in the Fish Analysis*). Mean monthly flows under A9_LLT would be 8% to 11% lower
16 than flows under Existing Conditions during March and April, respectively.

17 Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin
18 River were evaluated during the March and April steelhead kelt downstream migration period
19 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
20 *utilized in the Fish Analysis*). Mean monthly water temperatures under Alternative 9 would be 6%
21 higher than those under Existing Conditions during March and April.

22 **San Joaquin River**

23 Flows in the San Joaquin River for Alternative 9 are generally below those under Existing Conditions
24 for juveniles, adults or kelts (e.g., 13% lower in dry years during March and 10% lower in critical
25 years during April) except during January and November. Flows during January are similar to or
26 greater than Existing Conditions and flows during November are generally similar to Existing
27 Conditions.

28 Water temperature modeling was not conducted in the San Joaquin River.

29 **Mokelumne River**

30 Flows in the Mokelumne River for Alternative 9 are generally substantially below those under
31 Existing Conditions for juveniles, adults or kelts (e.g., 17% lower in below normal years during May)
32 except for higher flow conditions in some water years for January, February and December (up to
33 18% higher).

34 Water temperature modeling was not conducted in the Mokelumne River.

35 **Through-Delta**

36 The migration success for juvenile steelhead migrating down the Sacramento River would be similar
37 to Existing Conditions based on DPM results for winter-run Chinook salmon under Alternative 9.
38 Olfactory cues for steelhead migrating upstream the Sacramento River would also be similar to
39 Existing Conditions during the initial period of upstream migration, but would be reduced during

1 the later portion of the migration. The proportion of Sacramento River flows in the Delta would be
2 reduced 11–12% from January–March. Flows during the overall adult steelhead migration would
3 still represent 57–66% of Delta outflows. Based on the strength of olfactory cues and the similar in
4 Rio Vista flows, the impact would not be substantial.

5 Juvenile steelhead would benefit from increased flows transferred into the Old River corridor from
6 the San Joaquin River. The Old River fish migration corridor would be isolated from the Middle River
7 water conveyance corridor, reducing entrainment loss. The Old River fish migration corridor would
8 also reduce fish lost to false migration pathways into the south-central Delta. They still would be
9 exposed to potential predation loss as they migrate through or around Frank’s Tract into the San
10 Joaquin River, but this a greatly reduced amount of predator occupied habitat compared to the other
11 alternatives. Increased flows in the Old River corridor would reduce transit times and help mitigate
12 the predation risk. Overall the impact on juvenile steelhead migration from the San Joaquin River
13 basin would not be substantial.

14 For adult San Joaquin River basin steelhead, upstream migration success would depend on the
15 migration pathway selected. The majority of steelhead would migrate through the Old River fish
16 migration corridor because the San Joaquin River flow would be routed into the Old River thus
17 improving attraction cues. For steelhead adults utilizing the Old River corridor, migration success
18 would be improved relative to Existing Conditions because the corridor reduces false migration
19 pathways and would be isolated from the south Delta export facilities. Steelhead that migrate
20 upstream into the Middle River would be subject to entrainment at the south Delta facilities as there
21 is no opportunity for steelhead to migrate from the Middle River water conveyance corridor into the
22 Old River fish migration corridor. Salvaged steelhead could be returned to Old River. Steelhead that
23 migrate up the San Joaquin River past Stockton could pass through the barrier located downstream
24 of Old River. Overall the impact on adult steelhead would be unknown but is expected not to be
25 substantial because the majority of steelhead would use the Old River corridor where passage
26 would be improved.

27 **Summary of CEQA Conclusion**

28 The results of the Impact AQUA-96 analysis indicate different impacts between Alternative 9 and
29 Existing Conditions on locations upstream of the Delta, through Delta conditions on the Sacramento
30 River and through Delta conditions on the San Joaquin River.

31 Through-Delta migration success for juvenile Sacramento River steelhead under Alternative 9 would
32 be similar to Existing Conditions. Olfactory cues for adult Sacramento River steelhead would also be
33 similar to Existing Conditions for much of the upstream migration period. These impacts would not
34 be significant and no mitigation is required.

35 Through Delta San Joaquin River basin conditions for juveniles would be improved because of the
36 Old River fish migration corridor reducing entrainment losses and increased flows reducing transit
37 times and increasing survival. Through Delta San Joaquin River adult fish would also experience
38 increased olfactory cues, generally improved migration routes, and reduced entrainment at the
39 south Delta facilities. The impacts are less than significant and no mitigation is required.

40 Upstream of the Delta, collectively, the results of the Impact AQUA-96 CEQA analysis indicate that
41 the difference between the CEQA baseline and Alternative 9 could be significant because, under the
42 CEQA baseline, the alternative could substantially reduce the amount of suitable migration habitat
43 and substantially interfere with the movement of fish, contrary to the NEPA conclusion set forth

1 above. There would be flow reductions in the Feather, American, Stanislaus, San Joaquin, and
2 Mokelumne rivers and temperature increases in the Feather, American, and Stanislaus rivers that
3 would affect juvenile and adult steelhead migration. Impacts of Alternative 9 on flow would not have
4 biologically meaningful effects on kelt migration in any of the locations analyzed, or on juvenile and
5 adult migration in the Sacramento River and Clear Creek.

6 These results are primarily caused by four factors: differences in sea level rise, differences in climate
7 change, future water demands, and implementation of the alternative. The analysis described above
8 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
9 alternative from those of sea level rise, climate change and future water demands using the model
10 simulation results presented in this chapter. However, the increment of change attributable to the
11 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
12 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
13 implementation period, which does include future sea level rise, climate change, and water
14 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
15 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
16 effect of the alternative from those of sea level rise, climate change, and water demands.

17 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
18 term implementation period and Alternative 9 indicates that flows in the locations and during the
19 months analyzed above would generally be similar between Existing Conditions during the LLT and
20 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
21 found above would generally be due to climate change, sea level rise, and future demand, and not
22 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
23 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
24 result in a significant impact on migration habitat for steelhead. This impact is found to be less than
25 significant and no mitigation is required.

26 **Restoration Measures (CM2, CM4–CM7, and CM10)**

27 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
28 differences in restoration-related fish effects are anticipated anywhere in the affected environment
29 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
30 restoration measures described for steelhead under Alternative 1A (Impact AQUA-97 through
31 Impact AQUA-99) also appropriately characterize effects under Alternative 9.

32 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

33 **Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead**

34 **Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead**

35 **Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead**

36 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
37 steelhead, and most would be at least slightly beneficial. Specifically for AQUA-98, the effects of
38 contaminants on steelhead with respect to selenium, copper, ammonia and pesticides would not be
39 adverse. The effects of methylmercury on steelhead are uncertain.

1 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial,
2 or less than significant, and no mitigation is required.

3 **Other Conservation Measures (CM12–CM19 and CM21)**

4 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
5 differences in other conservation-related fish effects are anticipated anywhere in the affected
6 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
7 effects of other conservation measures described for steelhead under Alternative 1A (Impact AQUA-
8 100 through Impact AQUA-108) also appropriately characterize effects under Alternative 9.

9 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

10 **Impact AQUA-100: Effects of Methylmercury Management on Steelhead (CM12)**

11 **Impact AQUA-101: Effects of Invasive Aquatic Vegetation Management on Steelhead (CM13)**

12 **Impact AQUA-102: Effects of Dissolved Oxygen Level Management on Steelhead (CM14)**

13 **Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (CM15)**

14 **Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (CM16)**

15 **Impact AQUA-105: Effects of Illegal Harvest Reduction on Steelhead (CM17)**

16 **Impact AQUA-106: Effects of Conservation Hatcheries on Steelhead (CM18)**

17 **Impact AQUA-107: Effects of Urban Stormwater Treatment on Steelhead (CM19)**

18 **Impact AQUA-108: Effects of Removal/Relocation of Nonproject Diversions on Steelhead**
19 **(CM21)**

20 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
21 adverse effect, or beneficial effects on steelhead for NEPA purposes, for the reasons identified for
22 Alternative 1A.

23 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
24 less than significant, or beneficial on steelhead, for the reasons identified for Alternative 1A, and no
25 mitigation is required.

26 **Sacramento Splittail**

27 **Construction and Maintenance of CM1**

28 Sacramento splittail eggs, larvae, juvenile young-of-the-year, and adult spawners could occur in the
29 north Delta, south Delta and east Delta in June or July (see Table 11-6). Adult non-spawners could
30 occur in the north Delta in October and November.

1 **Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento**
2 **Splittail**

3 The potential effects of construction of water conveyance facilities on Sacramento splittail would be
4 similar to but greater than those described under Impact AQUA-109 under Alternative 1A.
5 Alternative 9 would have more in-water construction locations than Alternative 1A, which would
6 result in a temporary and permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to
7 28.7 acres for Alternative 1A (Table 11-5). Dredging under Alternative 9 would total 56.9 acres
8 (Table 11-9-1) compared to 27.5 acres under Alternative 1A (Table 11-5). Rock bank protection
9 under Alternative 9 would total 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-
10 5). The effects related to temporary increases in turbidity, accidental spills, and disturbance of
11 contaminated sediments would be similar to Alternative 1A, Impact AQUA-109 and the same
12 environmental commitments and mitigation measures (see Impact AQUA-1 for delta smelt and
13 Appendix 3B, *Environmental Commitments*) would be available to avoid and minimize potential
14 effects.

15 The potential for Sacramento splittail to be exposed to impact pile driving noise would be relatively
16 small, given the relatively small areas affected by underwater noise, and the expected limited use of
17 impact pile driving. Therefore, the potential for larval and juvenile Sacramento splittail to
18 experience an adverse effect (e.g., injury or mortality) from impact pile driving would be low.
19 Mitigation Measures AQUA-1a and AQUA-1b would serve to further minimize the potential for
20 effects from underwater noise.

21 **NEPA Effects:** Overall, as concluded for Alternative 1A, Impact AQUA-109, the effect would not be
22 adverse for Sacramento splittail.

23 **CEQA Conclusion:** Although Alternative 9 affects a larger in-water area than Alternative 1A, as
24 described in Impact AQUA-109, the impact of construction of the water conveyance facilities on
25 splittail would be less than significant except for construction noise associated with pile driving.
26 However, implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
27 reduce that noise impact to less than significant.

28 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
29 **of Pile Driving and Other Construction-Related Underwater Noise**

30 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

31 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
32 **and Other Construction-Related Underwater Noise**

33 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

34 **Impact AQUA-110: Effects of Maintenance of Water Conveyance Facilities on Sacramento**
35 **Splittail**

36 Although the facilities involved in maintenance activities under Alternative 9 (screen and gates)
37 would differ from the intakes of Alternative 1A, the same types of effects resulting from
38 maintenance activities would apply.

1 **NEPA Effects:** The potential effects of the maintenance of water conveyance facilities under
2 Alternative 9 would be the same as those described for Alternative 1A (see Impact AQUA-110), and
3 would not be adverse for Sacramento splittail.

4 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
5 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects
6 resulting from maintenance activities would apply. Consequently, as described in Alternative 1A,
7 Impact AQUA-110 for Sacramento splittail, the impact of the maintenance of water conveyance
8 facilities on Sacramento splittail would be less than significant and no mitigation would be required.

9 **Water Operations of CM1**

10 **Impact AQUA-111: Effects of Water Operations on Entrainment of Sacramento Splittail**

11 Juvenile splittail are vulnerable to entrainment at the south Delta export facilities when they migrate
12 from floodplain rearing habitat into Delta channels. Under Existing Conditions, large numbers of
13 juveniles are entrained in wetter years, when inundation of floodplain habitat and the Yolo Bypass
14 results in very high splittail production. Under Alternative 9, entrainment of splittail, particularly
15 those juveniles produced in the Yolo Bypass, would be substantially reduced due to the isolation of
16 the Old River fish corridor and associated channels from the pumping effects of the SWP/CVP south
17 Delta facilities. In addition, screening of the north Delta intakes at DCC and Georgiana Slough would
18 also reduce the number of splittail from the north Delta that enter Alternative 9's main conveyance
19 channel via Middle River. Juveniles produced from San Joaquin floodplains upstream of the Delta
20 would also be isolated from entrainment at the south Delta facilities by the creation of the isolated
21 fish migration corridor along Old River. Overall, this would benefit splittail.

22 **Water Exports from SWP/CVP North Delta Intake Facilities**

23 Entrainment of splittail would be minimal because the north Delta intakes at Georgiana Slough and
24 DCC would be screened to exclude juvenile and adult splittail. There would still be a risk of injury
25 from impingement associated with these north Delta intakes, and there would be monitoring to
26 assess these effects.

27 **Water Export with a Dual Conveyance for the SWP North Bay Aqueduct**

28 The effect of implementing dual conveyance for the NBA with a screened alternative Sacramento
29 River intake would be the same as described under Alternative 1A (Impact AQUA-111).

30 **Predation Associated with Entrainment**

31 Predation loss of juvenile splittail associated with the SWP/CVP south Delta facilities would be
32 substantially decreased because entrainment to these facilities would be substantially reduced
33 under Alternative 9.

34 Localized predation may increase if predatory fish aggregate at the new screened intake facilities to
35 be constructed at DCC and Georgiana Slough. There would potentially be increased predation loss in
36 the vicinity of the operable barriers designed to isolate the Old River fish migration corridor from
37 the Middle River water conveyance corridor. Predators are already abundant in this area of the
38 Delta, however, so the overall impact of the new operable barriers is expected to be minor.

1 Impacts of potential predation at Alternative 9's two north Delta intake facilities would be similar to
2 those described for Alternative 3, which has similar total screen length for NDD intakes (see
3 Alternative 3, Impact AQUA-111).

4 Potential predation at the north Delta would be offset by reduced predation loss at the SWP/CVP
5 south Delta intakes and the increased production of juvenile splittail resulting from CM2 actions
6 (Yolo Bypass Fisheries Enhancement). Further, the fishery agencies concluded that predation was
7 not a factor currently limiting splittail abundance.

8 Predators may aggregate near the operable barriers placed in various channels to isolate the Old
9 River fish passage corridor and the Middle River conveyance corridor, but the effect may not be
10 substantially greater than the NAA, because predators are already abundant in the interior and
11 south Delta. Monitoring can be implemented to determine whether predation at physical barriers
12 reaches levels of concern

13 **NEPA Effects:** Overall, effects from entrainment and entrainment-related predation on Sacramento
14 splittail would be beneficial to Sacramento splittail.

15 **CEQA Conclusion:** As described above in Impact AQUA-111, the potential impacts of operations on
16 Sacramento splittail entrainment and predation losses are considered to be beneficial, because
17 increased predation losses associated with screening structures would be offset by the substantial
18 reduction in entrainment losses from the isolation of the water conveyance corridor and the
19 increased production of juvenile splittail in the Yolo Bypass. No mitigation would be required.

20 **Impact AQUA-112: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 21 **Sacramento Splittail**

22 Sacramento splittail spawn in floodplains and channel margins and in side-channel habitat upstream
23 of the Delta, primarily in the Sacramento River and Feather River. Floodplain spawning
24 overwhelmingly dominates production in wet years. During low-flow years when floodplains are not
25 inundated, spawning in side channels and channel margins would be much more critical.

26 In general, Alternative 9 would have beneficial effects on splittail spawning habitat relative to the
27 NAA due to substantial increases in the quantity and quality of suitable spawning habitat in the Yolo
28 Bypass. There would also be beneficial effects on channel margin and side-channel spawning habitat
29 due to small to moderate increases in mean monthly flow in the Sacramento River and the Feather
30 River for a portion of the spawning period, and reduced exposures to critical water temperatures in
31 the Feather River.

32 **Floodplain Habitat**

33 Effects of Alternative 9 on floodplain spawning habitat were evaluated for Yolo Bypass. Increased
34 flows into Yolo Bypass may reduce flooding and flooded spawning habitat to some extent in the
35 Sutter Bypass (the upstream counterpart to Yolo Bypass) but this effect was not quantified. Effects
36 in Yolo Bypass were evaluated using a habitat suitability approach based on water depth (2 m
37 threshold) and inundation duration (minimum of 30 days). Effects of flow velocity were ignored
38 because flow velocity was generally very low throughout the modeled area for most conditions, with
39 generally 80 to 90% of the total available area having flow velocities of 0.5 foot per second or less (a
40 reasonable critical velocity for early life stages of splittail; Young and Cech 1996).

1 The proposed changes to the Fremont Weir would increase the frequency and duration of Yolo
 2 Bypass inundation events compared to NAA for above normal to critical water year types and
 3 slightly decrease the frequency and duration of Yolo Bypass inundation events for wet water years;
 4 the changes are attributable to the influence of the Fremont Weir notch at lower flows. There would
 5 be a small decrease in 30–49-day events, and a slightly larger decrease in 50–69-day inundation
 6 events, in wet years, that would be partly offset by an increase in ≥70-day events in wet years. For
 7 the drier type years (below normal, dry, and critical), Alternative 9 results in an increase in
 8 frequency of inundation events greater than 30 days compared to NAA. For below normal years,
 9 Alternative 9 would result in the occurrence of 1 inundation event ≥70 days, compared to 0 such
 10 events for NAA. For critical years, Alternative 9 would result in the occurrence of 1 inundation event
 11 30–49 days, compared to 0 such events for NAA. The overall project-related effects consist of an
 12 increase in occurrence of longer-duration inundation events during drier years that would be
 13 beneficial for splittail spawning by creating better spawning habitat conditions. (Figure 11-9-2,
 14 Table 11-9-52).

15 **Table 11-9-52. Differences in Frequencies of Inundation Events (for 82-Year Simulations) of**
 16 **Different Durations on the Yolo Bypass under Different Scenarios and Water Year Types, February**
 17 **through June, from 15 2-D and Daily CALSIM II Modeling Runs**

Number of Days of Continuous Inundation	Change in Number of Inundation Events for Each Scenario	
	EXISTING CONDITIONS vs. A9_LL1	NAA vs. A9_LL1
30–49 Days		
Wet	-4	-2
Above Normal	-1	-1
Below Normal	4	4
Dry	1	1
Critical	1	1
50–69 Days		
Wet	-5	-5
Above Normal	1	1
Below Normal	0	0
Dry	0	0
Critical	0	0
≥70 Days		
Wet	8	7
Above Normal	1	1
Below Normal	1	1
Dry	0	0
Critical	0	0

18
 19 There would be increases in area of suitable splittail habitat in Yolo Bypass under Alternative 9
 20 ranging from 5 to 944 acres relative to NAA (Table 11-9-53). Areas under A9_LL1 would be 56%,
 21 54%, and 185% greater than areas under NAA in wet, above normal, and below normal water years,
 22 respectively. There would be increases in area under A9_LL1 for critical years relative to NAA, but
 23 they would be minimal (5 acres) and there would be no increases in area for dry years. These results
 24 indicate that increases in inundated acreage in most water year types would result in increased
 25 habitat and have a beneficial effect on splittail spawning.

1 **Table 11-9-53. Increase in Splittail Weighted Habitat Area (acres and percent) in Yolo Bypass from**
 2 **Existing Biological Conditions to Alternative 9 by Water Year Type from 15 2-D and Daily CALSIM II**
 3 **Modeling Runs**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	1,083 (70%)	944 (56%)
Above Normal	627 (55%)	619 (54%)
Below Normal	230 (175%)	234 (185%)
Dry	0 (NA)	0 (NA)
Critical	5 (NA)	5 (NA)

NA = percent differences could not be computed because little or no splittail weighted habitat occurred in the bypass for NAA and Existing Conditions in those years (dividing by 0).

4
 5 A potential adverse effect of Alternative 9 that is not included in the modeling is reduced inundation
 6 of the Sutter Bypass as a result of increased flow diversion at the Fremont Weir. The Fremont Weir
 7 notch with gates opened would increase the amount Sacramento River flow diverted from the river
 8 into the bypass when the river’s flow is greater than about 14,600 cfs (Munévar pers. comm.). As
 9 much as about 6,000 cfs more flow would be diverted from the river with the opened notch than
 10 without the notch, resulting in a 6,000 cfs decrease in Sacramento River flow at the weir. A decrease
 11 of 6,000 cfs in the river, according to rating curves developed for the river at the Fremont Weir,
 12 could result in as much as 3 feet of reduction in river stage (Munévar pers. comm.), although
 13 understanding of how notch flows would affect river stage is incomplete (Kirkland pers. comm.). In
 14 any case, a lower river stage at the Fremont Weir would be expected to result in a lower level of
 15 inundation in the lower Sutter Bypass. Because of the uncertainties regarding how drawdown of the
 16 river will propagate, the relationship between notch flow and the magnitude of lower Sutter Bypass
 17 inundation is poorly known. Despite this uncertainty, it is evident that CM2 has the potential to
 18 reduce some of the habitat benefits of Yolo Bypass inundation on splittail production due to effects
 19 on Sutter Bypass inundation. Splittail use the Sutter Bypass for spawning and rearing as they do the
 20 Yolo Bypass.

21 ***Channel Margin and Side-Channel Habitat***

22 Splittail spawning and larval and juvenile rearing also occur in channel margin and side-channel
 23 habitat upstream of the Delta. These habitats are likely to be especially important during dry years,
 24 when flows are too low to inundate the floodplains (Sommer et al. 2007). Side-channel habitats are
 25 affected by changes in flow because greater flows cause more flooding, thereby increasing
 26 availability of such habitat, and because rapid reductions in flow dewater the habitats, potentially
 27 stranding splittail eggs and rearing larvae. Effects of the BDCP on flows in years with low-flows are
 28 expected to be most important to the splittail population because in years of high-flows, when most
 29 production comes from floodplain habitats, the upstream side-channel habitats contribute relatively
 30 little production.

31 Effects on channel margin and side-channel habitat were evaluated by comparing flow conditions
 32 for the Sacramento River at Wilkins Slough and the Feather River at the confluence with the
 33 Sacramento River for the time-frame February through June. These are the most important months
 34 for splittail spawning and larval rearing (Sommer pers. comm.), and juveniles likely emigrate from
 35 the side-channel habitats during May and June if conditions become unfavorable.

1 Differences between model scenarios for monthly average flows during February through June by
2 water-year type were determined for the Sacramento River at Wilkins Slough and for the Feather
3 River at the confluence (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

4 For the Sacramento River at Wilkins Slough (Appendix 11C, *CALSIM II Model Results utilized in the*
5 *Fish Analysis*) flows during February through June under A9_LLTT would be similar to flows under
6 NAA with the exception of occurrences of flow increases of 10% to 32% for drier water year types in
7 April and June. These results indicate that there would be some increases of flow (up to 32%) that
8 would have beneficial effects for splittail spawning conditions in the Sacramento River.

9 For the Feather River at the confluence flows during February through June would be similar to or
10 with small increases in flow compared to NAA (Appendix 11C, *CALSIM II Model Results utilized in the*
11 *Fish Analysis*). During April there would be a small increase in flow in dry years (7%), and moderate
12 increases during May in drier water year types (to 25%) that would have beneficial effects on
13 splittail spawning conditions in the Feather River.

14 Simulated daily and monthly water temperatures in Sacramento River at Hamilton City and Feather
15 River at the confluence with the Sacramento River, respectively were used to investigate the
16 potential effects of Alternative 9 on the suitability of water temperatures for splittail spawning and
17 egg incubation. A range of 45°F to 75°F was selected as the suitable range for splittail spawning and
18 egg incubation.

19 There would be no biologically meaningful difference (>5% absolute scale) between NAA and
20 Alternative 9 in the frequency of water temperatures in the Sacramento and Feather Rivers being
21 within the suitable 45°F to 75°F regardless of water year type (Table 11-9-54).

1 **Table 11-9-54. Difference (Percent Difference) in Percent of Days or Months^a during February to**
 2 **June in Which Temperature Would Be below 45°F or above 75°F in the Sacramento River at**
 3 **Hamilton City and Feather River at the Confluence with the Sacramento River^b**

	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
Sacramento River at Hamilton City		
<i>Temperatures below 45°F</i>		
Wet	-4 (-86%)	0 (0%)
Above Normal	-4 (-86%)	0 (0%)
Below Normal	-4 (-79%)	0 (0%)
Dry	-2 (-68%)	0 (0%)
Critical	-9 (-32%)	0 (0%)
All	-7 (-19%)	0 (0%)
<i>Temperatures above 75°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
Feather River at Sacramento River Confluence		
<i>Temperatures below 45°F</i>		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)
<i>Temperatures above 75°F</i>		
Wet	5 (NA)	0 (0%)
Above Normal	7 (NA)	-2 (-20%)
Below Normal	11 (NA)	0 (0%)
Dry	14 (325%)	1 (6%)
Critical	12 (700%)	-2 (-11%)
All	10 (780%)	-0.2 (-2%)

NA = could not be calculated because the denominator was 0.

^a Days were used in the Sacramento River and months were used in the Feather River.

^b Based on the modeling period of 1922 to 2003.

4
 5 Overall effects of Alternative 9 on flow consist of negligible effects (<5%) attributable to the project
 6 or beneficial effects on spawning conditions through increases in mean monthly flow (to 57%) in
 7 the Sacramento and Feather rivers and reduced occurrence of critical high water temperatures in
 8 the Feather River that would have beneficial effects on splittail spawning conditions (Table 11-9-
 9 54).

10 Overall, Alternative 9 would have negligible or beneficial effects on upstream spawning and rearing
 11 conditions in the upper Sacramento and Feather rivers.

1 **Stranding Potential**

2 As indicated above, rapid reductions in flow can dewater channel margin and side-channel habitats,
3 potentially stranding splittail eggs and rearing larvae. Due to a lack of quantitative tools and
4 historical data to evaluate possible stranding effects, the following provides a narrative summary of
5 potential effects. The Yolo Bypass is exceptionally well-drained because of grading for agriculture,
6 which likely helps limit stranding mortality of splittail. Moreover, water stage decreases on the
7 bypass are relatively gradual (Sommer et al. 2001). Stranding of Sacramento splittail in perennial
8 ponds on the Yolo Bypass does not appear to be a problem under Existing Conditions (Feyrer et al.
9 2004). Yolo Bypass improvements would be designed, in part, to further reduce the risk of stranding
10 by allowing water to inundate certain areas of the bypass to maximize biological benefits, while
11 keeping water away from other areas to reduce stranding in isolated ponds. Actions under
12 Alternative 9 to increase the frequency of Yolo Bypass inundation would increase the frequency of
13 potential stranding events. For splittail, an increase in inundation frequency would also increase the
14 production of Sacramento splittail in the bypass. While total stranding losses may be greater under
15 Alternative 9 than under NAA, the total number of splittail would be expected to be greater under
16 Alternative 9.

17 In the Yolo Bypass, Sommer et al. (2005) found these potential losses are offset by the improvement
18 in rearing conditions. Henning et al. (2006) also noted the potential for stranding risk as wetlands
19 desiccate and oxygen concentrations decline, but the seasonal timing of use by juveniles may
20 decrease these risks. Sommer et al. (2005) addressed the question of stranding and concluded the
21 potential improvements in habitat capacity outweighed the potential stranding problems that may
22 exist in some years.

23 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
24 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
25 as a result of egg mortality. The effects of Alternative 9 on splittail spawning habitat are largely
26 beneficial. There would be substantial benefits due to increased inundation acreages and an
27 increase in longer duration inundation events in the Yolo Bypass that would increase suitable
28 spawning conditions. Effects of Alternative 9 on mean monthly flows would consist primarily of
29 negligible effects (<5%) with occasional increases in flow (to 32% in the Sacramento River and to
30 25% in the Feather River) that would have beneficial effects on spawning conditions, with no
31 reductions in flow. Effects on flow then would be beneficial for spawning conditions. Effects of
32 Alternative 9 on water temperatures would be negligible in the Sacramento River, and would consist
33 of primarily beneficial effects (reduced occurrence of preferred temperature exceedances) in the
34 Feather River. There would be negligible effects on water temperatures in the Sacramento and
35 Feather Rivers, relative to NAA.

36 **CEQA Conclusion:** In general, Alternative 9 would have beneficial effects on splittail spawning
37 habitat relative to the Existing Conditions by increasing the quantity of spawning habitat in the Yolo
38 Bypass through increased acreage subjected to periodic inundation. There would be negligible
39 effects on channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and
40 the Feather River, with some beneficial effect due to increases in mean monthly flow for some
41 months and water year types during the spawning period. There would be negative effects on water
42 temperatures in the Feather River relative to the Existing Conditions, but the benefits due to
43 increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water
44 temperatures in the Feather River because the Yolo Bypass is a more important spawning habitat to

1 splittail than channel margin habitat in the Feather River, as evidenced by the large amount of
2 spawning activity when inundated.

3 ***Floodplain Habitat***

4 The proposed changes to the Fremont Weir under Alternative 9 would have moderate effects on the
5 frequency and duration of Yolo Bypass inundation events compared to Existing Conditions, with the
6 largest changes including both increases and decreases in longer-duration inundation events in
7 wetter water years and primarily no effect (0% difference) in drier water years (Table 11-9-52).
8 Comparisons of splittail weighted habitat area for Alternative 9 to Existing Conditions (Table 11-9-
9 53) indicate that Alternative 9 would result in increased acreage of suitable spawning habitat in
10 most water year types, of between 5 and 1,083 acres, depending on water year type. Increased areas
11 for wet, above normal, and below normal water years are predicted to be 70%, 55%, and 175%,
12 respectively, for Alternative 9. Comparisons for dry and critical water years indicate no project-
13 related change in inundated acreage for dry years and a project-related increase of 5 acres of
14 suitable spawning habitat in critical years, compared to 0 acres under Existing Conditions. These
15 results indicate that Alternative 9 would have beneficial effects on splittail habitat through
16 increasing spawning habitats by up to 175%.

17 ***Channel Margin and Side-Channel Habitat***

18 Modeled flows were evaluated in the Sacramento River at Wilkins Slough for the February through
19 June splittail spawning and early life stage rearing period (Appendix 11C, *CALSIM II Model Results*
20 *utilized in the Fish Analysis*). Results indicate that Alternative 9 would have primarily negligible
21 effects (<5%) and small-scale increases and decreases in mean monthly flow (to 15%) during
22 February through April. Effects of Alternative 9 during May, and June consist primarily of small to
23 moderate increases in flow (to 44%) that would have beneficial effects on spawning conditions, with
24 the exception of one moderate reduction in flow during May in wet years (-19%), when effects of
25 flow reductions on spawning conditions would be less critical. Therefore, the impact on spawning
26 habitat for Sacramento splittail on the upper Sacramento River would be less than significant.

27 Flows in the Feather River at the confluence with the Sacramento River were evaluated during
28 February through June. Flows during this period would generally be similar between Existing
29 Conditions and A9_LLTT during February, April and May with some exceptions, and with substantial
30 decreases during June and drier water years during March. (Appendix 11C, *CALSIM II Model Results*
31 *utilized in the Fish Analysis*). These results show that Alternative 9 on flow would not have
32 biologically meaningful effects on splittail rearing conditions in the Feather River.

33 There would be no difference between Existing Conditions and A9_LLTT in the number of years with
34 water temperatures below 45°F (Table 11-7-54) because there are never any months with
35 temperatures below 45°F under any scenario. Exceedances above 75°F under A9_LLTT would occur
36 more often than under Existing Conditions in dry and critical water years but not in other water
37 years. These results indicate that Alternative 9 would have negative temperature effects on splittail
38 spawning in the Feather River in dry and critical water years and would have no effect in below
39 normal, above normal and wet water year types.

40 ***Stranding Potential***

41 As described in the NEPA effects section above, rapid reductions in flow can dewater channel
42 margin and side-channel habitats, potentially stranding splittail eggs and rearing larvae. Due to a

1 lack of quantitative tools and historical data to evaluate possible stranding effects, potential effects
2 have been evaluated with a narrative summary. Effects for Alternative 9 would be as described for
3 Alternative 1A, which concludes that Yolo Bypass improvements would be designed, in part, to
4 further reduce the risk of stranding by allowing water to inundate certain areas of the bypass to
5 maximize biological benefits, while keeping water away from other areas to reduce stranding in
6 isolated ponds.

7 Collectively, these results indicate that the impact would be less than significant because it would
8 not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a
9 result of egg mortality, and no mitigation would be necessary. The effects of Alternative 9 on splittail
10 spawning habitat are largely beneficial. There would be substantial benefits due to increased
11 inundation acreages and an increase in longer duration inundation events in the Yolo Bypass that
12 would increase suitable spawning conditions. Benefits due to increased inundation in the Yolo
13 Bypass would outweigh relatively small, project-related increases in exceedance of preferred water
14 temperatures in the Feather River. This is because the Yolo Bypass is a more important splittail
15 spawning habitat than the Feather River channel margin habitat, as evidenced by the large amount
16 of spawning activity in the Yolo Bypass when inundated. Effects of Alternative 9 on mean monthly
17 flows would consist primarily of negligible effects (<5%), increases in flow (to 44% in the
18 Sacramento River and to 29% in the Feather River) that would have beneficial effects on spawning
19 conditions, with small, infrequent reductions in flow (to -19%) in the Sacramento River and more
20 persistent and substantial flow reductions (to -31%) in the Feather River that would occur at the
21 end of the spawning period and therefore would not have biologically meaningful effects on
22 spawning conditions.

23 **Summary of CEQA Conclusion**

24 Overall, these results indicate that the impact is less than significant because it would not
25 substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result
26 of egg mortality. No mitigation is necessary. Benefits to spawning habitat availability in the Yolo
27 Bypass would outweigh negative effects of increased exposures to water temperatures above the
28 upper threshold of 75°F in the Feather River, especially in drier water year types. Increased
29 occurrence of higher water temperatures would increase stress to splittail, but only a small
30 percentage of spawning occurs in the Feather River relative to the Yolo Bypass. Therefore, this
31 would have a less-than-significant impact on the splittail population. There would be negligible
32 effects on water temperatures in the Sacramento and Feather Rivers, relative to Existing Conditions.

33 The NEPA and CEQA conclusions differ for this impact statement because they were determined
34 using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA
35 and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These
36 baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water
37 years whereas the CEQA Existing Conditions do not. Second, the NAA baseline is assumed to occur
38 during the late long-term implementation period whereas the CEQA conclusion assume existing
39 climate conditions. Therefore, differences in model outputs between Existing Conditions and the
40 Alternative 1A are due primarily to both the alternative and future climate change.

41 **Impact AQUA-113: Effects of Water Operations on Rearing Habitat for Sacramento Splittail**

42 In general, Alternative 9 would have beneficial effects on splittail rearing habitat relative to the NAA
43 by increasing the quantity and quality of rearing habitat in the Yolo Bypass. There would be

1 beneficial effects on rearing conditions in channel margin and side-channel habitats from moderate
2 to substantial increases in mean monthly flow during most of the rearing period in the Sacramento
3 River and the Feather River. There would be a beneficial effect from reduced exposure to critical
4 water temperatures in the Feather River.

5 Floodplains are important rearing habitats for juvenile splittail during periods of high flows when
6 areas like the Yolo Bypass are inundated. During low flows when floodplains are not inundated,
7 splittail rear in side-channel and channel margin habitat. Therefore, the previous impact discussion
8 applies to rearing as well as spawning habitat for splittail.

9 **NEPA Effects:** Based on the analyses above, the effect of Alternative 9 on splittail rearing habitat
10 would not be adverse because it would not substantially reduce rearing habitat or substantially
11 reduce the number of fish as a result of mortality.

12 **CEQA Conclusion:** In general, Alternative 9 would have beneficial effects on splittail rearing habitat
13 relative to Existing Conditions by increasing the quantity of rearing habitat in the Yolo Bypass
14 through increased acreage subjected to periodic inundation. There would be negligible effects on
15 channel margin and side-channel habitats in the Sacramento River at Wilkins Slough and the
16 Feather River, with beneficial effect due to moderate to substantial increases in mean monthly flow
17 for some months and water year types during the rearing period. There would be negative effects on
18 water temperatures in the Feather River relative to Existing Conditions, but the benefits due to
19 increased inundation in the Yolo Bypass would outweigh the detrimental effects of increased water
20 temperatures in the Feather River because the Yolo Bypass is a more important rearing habitat to
21 splittail than channel margin habitat in the Feather River as evidenced by the large amount of
22 rearing activity when inundated.

23 As described above, floodplains are important rearing habitats for juvenile splittail during periods of
24 high flows when areas like the Yolo Bypass are inundated. During low flows when floodplains are
25 not inundated, splittail rear in side-channel and channel margin habitat. Therefore, the previous
26 impact discussion applies to rearing as well as spawning habitat for splittail. Based on the analyses
27 above, the impact of Alternative 9 on splittail rearing habitat would be less than significant because
28 it would not substantially reduce rearing habitat or substantially reduce the number of fish as a
29 result of mortality, and no mitigation would be necessary.

30 **Impact AQUA-114: Effects of Water Operations on Migration Conditions for Sacramento** 31 **Splittail**

32 **Upstream of the Delta**

33 In general, effects of Alternative 9 would not affect splittail migration conditions in the Sacramento
34 River or the Feather River relative to the NAA, based on negligible or beneficial effects on mean
35 monthly flow during the migration period and exposure to critical water temperatures in the
36 Feather River.

37 The effects of Alternative 9 on splittail migration conditions would be the same as described for
38 channel margin and side-channel habitats in the Sacramento River and Feather River for Impact
39 AQUA-112 above. There would be benefits to channel margin and side-channel habitat in both
40 locations from increases in mean monthly flow, and from decreased exposure to critical high water
41 temperatures compared to NAA conditions.

1 **Through-Delta**

2 Movement patterns within the Delta are not well understood. Under Alternative 9, screened intakes
3 from the Sacramento River at DCC and Georgiana sloughs would limit movement of splittail from the
4 Sacramento River into the central Delta. Several operable barriers would be installed to provide safe
5 fish migration corridors and to isolate water conveyance corridors (at head of Old River and San
6 Joaquin River, sloughs and canals between Old River and Middle River, locations at the mouth of Old
7 River, and near the lower Mokelumne River). The barriers would alter potential movement
8 pathways between the eastern Delta and other regions, and from the Sacramento River to the San
9 Joaquin River, but the degree of isolation would depend on timing and duration of closure. The
10 operable nature of the barriers would reduce impacts to migration conditions. Most barriers would
11 be operated to pass high flows, which would maintain periodic connectivity among Delta regions.

12 **NEPA Effects:** Alternative 9 would not substantially reduce or degrade upstream migration habitat
13 conditions or substantially reduce associated splittail mortality. While operable barriers would
14 provide safer migration and isolated water conveyance corridors through the Delta, they could also
15 restrict movement pathways within the Delta. Therefore, Alternative 9 could have minor effects on
16 through-Delta migration conditions. Overall, Alternative 9 would not be adverse to the splittail
17 population or their migration conditions.

18 **CEQA Conclusion:**

19 **Upstream of the Delta**

20 In general, effects of Alternative 9 would have beneficial effects on splittail migration conditions
21 relative to Existing Conditions, based on moderate to substantial increases in mean monthly flow in
22 the Sacramento River and the Feather River. There would be a negative effect based on a small
23 increase in exposure to critical water temperatures in the Feather River but this would be offset by
24 the more substantial beneficial effects from increases in mean monthly flow for much of the
25 migration period.

26 Effects of Alternative 9 on splittail migration conditions would be similar to those described for
27 channel margin and side-channel habitats in Impact AQUA-112. As concluded above, the impact
28 would be less than significant because it would not substantially reduce suitable migration habitat
29 or substantially reduce the number of fish as a result of mortality and no mitigation would be
30 necessary. Effects of Alternative 9 on flow would not have negative effects on the availability of
31 channel margin and main-channel habitat, and would have a beneficial effect through increases in
32 mean monthly flow for some months and water year types during the migration period. Benefits to
33 flow conditions would outweigh negative effects of increased exposures to critical water
34 temperatures in the Feather River.

35 **Through-Delta**

36 As described above in Impact AQUA-112, the potential impact is considered less than significant, and
37 no mitigation would be required.

38 **Summary of CEQA Conclusion**

39 Effects of Alternative 9 on upstream migration habitat would be beneficial, relative to Existing
40 Conditions, because of moderate to substantial increases in mean monthly flow in the Sacramento
41 River and the Feather River. The small increase in potential exposure to critical water temperatures

1 in the Feather River, would be offset by improved flows during much of the migration period.
2 Alternative 9 would also have only minor effects on through-Delta migration conditions. Overall,
3 Alternative 9 would be less than significant to the splittail population or their migration conditions,
4 and no mitigation would be required.

5 **Restoration Measures (CM2, CM4–CM7, and CM10)**

6 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
7 differences in restoration-related fish effects are anticipated anywhere in the affected environment
8 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
9 restoration measures described for Sacramento splittail under Alternative 1A (Impact AQUA-115
10 through Impact AQUA-117) also appropriately characterize effects under Alternative 9.

11 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

12 **Impact AQUA-115: Effects of Construction of Restoration Measures on Sacramento Splittail**

13 **Impact AQUA-116: Effects of Contaminants Associated with Restoration Measures on**
14 **Sacramento Splittail**

15 **Impact AQUA-117: Effects of Restored Habitat Conditions on Sacramento Splittail**

16 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
17 Sacramento splittail, and most would be at least slightly beneficial. Specifically for AQUA-116, the
18 effects of contaminants on Sacramento splittail with respect to selenium, copper, ammonia and
19 pesticides would not be adverse. The effects of methylmercury on Sacramento splittail are
20 uncertain.

21 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial,
22 or less than significant, and no mitigation is required.

23 **Other Conservation Measures (CM12–CM19 and CM21)**

24 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
25 differences in other conservation-related fish effects are anticipated anywhere in the affected
26 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
27 effects of other conservation measures described for Sacramento splittail under Alternative 1A
28 (Impact AQUA-118 through Impact AQUA-126) also appropriately characterize effects under
29 Alternative 9.

30 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

31 **Impact AQUA-118: Effects of Methylmercury Management on Sacramento Splittail (CM12)**

32 **Impact AQUA-119: Effects of Invasive Aquatic Vegetation Management on Sacramento**
33 **Splittail (CM13)**

34 **Impact AQUA-120: Effects of Dissolved Oxygen Level Management on Sacramento Splittail**
35 **(CM14)**

1 **Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail**
2 **(CM15)**

3 **Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (CM16)**

4 **Impact AQUA-123: Effects of Illegal Harvest Reduction on Sacramento Splittail (CM17)**

5 **Impact AQUA-124: Effects of Conservation Hatcheries on Sacramento Splittail (CM18)**

6 **Impact AQUA-125: Effects of Urban Stormwater Treatment on Sacramento Splittail (CM19)**

7 **Impact AQUA-126: Effects of Removal/Relocation of Nonproject Diversions on Sacramento**
8 **Splittail (CM21)**

9 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
10 adverse effect, or beneficial effects on Sacramento splittail for NEPA purposes, for the reasons
11 identified for Alternative 1A.

12 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
13 less than significant, or beneficial on Sacramento splittail, for the reasons identified for Alternative
14 1A, and no mitigation is required.

15 **Green Sturgeon**

16 **Construction and Maintenance of CM1**

17 **Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon**

18 The potential effects of construction of water conveyance facilities on green sturgeon would be
19 similar to but greater than those described under Impact AQUA-127, under Alternative 1A.
20 Alternative 9 would have more construction impact locations, resulting in temporary and
21 permanent in-water footprint of 31.4 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A
22 (Table 11-5). Dredging under Alternative 9 would total 56.9 acres (Table 11-9-1) compared to 27.5
23 acres under Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total
24 4,800 feet compared to 3,600 feet under Alternative 1A (Table 11-5). The effects related to
25 temporary increases in turbidity, accidental spills, in-water work activities, and disturbance of
26 contaminated sediments would be similar to Alternative 1A and the same environmental
27 commitments and mitigation measures would be available to avoid and minimize potential effects
28 (see Impact AQUA-1 for delta smelt and Appendix 3B, *Environmental Commitments*). The number of
29 juveniles that could be present in the north Delta during construction of the cofferdams, would
30 result in a moderate risk of exposure to potentially harmful underwater sound levels. Therefore,
31 there is a moderate potential for juvenile green sturgeon to experience an adverse effect (e.g., injury
32 or mortality). However, the relatively low incidence and intermittent use of impact pile driving
33 expected, and implementation of the avoidance and minimization measures included in Mitigation
34 Measures AQUA-1a and AQUA-1b would minimize potential effects.

35 **NEPA Effects:** Overall, the effects of Alternative 9 on green sturgeon would not be adverse.

36 **CEQA Conclusion:** Although Alternative 9 affects a larger in-water area than Alternative 1A, as
37 described in Impact AQUA-127, the impact of construction of the water conveyance facilities on

1 green sturgeon would be less than significant except for construction noise associated with pile
2 driving. The number of sites where noise impacts would potentially occur are greater under
3 Alternative 9 because it has more operable barrier construction sites than Alternative 1A. However,
4 implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
5 that noise impact to less than significant.

6 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
7 **of Pile Driving and Other Construction-Related Underwater Noise**

8 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

9 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
10 **and Other Construction-Related Underwater Noise**

11 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

12 **Impact AQUA-128: Effects of Maintenance of Water Conveyance Facilities on Green Sturgeon**

13 Although the facilities involved in maintenance activities under Alternative 9 (screen and gates)
14 would differ from the intakes of Alternative 1A, the same types of effects resulting from
15 maintenance activities would apply. Consequently, the potential effects of the maintenance of water
16 conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A
17 (see Impact AQUA-128).

18 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-128, the impact would not be adverse
19 for green sturgeon.

20 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
21 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects
22 resulting from maintenance activities would apply. Consequently, as described in Alternative 1A,
23 Impact AQUA-128 for green sturgeon, the impact of the maintenance of water conveyance facilities
24 on green sturgeon would be less than significant and no mitigation would be required.

25 **Water Operations of CM1**

26 **Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon**

27 Alternative 9 would substantially reduce entrainment of juvenile green sturgeon at the south Delta
28 export facilities compared to the NAA, due to screening and operable barriers to isolate fish
29 corridors from water conveyance corridors. Fish screens at north Delta intakes (DCC and Georgiana
30 Slough) would prevent entrainment and would reduce exposure to entrainment at agricultural
31 diversions in the east Delta. The effect would be beneficial.

32 **Predation Associated with Entrainment**

33 The impact would be the same as described for green sturgeon in Alternative 2A (see Impact AQUA-
34 129). In general, sturgeon in the Delta have low risk of predation from other fish because juvenile
35 sturgeon grow rapidly and develop protective bony scutes.

36 **NEPA Effects:** The overall effect of Alternative 9 operations on entrainment would benefit green
37 sturgeon. The effect would be beneficial.

1 **CEQA Conclusion:** As described in Alternative 2A, Impact AQUA-129 for green sturgeon, the impact
2 of the water operations on green sturgeon would be beneficial and no mitigation would be required.

3 **Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
4 **Green Sturgeon**

5 In general, Alternative 9 would not affect spawning and egg incubation habitat for green sturgeon
6 relative to the NAA.

7 **Sacramento River**

8 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
9 Bluff during the March to July spawning and egg incubation period for green sturgeon. Lower flows
10 can reduce the instream area available for spawning and egg incubation (Appendix 11C, *CALSIM II*
11 *Model Results utilized in the Fish Analysis*). Flows under A9_LLT would always be similar to or
12 greater than flows under NAA at both locations although flows can be lower or higher in individual
13 months of individual years. These results indicate that there would be very few reductions in flows
14 in the Sacramento River under Alternative 9.

15 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
16 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,
17 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
18 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
19 NAA and Alternative 9 in any month or water year type throughout the period.

20 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was
21 determined for each month (May through September) and year of the 82-year modeling period
22 (Table 11-9-8). The combination of number of days and degrees above the 63°F threshold were
23 further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and
24 Alternative 9 in the highest level of concern across all months and all 82 modeled years are
25 presented in Table 11-9-55. There would be substantial increases the number of days with “orange”
26 and “yellow” “levels of concern” between NAA and Alternative 9.

27 **Table 11-9-55. Differences between Baseline and Alternative 9 Scenarios in the Number of Years**
28 **in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern,**
29 **Sacramento River at Bend Bridge, May through September**

Level of Concern	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Red	10 (250%)	1 (7%)
Orange	3 (300%)	3 (75%)
Yellow	6 (300%)	3 (38%)
None	-19 (-25%)	-7 (-13%)

30
31 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type
32 during May through September (Table 11-9-56). Total degree-days under Alternative 9 would be
33 17% higher than under NAA during June, and no different (<5%) in the other months of the period.

1 **Table 11-9-56. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days (°F-**
 2 **Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the**
 3 **Sacramento River at Bend Bridge, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	55 (423%)	0 (0%)
	Above Normal	4 (NA)	-1 (-20%)
	Below Normal	3 (NA)	1 (50%)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	0 (0%)
	All	63 (485%)	0 (0%)
June	Wet	1 (NA)	1 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	1 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	19 (NA)	1 (6%)
	All	21 (NA)	3 (17%)
July	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	2 (NA)
	Dry	1 (NA)	1 (NA)
	Critical	612 (7,650%)	-18 (-2.8%)
	All	614 (7,675%)	-16 (-3%)
August	Wet	2 (NA)	-1 (-33%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	78 (NA)	12 (18%)
	Critical	1,507 (750%)	-54 (-3%)
	All	1,588 (790%)	-41 (-2%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	-2 (-100%)
	Below Normal	7 (NA)	-6 (-46%)
	Dry	511 (1,648%)	28 (5%)
	Critical	1,256 (470%)	-6 (0%)
	All	1,775 (596%)	16 (1%)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
 7 the Sacramento River during the March through June green sturgeon spawning and egg incubation
 8 period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT
 9 would almost always be similar to or greater than flows under NAA at both locations, except in dry
 10 years during March at Thermalito (7% lower). These results indicate that there would be very few
 11 reductions in flows in the Feather River under Alternative 9 independent of climate change.

1 Mean monthly water temperatures in the Feather River at Gridley were examined during the
2 February through June green sturgeon spawning and egg incubation period (Appendix 11D,
3 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
4 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
5 NAA and Alternative 9 in any month or water year type throughout the period.

6 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
7 was evaluated during May through September (Table 11-9-57). For this impact, only the months of
8 May and June were examined because spawning and egg incubation does not generally extend
9 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131. In
10 both May and June, the percent of months exceeding the threshold under Alternative 9 would be
11 similar to or lower (up to 17% lower on an absolute scale) than the percent under NAA.

12 **Table 11-9-57. Differences between Baseline and Alternative 9 Scenarios in Percent of Months**
13 **during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather**
14 **River at Gridley Exceed the 64°F Threshold, May through September**

Month	Degrees Above Threshold				
	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. A9_LL1					
May	30 (92%)	21 (113%)	11 (113%)	11 (300%)	6 (250%)
June	6 (7%)	9 (10%)	14 (17%)	27 (42%)	36 (74%)
July	0 (0%)	0 (0%)	0 (0%)	10 (11%)	23 (34%)
August	0 (0%)	0 (0%)	9 (9%)	19 (23%)	25 (40%)
September	-6 (-9%)	0 (0%)	17 (61%)	27 (367%)	23 (950%)
NAA vs. A9_LL1					
May	-10 (-14%)	-17 (-30%)	-11 (-35%)	-4 (-20%)	-4 (-30%)
June	0 (0%)	0 (0%)	-2 (-3%)	-1 (-1%)	-4 (-4%)
July	0 (0%)	0 (0%)	0 (0%)	0 (0%)	-5 (-5%)
August	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	-10 (-10%)
September	-5 (-7%)	-5 (-8%)	-4 (-8%)	-9 (-20%)	-2 (-9%)

15
16 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
17 May through September (Table 11-9-58). Only May and June were examined for spawning and egg
18 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-
19 months exceeding the threshold under Alternative 9 would be 10% lower than that under NAA
20 during May and no different (<5%) in June.

1 **Table 11-9-58. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Months**
 2 **(°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 64°F in**
 3 **the Feather River at Gridley, May through September**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
May	Wet	26 (433%)	2 (7%)
	Above Normal	12 (109%)	-2 (-8%)
	Below Normal	21 (263%)	-3 (-9%)
	Dry	19 (136%)	-10 (-23%)
	Critical	18 (106%)	-2 (-5%)
	All	95 (170%)	-16 (-10%)
June	Wet	68 (91%)	1 (1%)
	Above Normal	27 (53%)	-2 (-3%)
	Below Normal	33 (51%)	1 (1%)
	Dry	49 (52%)	-4 (-3%)
	Critical	38 (68%)	-1 (-1%)
	All	214 (63%)	-6 (-1%)
July	Wet	23 (14%)	7 (4%)
	Above Normal	15 (28%)	-2 (-3%)
	Below Normal	32 (47%)	0 (0%)
	Dry	54 (63%)	10 (8%)
	Critical	62 (78%)	8 (6%)
	All	186 (41%)	23 (4%)
August	Wet	15 (8%)	-2 (-1%)
	Above Normal	19 (42%)	-3 (-4%)
	Below Normal	32 (46%)	0 (0%)
	Dry	82 (121%)	4 (3%)
	Critical	49 (58%)	-1 (-1%)
	All	197 (44%)	-2 (0%)
September	Wet	-25 (-64%)	2 (17%)
	Above Normal	-6 (-38%)	3 (43%)
	Below Normal	36 (129%)	-4 (-6%)
	Dry	53 (189%)	1 (1%)
	Critical	51 (255%)	-3 (-4%)
	All	109 (83%)	-1 (0%)

NA = could not be calculated because the denominator was 0.

4

5 **San Joaquin River**

6 Flows in the San Joaquin River at Vernalis under Alternative 9 would be similar to flows under NAA
 7 during the March through June spawning and egg incubation period, (Appendix 11C, *CALSIM II*
 8 *Model Results utilized in the Fish Analysis*).

9 No water temperatures modeling was conducted in the San Joaquin River.

1 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
2 not have the potential to substantially reduce the amount of suitable habitat. There would be limited
3 project-related effects to flows and water temperatures in the Sacramento and Feather Rivers that
4 would not affect spawning and egg incubation conditions for green sturgeon.

5 **CEQA Conclusion:** In general, Alternative 9 would not affect spawning and egg incubation habitat for
6 green sturgeon relative to Existing Conditions.

7 **Sacramento River**

8 Mean monthly flows were examined in the Sacramento River between Keswick and upstream of Red
9 Bluff during the March to July spawning and egg incubation period for green sturgeon. Flows under
10 A9_LL1T at both locations would generally be similar to or greater than under Existing Conditions,
11 except in below normal years during March at both locations (11% to 20% lower), wet years during
12 May at both locations (20% to 25% lower), above normal years during March and April at Keswick
13 (7% lower for both), and below normal years during April (7% lower) at Keswick although flows
14 can be lower or higher in individual months of individual years (Appendix 11C, *CALSIM II Model*
15 *Results utilized in the Fish Analysis*).

16 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
17 the March through July green sturgeon spawning and egg incubation period (Appendix 11D,
18 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
19 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
20 Existing Conditions and Alternative 9 in any month or water year type throughout the period, except
21 for a 5% increase in wet years during May.

22 The number of days on which temperature exceeded 63°F by >0.5°F to >5°F in 0.5°F increments was
23 determined for each month (May through September) and year of the 82-year modeling period
24 (Table 11-9-55). The combination of number of days and degrees above the 63°F threshold were
25 further assigned a “level of concern”, as defined in Table 11-9-9. Differences between baselines and
26 Alternative 9 in the highest level of concern across all months and all 82 modeled years are
27 presented in Table 11-9-10. The number of “red” years would be 250% higher under Alternative 9
28 relative to Existing Conditions.

29 Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type
30 during May through September (Table 11-9-56). Water temperatures under Alternative 9 would
31 exceed the threshold 63 degree-days (485%) and 21 degree-days (no relative change calculation
32 possible due to division by 0) more than those under Existing Conditions during May and June,
33 respectively.

34 **Feather River**

35 Flows were examined in the Feather River between Thermalito Afterbay and the confluence with
36 the Sacramento River during the March through June green sturgeon spawning and egg incubation
37 period. At Thermalito Afterbay, flows under A9_LL1T would generally be similar to or greater than
38 those under Existing Conditions, except in below normal and dry years during March (39% and 18%
39 lower, respectively) and wet years during May and June (35% and 21% lower, respectively)
40 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At the confluence with the
41 Sacramento River, flows under A9_LL1T would generally be up to 31% lower during March and June,
42 and generally similar to or greater than flows under Existing Conditions during the April and May,

1 except in wet and above normal years during May (27% and 11% lower, respectively). These results
2 indicate that there would be reductions in flows in the Feather River under Alternative 9 relative to
3 Existing Conditions. Mean monthly water temperatures in the Feather River at Gridley were
4 examined during the February through June green sturgeon spawning and egg incubation period
5 (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results*
6 *utilized in the Fish Analysis*). There would generally be no differences (<5%) in mean monthly water
7 temperature between Existing Conditions and Alternative 9 in any month or water year type
8 throughout the period, except during February, in which mean monthly temperatures under
9 Alternative 9 would be 6% higher than that under Existing Conditions.

10 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
11 was evaluated during May through September (Table 11-9-57). For this impact, only the months of
12 May and June were examined because spawning and egg incubation does not generally extend
13 beyond June in the Feather River. Subsequent months are examined under Impact AQUA-131.
14 During the period, the percent of months exceeding the threshold under Alternative 9 would be
15 similar to or higher (up to 23% higher on an absolute scale) than the percent under Existing
16 Conditions.

17 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
18 May through September (Table 11-9-58). Only May and June were examined for spawning and egg
19 incubation habitat here. Subsequent months are examined under Impact AQUA-131. Total degree-
20 months exceeding the threshold under Alternative 9 would be 43% to 154% higher than those
21 under Existing Conditions during May and June.

22 ***San Joaquin River***

23 Flows in the San Joaquin River at Vernalis under Alternative 9 would be up to 38% lower than flows
24 under Existing Conditions during the March through June spawning and egg incubation period,
25 particularly in drier water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 No water temperatures modeling was conducted in the San Joaquin River.

27 Collectively, the results of the Impact AQUA-130 CEQA analysis indicate that the difference between
28 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
29 alternative could substantially reduce suitable spawning and egg incubation habitat and
30 substantially reduce the number of fish from egg mortality, contrary to the NEPA conclusion set
31 forth above. There would be flow reductions during substantial portions of the green sturgeon
32 spawning and egg incubation period under Alternative 9 in the Feather and San Joaquin rivers.
33 Further, there would be low, but persistent, temperature increases of Alternative 9.

34 These results are primarily caused by four factors: differences in sea level rise, differences in climate
35 change, future water demands, and implementation of the alternative. The analysis described above
36 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
37 alternative from those of sea level rise, climate change and future water demands using the model
38 simulation results presented in this chapter. However, the increment of change attributable to the
39 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
40 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
41 implementation period, which does include future sea level rise, climate change, and water
42 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
4 term implementation period and Alternative 9 indicates that flows in the locations and during the
5 months analyzed above would generally be similar between Existing Conditions during the LLT and
6 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
7 found above would generally be due to climate change, sea level rise, and future demand, and not
8 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
9 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
10 result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is
11 found to be less than significant and no mitigation is required.

12 **Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon**

13 **Upstream of the Delta**

14 In general, Alternative 9 would not reduce the quantity and quality of green sturgeon larval and
15 juvenile rearing habitat relative to the NAA.

16 Water temperature was used to determine the potential effects of H3 on green sturgeon larval and
17 juvenile rearing habitat because larvae and juveniles are benthically oriented and, therefore, their
18 habitat is more likely to be limited by changes in water temperature than flow rates.

19 ***Sacramento River***

20 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
21 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*
22 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There
23 would be no differences (<5%) in mean monthly water temperature between NAA and Alternative 9
24 in any month or water year type throughout the period.

25 ***Feather River***

26 Mean monthly water temperatures in the Feather River at Gridley were examined during the April
27 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
28 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
29 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 9 in any
30 month or water year type throughout the period.

31 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
32 was evaluated during May through September (Table 11-9-57). The percent of months exceeding
33 the threshold under Alternative 9 would be similar to or lower (up to 17% lower on an absolute
34 scale) than the percent under NAA in all months of the juvenile rearing period.

35 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
36 May through September (Table 11-9-58). Total degree-months exceeding the threshold under
37 Alternative 9 would be 10% lower than those under NAA during May and would be similar to (<5%)
38 those under NAA during June through September.

1 **San Joaquin River**

2 Water temperature modeling was not conducted in the San Joaquin River.

3 **Through-Delta**

4 Operable barriers on the eastern ends of Woodward Canal, Santa Fe Canal, and Connection Slough
5 would eliminate flows through these sloughs, potentially altering water quality conditions locally
6 and reducing habitat connectivity for Delta resident green sturgeon. The structural components of
7 these barriers would have small localized impacts on benthic habitat, but this loss of Delta benthic
8 habitat would be small overall (less than 1% loss). Changes to existing benthic foraging habitat
9 would be offset by creation of additional tidal habitat.

10 **NEPA Effects:** Collectively, the results indicate that the effect would not be adverse because it would
11 not substantially reduce suitable rearing habitat. Upstream flows and water temperatures under
12 Alternative 9 during the rearing period would not substantially differ in any river evaluated
13 between Alternative 9 and the NEPA point of comparison. Further, in-Delta rearing habitat would
14 not be affected by Alternative 9.

15 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of green
16 sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

17 **Sacramento River**

18 Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during
19 the May through October green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River*
20 *Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean
21 monthly water temperature under Alternative 9 would be similar to those under Existing Conditions
22 during May through July, but 5% to 9% lower than those under Existing Conditions during August
23 through October.

24 **Feather River**

25 Mean monthly water temperatures in the Feather River at Gridley were examined during the April
26 through August green sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water*
27 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
28 be no differences (<5%) in mean monthly water temperature between Existing Conditions and
29 Alternative 9 in any month of the rearing period.

30 The percent of months exceeding the 64°F temperature threshold in the Feather River at Gridley
31 was evaluated during May through September (Table 11-9-57). The percent of months exceeding
32 the threshold under Alternative 9 would be similar to or greater (up to 36% higher on an absolute
33 scale) than the percent under Existing Conditions in all months during the period.

34 Total degree-days exceeding 64°F were summed by month and water year type at Gridley during
35 May through September (Table 11-9-58). Total degree-months exceeding the threshold under
36 Alternative 9 would be 41% to 170% greater than those under Existing Conditions depending on
37 month.

38 **San Joaquin River**

39 Water temperature modeling was not conducted in the San Joaquin River.

1 **Through-Delta**

2 As described above in Impact AQUA-131 for the NEPA effect, the impact of the water operations on
3 green sturgeon rearing habitat would be less than significant and no mitigation would be required.

4 Collectively, the results of the Impact AQUA-131 CEQA analysis indicate that the difference between
5 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
6 alternative could substantially reduce suitable rearing habitat, contrary to the NEPA conclusion set
7 forth above. There would be temperature increases under Alternative 9 in the Sacramento and
8 Feather Rivers during the rearing period that could substantially degrade rearing habitat suitability.
9 There would be no effects of Alternative 9 on in-Delta rearing habitat.

10 These results are primarily caused by four factors: differences in sea level rise, differences in climate
11 change, future water demands, and implementation of the alternative. The analysis described above
12 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
13 alternative from those of sea level rise, climate change and future water demands using the model
14 simulation results presented in this chapter. However, the increment of change attributable to the
15 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
16 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
17 implementation period, which does include future sea level rise, climate change, and water
18 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
19 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
20 effect of the alternative from those of sea level rise, climate change, and water demands.

21 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
22 term implementation period and Alternative 9 indicates that flows in the locations and during the
23 months analyzed above would generally be similar between Existing Conditions during the LLT and
24 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
25 found above would generally be due to climate change, sea level rise, and future demand, and not
26 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
27 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
28 result in a significant impact on green sturgeon spawning and egg incubation habitat. This impact is
29 found to be less than significant and no mitigation is required.

30 **Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon**

31 **Upstream of the Delta**

32 In general, the effects of Alternative 9 on green sturgeon migration conditions relative to the NAA
33 are uncertain.

34 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
35 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
36 the Sacramento River during the April through October larval migration period, the August through
37 March juvenile migration period, and the November through June adult migration period (Appendix
38 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
39 entire year, flows during all months were compared. Reduced flows could slow or inhibit
40 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
41 cues and pass impediments by adults.

1 Sacramento River flows under A9_LLT would nearly always be similar to or greater than flows
2 under NAA in all months, except during October at Keswick (up to 14% lower) and during August
3 and October at Wilkins Slough (up to 15% lower).

4 Flows under A9_LLT would generally be lower by up to 14% than those under NAA in the Feather
5 River during October depending on location and water year type. Flows during other months under
6 A9_LLT would generally be similar to or greater than flows under NAA, with few exceptions (up to
7 22% lower) depending on month, location, and water year type.

8 Larval transport flows were also examined by utilizing the positive correlation between white
9 sturgeon year class strength and Delta outflow during April and May (USFWS 1995) under the
10 assumption that the mechanism responsible for the relationship is that Delta outflow provides
11 improved green sturgeon larval transport that results in improved year class strength. Results for
12 white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation
13 between Delta outflow and year class strength, green sturgeon year class strength would be lower
14 under Alternative 9.

15 **Through-Delta**

16 The impact of Alternative 9 on in-Delta conditions would be the same as described for splittail in
17 Impact AQUA-114. The effect on green sturgeon would not be adverse.

18 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 9 and
19 NAA. However, due to the removal of water at the north Delta intakes, there are substantial
20 differences in through-Delta flows between Alternative 9 and NAA (see Table 11-9-63 below).
21 Analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green
22 sturgeon, found a positive correlation between year class strength and Delta outflow during April
23 and May. However, this conclusion was reached in the absence of north Delta intakes and the exact
24 mechanism that causes this correlation is not known at this time. One hypothesis suggests that the
25 correlation is caused by high flows in the upper river resulting in improved migration, spawning,
26 and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation
27 is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river
28 to spawn. It is also possible that some combination of these factors are working together to produce
29 the positive correlation between high flows and sturgeon year-class strength.

30 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation
31 between year class strength and river/Delta flow will be addressed through targeted research and
32 monitoring to be conducted in the years leading up to the initiation of north Delta facilities
33 operations. If these targeted investigations determine that the primary mechanisms behind the
34 positive correlation between high flows and sturgeon year-class strength are related to upstream
35 conditions, then Alternative 9 would be deemed Not Adverse due to the similarities in upstream
36 flow conditions between Alternative 9 and NAA. However, if the targeted investigations lead to a
37 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and
38 through-Delta flow conditions, then Alternative 9 would be deemed Adverse due to the magnitude of
39 reductions in through-Delta flow conditions in Alternative 9 as compared to NAA.

40 **CEQA Conclusion:** In general, under Alternative 9 water operations, migration habitat for green
41 sturgeon would not be affected relative to the CEQA baseline.

1 Upstream of the Delta

2 Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between
3 Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with
4 the Sacramento River during the April through October larval migration period, the August through
5 March juvenile migration period, and the November through June adult migration period (Appendix
6 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the
7 entire year, flows during all months were compared. Reduced flows could slow or inhibit
8 downstream migration of larvae and juveniles and reduce the ability to sense upstream migration
9 cues and pass impediments by adults.

10 Sacramento River flows at Keswick under A9_LLT would generally be similar to or greater than
11 flows under Existing Conditions in all months, except during October and December (up to 15%
12 lower) and in some water year types throughout the rest of the period (up to 27% lower). Flows at
13 Wilkins Slough under A9_LLT would generally be similar to or greater than flows under Existing
14 Conditions in all months), except during October during which flows would be up to 13% lower than
15 under Existing Conditions, depending on month and water year type and in some water year types
16 throughout the rest of the period (up to 28% lower).

17 Flows in the Feather River at Thermalito under A9_LLT would generally be up to 55% lower than
18 flows under Existing Conditions during October through February and generally similar to or
19 greater than flows under Existing Conditions during the rest of the period, with some exceptions (up
20 to 56% lower). Flows in the Feather River at the confluence with the Sacramento River under
21 A9_LLT would generally be up to 35% lower than flows under Existing Conditions during March,
22 June, July and October, and generally similar to or greater than flows under Existing Conditions
23 during the rest of the period, with some exceptions (up to 33% lower).

24 For Delta outflow, the percent of months exceeding outflow thresholds under A9_LLT would nearly
25 always be lower than those under Existing Conditions for each flow threshold, water year type, and
26 month (up to 50% lower) with few exceptions (see Table 11-9-63 below).

27 Through-Delta

28 As described above, the potential impact is considered less than significant, and no mitigation would
29 be required.

30 Summary of CEQA Conclusion

31 Collectively, the results of the Impact AQUA-132 CEQA analysis indicate that the difference between
32 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
33 alternative could substantially interfere with the movement of fish, contrary to the NEPA conclusion
34 set forth above. The frequent and often large reductions in flows in the Feather River would reduce
35 the ability of green sturgeon to migrate successfully. Flows would generally be similar in the
36 Sacramento River, except during 1 or 2 months depending on location. Exceedance of Delta outflow
37 thresholds would be lower under Alternative 9 than under Existing Conditions, although there is
38 high uncertainty that year class strength is due to Delta outflow or if both year class strength and
39 Delta outflows co-vary with another unknown factor. Through-Delta migration would not be
40 affected by Alternative 9 relative to the CEQA baseline.

41 These results are primarily caused by four factors: differences in sea level rise, differences in climate
42 change, future water demands, and implementation of the alternative. The analysis described above

1 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
2 alternative from those of sea level rise, climate change and future water demands using the model
3 simulation results presented in this chapter. However, the increment of change attributable to the
4 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
5 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
6 implementation period, which does include future sea level rise, climate change, and water
7 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
8 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
9 effect of the alternative from those of sea level rise, climate change, and water demands.

10 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
11 term implementation period and Alternative 9 indicates that flows in the locations and during the
12 months analyzed above would generally be similar between Existing Conditions during the LLT and
13 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
14 found above would generally be due to climate change, sea level rise, and future demand, and not
15 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
16 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
17 result in a significant impact on migration conditions for green sturgeon. This impact is found to be
18 less than significant and no mitigation is required.

19 **Restoration Measures (CM2, CM4–CM7, and CM10)**

20 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
21 differences in restoration-related fish effects are anticipated anywhere in the affected environment
22 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
23 restoration measures described for green sturgeon under Alternative 1A (Impact AQUA-133
24 through Impact AQUA-135) also appropriately characterize effects under Alternative 9.

25 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

26 **Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon**

27 **Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green** 28 **Sturgeon**

29 **Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon**

30 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
31 green sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-134, the effects
32 of contaminants on green sturgeon with respect to copper, ammonia and pesticides would not be
33 adverse. The effects of methylmercury and selenium on green sturgeon are uncertain.

34 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial,
35 or less than significant, and no mitigation is required.

36 **Other Conservation Measures (CM12–CM19 and CM21)**

37 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
38 differences in other conservation-related fish effects are anticipated anywhere in the affected
39 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish

1 effects of other conservation measures described for green sturgeon under Alternative 1A (Impact
2 AQUA-136 through Impact AQUA-144) also appropriately characterize effects under Alternative 9.

3 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

4 **Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (CM12)**

5 **Impact AQUA-137: Effects of Invasive Aquatic Vegetation Management on Green Sturgeon**
6 **(CM13)**

7 **Impact AQUA-138: Effects of Dissolved Oxygen Level Management on Green Sturgeon (CM14)**

8 **Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon**
9 **(CM15)**

10 **Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (CM16)**

11 **Impact AQUA-141: Effects of Illegal Harvest Reduction on Green Sturgeon (CM17)**

12 **Impact AQUA-142: Effects of Conservation Hatcheries on Green Sturgeon (CM18)**

13 **Impact AQUA-143: Effects of Urban Stormwater Treatment on Green Sturgeon (CM19)**

14 **Impact AQUA-144: Effects of Removal/Relocation of Nonproject Diversions on Green**
15 **Sturgeon (CM21)**

16 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
17 adverse effect, or beneficial effects on green sturgeon for NEPA purposes, for the reasons identified
18 for Alternative 1A.

19 *CEQA Conclusion:* The nine impact mechanisms would be considered to range from no impact, to
20 less than significant, or beneficial on green sturgeon, for the reasons identified for Alternative 1A,
21 and no mitigation is required.

22 **White Sturgeon**

23 **Construction and Maintenance of CM1**

24 Juvenile and adult spawning white sturgeon could be present in the vicinity of the intake and barge
25 landings during in-water construction. Table 11-6 illustrates the species and life stages of white
26 sturgeon present in the north, east, and south Delta during the in-water construction window
27 (expected to be June 1–October 31). Juveniles may be present year-round in all the construction
28 areas. The potential for exposure of white sturgeon to construction-related activities is expected to
29 be low, and would be limited to two construction seasons (one for installation of cofferdams and
30 barge landings, and one for removal of cofferdams and barge landings).

31 **Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon**

32 *NEPA Effects:* The potential effects of construction of water conveyance facilities on white sturgeon
33 under Alternative 9 would be the same as those described for green sturgeon under Alternative 9
34 (see Impact AQUA-127), which concluded that environmental commitments and mitigation

1 measures would be available to avoid and minimize potential effects, and that the effect would not
2 be adverse for white sturgeon.

3 **CEQA Conclusion:** As described in Impact AQUA-127 for green sturgeon under Alternative 9, the
4 impact of the construction of water conveyance facilities on white sturgeon under Alternative 9
5 would be less than significant except for construction noise associated with pile driving.
6 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
7 that noise impact to less than significant.

8 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
9 **of Pile Driving and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

11 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
12 **and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

14 **Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon**

15 The potential effects of maintenance of water conveyance facilities on white sturgeon under
16 Alternative 9 would be the same as those described for green sturgeon under Alternative 9 (see
17 Impact AQUA-128).

18 **NEPA Effects:** As concluded for Impact AQUA-128 for green sturgeon, the effect would not be
19 adverse for white sturgeon.

20 **CEQA Conclusion:** As described in Impact AQUA-128 for green sturgeon under Alternative 9, the
21 impact of the construction of water conveyance facilities on white sturgeon under Alternative 9
22 would be less than significant and no mitigation would be required.

23 **Water Operations of CM1**

24 **Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon**

25 The potential effects of the water operations under Alternative 9 would be the same as those
26 described for green sturgeon (see Alternative 9, Impact AQUA-129). As concluded in Impact AQUA-
27 129, the impact would be beneficial for white sturgeon.

28 **Predation Associated with Entrainment**

29 The potential effects would be the same as described for green sturgeon in Alternative 2A, Impact
30 AQUA-129. In general, sturgeon in the Delta have low risk of predation from other fish because
31 juveniles grow rapidly and develop protective bony scutes.

32 **NEPA Effects:** The overall effect of Alternative 9 operations on entrainment would benefit white
33 sturgeon. The effect would be beneficial.

34 **CEQA Conclusion:** As described under Alternative 9, Impact AQUA-129 for green sturgeon, the
35 impact of the water operations on white sturgeon would be beneficial and no mitigation would be
36 required.

1 **Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
2 **White Sturgeon**

3 In general, Alternative 9 would not affect spawning and egg incubation habitat for white sturgeon
4 relative to the NAA.

5 ***Sacramento River***

6 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
7 May spawning and egg incubation period for white sturgeon. Flows under A9_LLT at Wilkins Slough
8 from February to May would always be similar to or greater than those under NAA. Flows under
9 A9_LLT at Verona from February to May would be lower by up to 7% during March and generally
10 similar to or greater than flows under NAA during the rest of the period, except in below normal and
11 dry years during February (7% and 5% lower, respectively) and wet and above normal years during
12 April (7% and 6% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
13 *Analysis*).

14 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
15 the February through May white sturgeon spawning period (Appendix 11D, *Sacramento River Water*
16 *Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
17 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 9 in any
18 month or water year type throughout the period.

19 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by
20 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year
21 of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees
22 above each threshold were further assigned a “level of concern”, as defined in Table 11-9-9.
23 Differences between baselines and Alternative 9 in the highest level of concern across all months
24 and all 82 modeled years are presented in Table 11-9-59. For the 61°F threshold, there would be 4
25 fewer (43% fewer) “red” years under Alternative 9 than under NAA. For the 68°F threshold, there
26 would be negligible differences in the number of years under each level of concern between NAA
27 and Alternative 9

1 **Table 11-9-59. Differences between Baselines and Alternative 9 Scenarios in the Number of Years**
 2 **in Which Water Temperature Exceedances above the 61°F and 68°F Thresholds Are within Each**
 3 **Level of Concern, Sacramento River at Hamilton City, March through June**

Level of Concern	EXISTING CONDITIONS vs. A9_LL1	NAA vs. A9_LL1
61°F threshold		
Red	45 (563%)	-4 (-8%)
Orange	-1 (-7%)	2 (14%)
Yellow	-21 (-68%)	0 (0%)
None	-23 (-82%)	2 (40%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	1 (NA)	1 (100%)
Yellow	2 (NA)	-1 (-50%)
None	-3 (-4%)	0 (0%)

NA = could not be calculated because the denominator was 0.

4
 5 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at
 6 Hamilton City during March through June (Table 11-9-60, Table 11-9-61). Total degree-days
 7 exceeding the 61°F threshold under Alternative 9 would be the same as or similar to (<5%
 8 difference) total degree-days under NAA during March and June. During April, total degree days
 9 exceeding the threshold would be 5% higher than those under NAA and during May total degree
 10 days exceeding the threshold would be 9% lower. Total degree-days exceeding the 68°F threshold
 11 would not differ between NAA and Alternative 9 during March and April, but would be 5% lower
 12 under Alternative 9 than under NAA during May and 17% higher during June.

1 **Table 11-9-60. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days (°F-**
 2 **Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the**
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LL1	NAA vs. A9_LL1
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	4 (NA)	0 (0%)
	Dry	11 (NA)	0 (0%)
	Critical	1 (NA)	0 (0%)
	All	16 (NA)	0 (0%)
April	Wet	66 (550%)	0 (0%)
	Above Normal	60 (600%)	-8 (-10%)
	Below Normal	73 (1,217%)	11 (16%)
	Dry	159 (312%)	15 (8%)
	Critical	16 (1,600%)	2 (13%)
	All	374 (468%)	20 (5%)
May	Wet	1,097 (329%)	-18 (-1%)
	Above Normal	342 (157%)	-9 (-2%)
	Below Normal	429 (233%)	-20 (-3%)
	Dry	147 (73%)	-286 (-45%)
	Critical	355 (176%)	5 (1%)
	All	2,370 (208%)	-328 (-9%)
June	Wet	1,006 (174%)	48 (3%)
	Above Normal	315 (103%)	-51 (-8%)
	Below Normal	550 (261%)	48 (7%)
	Dry	725 (216%)	23 (2%)
	Critical	621 (166%)	75 (8%)
	All	3,217 (179%)	143 (3%)

NA = could not be calculated because the denominator was 0.

4

1 **Table 11-9-61. Differences between Baseline and Alternative 9 Scenarios in Total Degree-Days (°F-**
 2 **Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the**
 3 **Sacramento River at Hamilton City, March through June**

Month	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
April	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
May	Wet	36 (514%)	0 (0%)
	Above Normal	18 (NA)	-2 (-10%)
	Below Normal	1 (NA)	1 (NA)
	Dry	0 (NA)	-2 (-100%)
	Critical	1 (NA)	0 (0%)
	All	56 (800%)	-3 (-5%)
June	Wet	9 (NA)	1 (13%)
	Above Normal	5 (500%)	1 (20%)
	Below Normal	2 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	32 (NA)	5 (19%)
	All	48 (4,800%)	7 (17%)

NA = could not be calculated because the denominator was 0.

4

5 **Feather River**

6 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
 7 River were examined during the February to May spawning and egg incubation period for white
 8 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under A9_LLT
 9 at Thermalito Afterbay would generally be similar to or greater than flows under NAA, except in
 10 below normal years during February (6% lower) and dry years during March (7% lower). Flows
 11 under A9_LLT at the confluence with the Sacramento River would always be similar to or greater
 12 than flows under NAA. These results indicate that there would be very few reductions in flows in the
 13 Feather River during the white sturgeon spawning and egg incubation period under Alternative 9.

14 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the
 15 confluence with the Sacramento River were examined during the February through May white
 16 sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ
 17 between NAA and Alternative 9 at either location throughout the period.

1 **San Joaquin River**

2 Flows in the San Joaquin River at Vernalis under Alternative 9 during February through May would
3 not be different from flows under NAA (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*).

5 Water temperature modeling was not conducted for the San Joaquin River.

6 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it does
7 not have the potential to substantially reduce the amount of suitable habitat. Flows under
8 Alternative 9 would generally be similar to flows under the NAA. In addition, exceedances above key
9 water temperature thresholds for spawning adults and egg incubation under Alternative 9 would
10 generally be similar to or lower than exceedances under the NAA.

11 **CEQA Conclusion:** In general, under Alternative 9 water operations, the quantity and quality of
12 spawning and egg incubation habitat for white sturgeon would not be reduced relative to the CEQA
13 baseline.

14 **Sacramento River**

15 Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to
16 May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results*
17 *utilized in the Fish Analysis*). At Wilkins Slough, flows under A9_LLT would be similar to or greater
18 than those under Existing Conditions, except in below normal water years during March (7% lower)
19 and wet water years during May (19% lower). At Verona, flows under A9_LLT would be generally up
20 to 16% lower than under Existing Conditions during February through April, and generally similar
21 during May, except in wet years during May (22% lower). These results indicate that there would be
22 small, yet frequent, reductions in flows in the Sacramento River under Alternative 9 relative to
23 Existing Conditions. Mean monthly water temperatures in the Sacramento River at Hamilton City
24 were examined during the February through May white sturgeon spawning period (Appendix 11D,
25 *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the*
26 *Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between
27 Existing Conditions and Alternative 9 in any month or water year type throughout the period, except
28 for a 6% increase in wet years during May.

29 The number of days on which temperature exceeded a 61°F optimal and 68°F lethal threshold by
30 >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year
31 of the 82-year modeling period (Table 11-9-8). The combination of number of days and degrees
32 above each threshold were further assigned a “level of concern”, as defined in Table 11-9-9.

33 Differences between baselines and Alternative 9 in the highest level of concern across all months
34 and all 82 modeled years are presented in Table 11-9-59. For the 61°F threshold, there would be 45
35 more (563% increase) “red” years under Alternative 9 than under Existing Conditions. For the 68°F
36 threshold, there would be negligible differences in the number of years under each level of concern
37 between Existing Conditions and Alternative 9.

38 Total degree-days exceeding 61°F and 68°F were summed by month and water year type at
39 Hamilton City during March through June (Table 11-9-60, Table 11-9-61). Total degree-days
40 exceeding the 61°F threshold under Alternative 9 would be 16 degree-days (percent change unable
41 to be calculated due to division by 0) to 3,217 degree-days (179%) higher depending on month.
42 Total degree-days exceeding the 68°F threshold would not differ between Existing Conditions and
43 Alternative 9 during March and April. During May and June, total degree-days would be 56 (800%)

1 and 48 (4,800%) degree-days higher under Alternative 9, although these small absolute differences
2 would not cause a biologically meaningful effect on white sturgeon.

3 **Feather River**

4 Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento
5 River were examined during the February to May spawning and egg incubation period for white
6 sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Thermalito
7 Afterbay under A9_LLT would be lower than flows under Existing Conditions by up to 55% during
8 February and generally greater than or similar to flows under NAA during March through May with
9 the Sacramento River in below normal and dry water years during March (39% and 18% lower,
10 respectively) and in wet years during May (35% lower). Flows at the confluence with the
11 Sacramento River under A9_LLT would generally be similar to or greater than flows under Existing
12 Conditions during February, April, and May except in below normal years during February (15%
13 lower) and in wet and above normal water years during May (27% and 11% lower, respectively).
14 Flows under A9_LLT would generally be lower during March (up to 15% lower). These results
15 indicate that there would be few reductions in flows in the Feather River under Alternative 9
16 relative to Existing Conditions.

17 Mean monthly water temperatures in the Feather River below Thermalito Afterbay and at the
18 confluence with the Sacramento River were examined during the February through May white
19 sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality
20 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water
21 temperatures would not differ between Existing Conditions and Alternative 9 at either location
22 throughout the period, except below Thermalito Afterbay during February, in which temperatures
23 under Alternative 9 would be 6% higher than temperatures under Existing Conditions.

24 **San Joaquin River**

25 Mean monthly flows in the San Joaquin River at Vernalis under Alternative 9 during February
26 through May would generally be lower than those under Existing Conditions, particularly in drier
27 water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

28 Water temperature modeling was not conducted for the San Joaquin River.

29 **Summary of CEQA Conclusion**

30 Collectively, the results of the Impact AQUA-148 CEQA analysis indicate that the difference between
31 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
32 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA
33 conclusion set forth above. Flows in the Sacramento River at Verona and in the San Joaquin River are
34 consistently lower under Alternative 9 relative to Existing Conditions, which would consistently
35 reduce the amount of suitable habitat during the white sturgeon spawning and egg incubation
36 period. Water temperature exceedances would be substantially higher under Alternative 9 relative
37 to Existing Conditions. Elevated water temperatures can lead to reduced white sturgeon spawning
38 success and higher egg mortality. There would be no effects of Alternative 9 on white sturgeon
39 spawning habitat in the Feather River.

40 These results are primarily caused by four factors: differences in sea level rise, differences in climate
41 change, future water demands, and implementation of the alternative. The analysis described above
42 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the

1 alternative from those of sea level rise, climate change and future water demands using the model
2 simulation results presented in this chapter. However, the increment of change attributable to the
3 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
4 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
5 implementation period, which does include future sea level rise, climate change, and water
6 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
7 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
8 effect of the alternative from those of sea level rise, climate change, and water demands.

9 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
10 term implementation period and Alternative 9 indicates that flows in the locations and during the
11 months analyzed above would generally be similar between Existing Conditions during the LLT and
12 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
13 found above would generally be due to climate change, sea level rise, and future demand, and not
14 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
15 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
16 result in a significant impact on spawning and egg incubation habitat for white sturgeon. This
17 impact is found to be less than significant and no mitigation is required.

18 **Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon**

19 **Upstream of the Delta**

20 In general, Alternative 9 would not affect quantity and quality of white sturgeon larval and juvenile
21 rearing habitat relative to the NAA.

22 Water temperature was used to determine the potential effects of Alternative 9 on white sturgeon
23 larval and juvenile rearing habitat because larvae and juveniles are benthically oriented and,
24 therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

25 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
26 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water
27 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would
28 be no differences (<5%) in mean monthly water temperature between NAA and Alternative 9 in any
29 month or water year type throughout the period.

30 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the
31 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality
32 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no
33 differences (<5%) in mean monthly water temperature between NAA and Alternative 9 in any
34 month or water year type throughout the period.

35 Water temperatures were not modeled in the San Joaquin River.

36 **Through-Delta**

37 The potential effects of the water operations of Alternative 9 on Delta rearing habitat would be the
38 same as those described for green sturgeon (see Impact AQUA-131). As concluded in Impact AQUA-
39 131, the impact would not be adverse for white sturgeon.

1 **NEPA Effects:** These results indicate that the effect would not be adverse because it does not have
2 the potential to substantially reduce the amount of suitable habitat.

3 **CEQA Conclusion:**

4 Water temperatures in the upper Sacramento and Feather Rivers would be similar between NAA
5 and Alternative 9 during the juvenile white sturgeon rearing period. In-Delta juvenile white
6 sturgeon rearing habitat would not be affected by Alternative 9 relative to NAA.

7 **Upstream of the Delta**

8 In general, Alternative 9 would not affect the quantity and quality of white sturgeon larval and
9 juvenile rearing habitat relative to Existing Conditions.

10 Water temperature was used to determine the potential effects of Alternative 9 on white sturgeon
11 larval and juvenile rearing habitat because larvae and juveniles are benthically oriented and,
12 therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

13 Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during
14 the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water
15 Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean
16 monthly water temperatures would be similar between Existing Conditions and Alternative 9 during
17 November through July and September, but 6% higher under Alternative 9 relative to Existing
18 Conditions during August and 5% higher during October.

19 Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the
20 year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality
21 Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water
22 temperatures would be similar between Existing Conditions and Alternative 9 during March through
23 September, but 6% to 8% higher under Alternative 9 during October through February.

24 Water temperatures were not modeled in the San Joaquin River.

25 **Through-Delta**

26 As described in Impact AQUA-131 for green sturgeon, the impact of the water operations on white
27 sturgeon rearing habitat would be less than significant and no mitigation would be required.

28 **Summary of CEQA Conclusion**

29 Considering the mostly small increase in temperature exceedance under Alternative 9, it is
30 concluded that this impacts would be less than significant because it does not have the potential to
31 substantially reduce the amount of suitable habitat. No mitigation would be necessary.

32 **Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon**

33 In general, the effects of Alternative 9 on white sturgeon migration conditions relative to the NAA
34 are uncertain.

35 **Upstream of the Delta**

36 Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins
37 Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number

1 of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona)
 2 (Table 11-9-62). Exceedances of the 17,700 cfs threshold for Wilkins Slough under A9_LLT were
 3 identical to those under NAA. The number of months per year above 31,000 cfs at Verona under
 4 A9_LLT would be up to 33% lower than under NAA. Overall, there is no consistent difference
 5 between Alternative 9 and NAA.

6 **Table 11-9-62. Difference and Percent Difference in Number of Months in Which Flow Rates**
 7 **Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona**

	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wilkins Slough, 17,700 cfs^a		
Wet	-0.04 (-2%)	0 (0%)
Above Normal	0.2 (12%)	0 (0%)
Below Normal	-0.1 (-25%)	0 (0%)
Dry	0 (0%)	0 (0%)
Critical	0 (0%)	0 (0%)
Wilkins Slough, 5,300 cfs^b		
Wet	-0.1 (-1%)	0.1 (2%)
Above Normal	-0.3 (-4%)	0.1 (1%)
Below Normal	0.4 (7%)	0.6 (13%)
Dry	0.8 (17%)	0.6 (11%)
Critical	0.2 (5%)	0.1 (2%)
Verona, 31,000 cfs^a		
Wet	-0.5 (-21%)	-0.2 (-9%)
Above Normal	-0.2 (-10%)	0 (0%)
Below Normal	-0.2 (-43%)	-0.1 (-33%)
Dry	-0.1 (-40%)	-0.1 (-25%)
Critical	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Months analyzed: February through May.

^b Months analyzed: November through May.

8

9 Larval transport flows were also examined by utilizing the positive correlation between year class
 10 strength and Delta outflow during April and May (USFWS 1995) under the assumption that the
 11 mechanism responsible for the relationship is that Delta outflow provides improved larval transport
 12 that results in improved year class strength. The percentage of months exceeding flow thresholds
 13 under A9_LLT would generally be lower by up to 50% than those under NAA for each flow
 14 threshold, water year type, and month (Table 11-9-63). These results indicate that, using the
 15 positive correlation between Delta outflow and year class strength, year class strength would
 16 generally be lower under Alternative 9.

1 **Table 11-9-63. Difference and Percent Difference in Percentage of Months in Which Average Delta**
 2 **Outflow is Predicted to Exceed 15,000, 20,000, and 25,000 Cubic Feet per Second (cfs) in April and**
 3 **May of Wet and Above-Normal Water Years**

Flow	Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
April			
15,000 cfs	Wet	-8 (-8%)	-8 (-8%)
	Above Normal	-17 (-18%)	-17 (-18%)
20,000 cfs	Wet	-4 (-5%)	-4 (-5%)
	Above Normal	-17 (-22%)	-8 (-13%)
25,000 cfs	Wet	-8 (-10%)	-4 (-5%)
	Above Normal	-17 (-29%)	-8 (-17%)
May			
15,000 cfs	Wet	-15 (-17%)	-8 (-10%)
	Above Normal	-42 (-50%)	-17 (-29%)
20,000 cfs	Wet	-27 (-32%)	-4 (-6%)
	Above Normal	-8 (-20%)	0 (0%)
25,000 cfs	Wet	-19 (-28%)	-8 (-13%)
	Above Normal	-17 (-50%)	-8 (-33%)
April/May Average			
15,000 cfs	Wet	-8 (-8%)	0 (0%)
	Above Normal	-33 (-33%)	-25 (-27%)
20,000 cfs	Wet	-15 (-17%)	-12 (-14%)
	Above Normal	-17 (-25%)	0 (0%)
25,000 cfs	Wet	-19 (-24%)	-8 (-11%)
	Above Normal	0 (0%)	0 (0%)

4
 5 For juveniles, year-round migration flows at Verona would generally be up to 13% lower under
 6 A9_LLT relative to NAA during January, March, and October and similar to or greater than flows
 7 under NAA during the rest of the year, with some exceptions (Appendix 11C, *CALSIM II Model Results*
 8 *utilized in the Fish Analysis*).

9 For adults, the average number of months per year during the November through May adult
 10 migration period in which flows in the Sacramento River at Wilkins Slough exceed 5,300 cfs was
 11 determined (Table 11-9-62). The average number of months exceeding 5,300 cfs under A9_LLT
 12 would generally be similar to or greater than the number of months under NAA, except in below
 13 normal and dry years (11% to 13% lower).

14 **Through-Delta**

15 The impact of Alternative 9 on in-Delta movement conditions would be the same as described for
 16 splittail in Impact AQUA-114. The effect on white sturgeon would not be adverse.

17 **NEPA Effects:** Upstream flows (above north Delta intakes) are similar between Alternative 9 and
 18 NAA (Table 11-9-62). However, due to the removal of water at the north Delta intakes, there are
 19 substantial differences in through-Delta flows between Alternative 9 and NAA (Table 11-9-63).
 20 Analysis of white sturgeon year-class strength (USFWS 1995) found a positive correlation between

1 year class strength and Delta outflow during April and May. However, this conclusion was reached in
2 the absence of north Delta intakes and the exact mechanism that causes this correlation is not
3 known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper
4 river resulting in improved migration, spawning, and rearing conditions in the upper river. Another
5 hypothesis suggests that the positive correlation is a result of higher flows through the Delta
6 triggering more adult sturgeon to move up into the river to spawn. It is also possible that some
7 combination of these factors are working together to produce the positive correlation between high
8 flows and sturgeon year-class strength.

9 The scientific uncertainty regarding which mechanisms are responsible for the positive correlation
10 between year class strength and river/Delta flow will be addressed through targeted research and
11 monitoring to be conducted in the years leading up to the initiation of north Delta facilities
12 operations. If these targeted investigations determine that the primary mechanisms behind the
13 positive correlation between high flows and sturgeon year-class strength are related to upstream
14 conditions, then Alternative 9 would be deemed Not Adverse due to the similarities in upstream
15 flow conditions between Alternative 9 and NAA. However, if the targeted investigations lead to a
16 conclusion that the primary mechanisms behind the positive correlation are related to in-Delta and
17 through-Delta flow conditions, then Alternative 9 would be deemed Adverse due to the magnitude of
18 reductions in through-Delta flow conditions in Alternative 9 as compared to NAA.

19 **CEQA Conclusion:** In general, under Alternative 9 water operations, migration conditions for white
20 sturgeon would not be reduced relative to the CEQA baseline.

21 **Upstream of the Delta**

22 The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough
23 under A9_LLТ would generally be similar to or greater than those under Existing Conditions, except
24 in below normal years (25% lower) (Table 11-9-62). The number of months per year above 31,000
25 cfs at Verona under A9_LLТ would be 10% to 43% lower than the number under Existing Conditions
26 in all water year types except critical years.

27 For Delta outflow, the percent of months exceeding outflow thresholds under A9_LLТ would nearly
28 always be lower than those under Existing Conditions for each flow threshold, water year type, and
29 month (up to 50% lower) with few exceptions (Table 11-9-63).

30 For juveniles, year-round migration flows at Verona would be up to 18% lower under A9_LLТ
31 relative to Existing Conditions in most water year types in five of 12 months, January through April
32 and October (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under
33 A9_LLТ during other months are generally similar to or greater than flows under Existing
34 Conditions with some exceptions (up to 29% lower).

35 For adult migration, the average number of months exceeding 5,300 cfs under A9_LLТ would
36 generally be similar to or greater than the number of months under Existing Conditions (Table 11-9-
37 62).

38 **Through-Delta**

39 As described above in Impact AQUA-150, the potential impact is considered less than significant, and
40 no mitigation would be required.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-150 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce the amount of suitable habitat, contrary to the NEPA
5 conclusion set forth above. The exceedance of flow thresholds in the Sacramento River and for Delta
6 outflow would be lower under Alternative 9 than under Existing Conditions, although there is high
7 uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta
8 outflows are caused by another unknown factor. Juvenile migration flows in the Sacramento River at
9 Verona would be up to 18% lower in five of 12 months relative to Existing Conditions. These
10 reduced flows would have a substantial effect on the ability to migrate downstream, delaying or
11 slowing rates of successful migration downstream and increasing the risk of mortality. There would
12 be no effect of through-Delta migration conditions for white sturgeon under Alternative 9 relative to
13 the CEQA baseline.

14 These results are primarily caused by four factors: differences in sea level rise, differences in climate
15 change, future water demands, and implementation of the alternative. The analysis described above
16 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
17 alternative from those of sea level rise, climate change and future water demands using the model
18 simulation results presented in this chapter. However, the increment of change attributable to the
19 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
20 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
21 implementation period, which does include future sea level rise, climate change, and water
22 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
23 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
24 effect of the alternative from those of sea level rise, climate change, and water demands.

25 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
26 term implementation period and Alternative 9 indicates that flows in the locations and during the
27 months analyzed above would generally be similar between Existing Conditions during the LLT and
28 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
29 found above would generally be due to climate change, sea level rise, and future demand, and not
30 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
31 level rise and climate change, is similar to the NEPA conclusion of not adverse, and therefore would
32 not in itself result in a significant impact on migration conditions for white sturgeon. Additionally, as
33 described above in the NEPA Effects statement, further investigation is needed to better understand
34 the association of Delta outflow to sturgeon recruitment, and if needed, adaptive management
35 would be used to make adjustments to meet the biological goals and objectives. This impact is found
36 to be less than significant and no mitigation is required.

37 **Restoration Measures (CM2, CM4–CM7, and CM10)**

38 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
39 differences in restoration-related fish effects are anticipated anywhere in the affected environment
40 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
41 restoration measures described for white sturgeon under Alternative 1A (Impact AQUA-151
42 through Impact AQUA-153) also appropriately characterize effects under Alternative 9.

43 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

1 **Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon**

2 **Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White**
3 **Sturgeon**

4 **Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon**

5 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
6 white sturgeon, and most would be at least slightly beneficial. Specifically for AQUA-152, the effects
7 of contaminants on white sturgeon with respect to copper, ammonia and pesticides would not be
8 adverse. The effects of methylmercury and selenium on white sturgeon are uncertain.

9 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial,
10 or less than significant, and no mitigation is required.

11 **Other Conservation Measures (CM12–CM19 and CM21)**

12 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
13 differences in other conservation-related fish effects are anticipated anywhere in the affected
14 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
15 effects of other conservation measures described for white sturgeon under Alternative 1A (Impact
16 AQUA-154 through Impact AQUA-162) also appropriately characterize effects under Alternative 9.

17 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

18 **Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (CM12)**

19 **Impact AQUA-155: Effects of Invasive Aquatic Vegetation Management on White Sturgeon**
20 **(CM13)**

21 **Impact AQUA-156: Effects of Dissolved Oxygen Level Management on White Sturgeon (CM14)**

22 **Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon**
23 **(CM15)**

24 **Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (CM16)**

25 **Impact AQUA-159: Effects of Illegal Harvest Reduction on White Sturgeon (CM17)**

26 **Impact AQUA-160: Effects of Conservation Hatcheries on White Sturgeon (CM18)**

27 **Impact AQUA-161: Effects of Urban Stormwater Treatment on White Sturgeon (CM19)**

28 **Impact AQUA-162: Effects of Removal/Relocation of Nonproject Diversions on White**
29 **Sturgeon (CM21)**

30 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
31 adverse effect, or beneficial effects on white sturgeon for NEPA purposes, for the reasons identified
32 for Alternative 1A.

1 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
2 less than significant, or beneficial on white sturgeon, for the reasons identified for Alternative 1A,
3 and no mitigation is required.

4 **Pacific Lamprey**

5 **Construction and Maintenance of CM1**

6 Pacific lamprey are present in the north, east, and south Delta. Table 11-6 illustrates the species and
7 life stages of Pacific lamprey present in these areas during the in-water construction window
8 (expected to be June 1–October 31). Ammocoetes (larvae) are present year-round in all of the
9 regions. Adult spawners may be migrating by the construction sites in June and July.

10 **Impact AQUA-163: Effects of Construction of Water Conveyance Facilities on Pacific Lamprey**

11 The potential effects of construction of water conveyance facilities on Pacific lamprey would be the
12 same as described under Impact AQUA-163 under Alternative 1A. Alternative 9 would have more
13 construction impact locations, resulting in temporary and permanent in-water footprint of 31.4
14 acres (Table 11-9-1) compared to 28.7 acres for Alternative 1A (Table 11-5). Dredging under
15 Alternative 9 would total 56.9 acres (Table 11-9-1) while there would be 27.5 acres under
16 Alternative 1A (Table 11-5). Rock bank protection under Alternative 9 would total 4,800 feet
17 compared to approximately 3,600 feet under Alternative 1A (Table 11-5). Because Alternative 9 has
18 more in-water construction locations the potential for noise effects is greater proportional to the
19 increased number of sites compared to Alternative 1A.

20 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-163, environmental commitments and
21 mitigation measures would be available to avoid and minimize potential effects, and the effect would
22 not be adverse for Pacific lamprey.

23 **CEQA Conclusion:** Although Alternative 9 affects a larger in-water area than Alternative 1A, as
24 described in Impact AQUA-163, the impact of construction of the water conveyance facilities on
25 Pacific lamprey would be less than significant except for construction noise associated with pile
26 driving. The number of sites where noise impacts would potentially occur are greater under
27 Alternative 9 because it has more operable barrier construction sites than Alternative 1A. However,
28 implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
29 that noise impact to less than significant.

30 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects** 31 **of Pile Driving and Other Construction-Related Underwater Noise**

32 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

33 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving** 34 **and Other Construction-Related Underwater Noise**

35 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

36 **Impact AQUA-164: Effects of Maintenance of Water Conveyance Facilities on Pacific Lamprey**

37 Although the facilities involved in maintenance activities under Alternative 9 (screen and gates)
38 would differ from the intakes of Alternative 1A, the same types of effects resulting from

1 maintenance activities would apply. Consequently, the potential effects of the maintenance of water
2 conveyance facilities under Alternative 9 would be the same as those described for Alternative 1A
3 (see Impact AQUA-164).

4 **NEPA Effects:** As concluded in Impact AQUA-164, the impact would not be adverse for Pacific
5 lamprey.

6 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
7 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects
8 resulting from maintenance activities would apply. Consequently, as described in Impact AQUA-164
9 for Pacific lamprey, the impact of the maintenance of water conveyance facilities on Pacific lamprey
10 would be less than significant and no mitigation would be required.

11 **Water Operations of CM1**

12 **Impact AQUA-165: Effects of Water Operations on Entrainment of Pacific Lamprey**

13 Entrainment of Pacific lamprey at the SWP/CVP south Delta facilities would be substantially reduced
14 under Alternative 9 compared to the NAA. Screening at the north Delta diversion sites, on the DCC
15 and at Georgiana Slough, would be designed and operated to exclude lamprey. The project adaptive
16 management plan includes monitoring of the new north Delta screens to determine their
17 effectiveness and if they are not meeting expectations additional measures (i.e., modifications to
18 screens or other structural components or changes in water diversion operations) may be
19 implemented to improve screen performance. The screened intakes on the DCC and at Georgiana
20 Slough would prevent Sacramento River basin lamprey from entering the interior delta, thus
21 reducing potential entrainment to agricultural diversions in the Delta compared to the NAA.

22 **Predation Associated with Entrainment**

23 Lamprey pre-screen predation loss at the south Delta facilities is assumed to be proportional to
24 entrainment loss. Due to the substantial reduction in lamprey predation at the SWP/CVP south Delta
25 facilities under Alternative 9, there would also be a reduction in predation loss.

26 **NEPA Effects:** The overall effect of entrainment and entrainment-related predation on lamprey is
27 considered beneficial.

28 **CEQA Conclusion:** As described above, annual entrainment losses of lamprey would be substantially
29 reduced under Alternative 9 relative to Existing Conditions. The impact of predation loss at the
30 north Delta would be unknown, since there is little available knowledge on their distribution and
31 abundance in the Delta. Overall the impact on Pacific lamprey from water operations would be
32 considered beneficial. No mitigation would be required.

33 **Impact AQUA-166: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 34 **Pacific Lamprey**

35 In general, effects of Alternative 9 on Pacific lamprey spawning habitat would be negligible relative
36 to the NAA.

37 Flow-related impacts to Pacific lamprey spawning habitat were evaluated by estimating effects of
38 flow alterations on redd dewatering risk and effects on water temperature for the Sacramento River
39 at Keswick, Sacramento River at Red Bluff, Trinity River downstream of Lewiston, Feather River at

1 Thermalito Afterbay, and the American River at Nimbus Dam and at the confluence with the
2 Sacramento River. Pacific lamprey spawn in these rivers between January and August. Rapid
3 reductions in flow can dewater redds leading to mortality. Dewatering risk to redd cohorts was
4 characterized by the number of cohorts experiencing a month-over-month reduction in flows (using
5 CALSIM II outputs) of greater than 50%. Water temperature results from the SRWQM and the
6 Reclamation Temperature Model were used to assess the exceedances of water temperatures under
7 all model scenarios in the upper Sacramento, Trinity, Feather, and American Rivers.

8 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-
9 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. Small-scale spawning
10 location suitability characteristics (e.g., depth, velocity, substrate) of Pacific lamprey are not
11 adequately described to employ a more formal analysis such as a weighted usable area analysis.
12 Therefore, the change in month-over-month flows is used as a surrogate for a more formal analysis,
13 and a month-over-month flow reduction of 50% was chosen as a best professional estimate of flow
14 conditions in which redd dewatering is expected to occur, but does not estimate empirically derived
15 redd dewatering events. As such, there is uncertainty that these values represent actual redd
16 dewatering events, and results should be treated as rough estimates of flow fluctuations under each
17 model scenario. Results were expressed as the number of cohorts exposed to dewatering risk and as
18 a percentage of the total number of cohorts anticipated in the river based on the applicable time-
19 frame, January to August.

20 Comparisons for Alternative 9 relative to NAA indicate negligible (<5%) to small reductions (to -
21 13%) for all locations analyzed, indicating that project-related effects of Alternative 9 on flow would
22 be beneficial and would not have negative effects on the number of Pacific lamprey redd cohorts
23 predicted to experience a month-over-month change in flow of greater than 50% in all locations
24 analyzed. (Table 11-9-64).

25 **Table 11-9-64. Differences between Model Scenarios in Dewatering Risk of Pacific Lamprey Redd**
26 **Cohorts^a**

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A9_LL1	NAA vs. A9_LL1
Sacramento River at Keswick	Difference	13	-9
	Percent Difference	24%	-12%
Sacramento River at Red Bluff	Difference	9	-9
	Percent Difference	17%	-13%
Trinity River downstream of Lewiston	Difference	-3	-3
	Percent Difference	-2%	-2%
Feather River at Thermalito Afterbay	Difference	-49	-7
	Percent Difference	-33%	-7%
American River at Nimbus Dam	Difference	31	-6
	Percent Difference	37%	-5%
American River at Sacramento River confluence	Difference	34	-6
	Percent Difference	36%	-4%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 9 than Existing Conditions or NAA.

1 Significant reduction in survival of eggs and embryos of Pacific lamprey were observed at 22°C
 2 (71.6°F; Meeuwig et al. 2005). Therefore, in the Sacramento River, this analysis predicted the
 3 number of consecutive 49 day periods for the entire 82-year CALSIM period during which at least
 4 one day exceeds 22°C (71.6°F) using daily data from SRWQM. For other rivers, the analysis
 5 predicted the number of consecutive 2 month periods during which at least one month exceeds 22°C
 6 (71.6°F) using monthly averaged data from the Reclamation temperature model. Each individual
 7 day or month starts a new “egg cohort” such that there are 19,928 cohorts for the Sacramento River,
 8 corresponding to 82 years of eggs being laid every day each year from January 1 through August 31,
 9 and 648 cohorts for the other rivers using monthly data over the same period. The incubation
 10 periods used in this analysis are conservative and represent the extreme long end of the egg
 11 incubation period (Brumo 2006). Also, the utility of the monthly average time step is limited
 12 because the extreme temperatures are masked; however, no better analytical tools are currently
 13 available for this analysis. Exact spawning locations of Pacific lamprey are not well defined.
 14 Therefore, this analysis uses the widest range in which the species is thought to spawn in each river.

15 In most locations, egg cohort exposure would generally not differ between NAA and Alternative 9
 16 (Table 11-9-65). However, the number of cohorts exposed to 22°C (71.6°F) under Alternative 9
 17 would be 91% lower in the Trinity River at Lewiston.

18 **Table 11-9-65. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey Egg**
 19 **Cohort Temperature Exposure^a**

Location	EXISTING CONDITIONS	
	vs. A9_LL1	NAA vs. A9_LL1
Sacramento River at Keswick	50 (NA)	-1 (-2%)
Sacramento River at Hamilton City	1,034 (NA)	-34 (-3%)
Trinity River at Lewiston	6 (300%)	-81 (-91%)
Trinity River at North Fork	14 (NA)	-3 (-18%)
Feather River at Fish Barrier Dam	1 (NA)	0 (0%)
Feather River below Thermalito Afterbay	81 (338%)	13 (14%)
American River at Nimbus	72 (655%)	-2 (-2%)
American River at Sacramento River Confluence	156 (279%)	-4 (-2%)
Stanislaus River at Knights Ferry	4 (NA)	2 (100%)
Stanislaus River at Riverbank	88 (4,400%)	1 (1%)

NA = could not be calculated because the denominator was 0.

^a Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F during January to August on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in Alternative 9 than in EXISTING CONDITIONS or NAA.

20

21 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
 22 would not substantially reduce suitable spawning habitat or substantially reduce the number of fish
 23 as a result of egg mortality. This is based on prevalence of negligible effects or beneficial effects on
 24 redd dewatering risk for all locations analyzed (reductions in cohort exposure to flow reductions
 25 ranging from negligible, <5%, to -13%), and a small effect on water temperatures in the Feather

1 River (14% increase in egg cohorts exposed to water temperatures above 71.6°F) that would not
2 have biologically meaningful effects on spawning success.

3 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of Pacific
4 lamprey spawning habitat relative to Existing Conditions.

5 Rapid reductions in flow can dewater redds leading to mortality. Effects of Alternative 9 on month-
6 over-month flow reduction compared to Existing Conditions consist of negligible effects (<5%
7 difference) in the Trinity River, a substantial decrease (-33%) in the Feather River, and moderate
8 (17%) to substantial increases in dewatering exposures in the Sacramento River (to 24%) and the
9 American River (to 37%) (Table 11-9-64). The moderate to substantial increases in egg cohorts
10 exposed to dewatering risk in the Sacramento River and the American River would affect spawning
11 success for these locations. The number of egg cohorts exposed to 22°C (71.6°F) under Alternative 9
12 would be greater than that under Existing Conditions in all the river locations (Table 11-9-65).

13 **Summary of CEQA Conclusion**

14 Collectively, the results of the Impact AQUA-166 CEQA analysis indicate that the difference between
15 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
16 alternative could substantially reduce suitable spawning habitat and substantially reduce the
17 number of fish as a result of egg mortality contrary to the NEPA conclusion set forth above. Impacts
18 of Alternative 9 on flow would result in moderate to substantial increases in Pacific lamprey redd
19 dewatering risk in the Sacramento River (to 24%) and the American River (to 37%). Impacts of
20 Alternative 9 on water temperatures in the Feather River would substantially increase exposure of
21 egg cohorts (81 cohorts or 338%) to water temperatures above 71.6°F during the incubation period
22 which could cause mortality and negatively affect spawning success.

23 These results are primarily caused by four factors: differences in sea level rise, differences in climate
24 change, future water demands, and implementation of the alternative. The analysis described above
25 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
26 alternative from those of sea level rise, climate change and future water demands using the model
27 simulation results presented in this chapter. However, the increment of change attributable to the
28 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
29 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
30 implementation period, which does include future sea level rise, climate change, and water
31 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
32 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
33 effect of the alternative from those of sea level rise, climate change, and water demands.

34 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
35 term implementation period and Alternative 9 indicates that flows in the locations and during the
36 months analyzed above would generally be similar between Existing Conditions during the LLT and
37 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
38 found above would generally be due to climate change, sea level rise, and future demand, and not
39 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
40 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
41 result in a significant impact on Pacific lamprey spawning habitat. This impact is found to be less
42 than significant and no mitigation is required.

Impact AQUA-167: Effects of Water Operations on Rearing Habitat for Pacific Lamprey

In general, effects of Alternative 9 on Pacific lamprey rearing habitat would be negligible relative to the NAA.

Flow-related impacts to Pacific lamprey rearing habitat were evaluated by estimating effects of flow alterations on ammocoete stranding risk for the Sacramento River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus Dam and at the confluence with the Sacramento River. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand ammocoetes leading to mortality. The analysis of ammocoete stranding was conducted by analyzing a range of month-over-month flow reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort was considered stranded if at least one month-over-month flow reduction was greater than the flow reduction at any time during the period.

Effects of Alternative 9 on Pacific lamprey ammocoete stranding were analyzed by calculating month-over-month flow reductions for the Sacramento River at Keswick for January through August (Table 11-9-66). Results for Alternative 9 compared to NAA indicate either no effect (0%) or negligible effects (<5%) on cohort exposures to all flow reductions, with the exception of a moderate increase (18%), to flow reduction events of 85%. These results indicate that project-related effects of Alternative 9 on flow would not have biologically meaningful negative effects on Pacific lamprey ammocoete stranding in the Sacramento River at Keswick.

Table 11-9-66. Percent Difference between Model Scenarios in the Number of Pacific Lamprey Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Keswick

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	2	-1
-65%	1	1
-70%	0	0
-75%	1	4
-80%	7	0
-85%	73	18
-90%	NA	NA

NA = all values were 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

Results of comparisons for the Sacramento River at Red Bluff (Table 11-9-67) for Alternative 9 compared to NAA indicate no change (0%) or negligible effects (≤5%) in all flow reduction categories. These results indicate that project-related effects of Alternative 9 on flow would not affect Pacific lamprey ammocoete cohort stranding in the Sacramento River at Red Bluff.

1 **Table 11-9-67. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
 3 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	4	0
-60%	4	3
-65%	3	1
-70%	13	0
-75%	6	-3
-80%	13	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

4
 5 Comparisons for the Trinity River indicate no effect (0%) or negligible effects ($\leq 5\%$) attributable to
 6 the project for all flow reduction categories (Table 11-9-68). These results indicate that project-
 7 related effects of Alternative 9 on flow would not affect Pacific lamprey ammocoete stranding in the
 8 Trinity River.

9 **Table 11-9-68. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	24	0
-80%	24	-3
-85%	14	-3
-90%	36	0

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

11
 12 Comparisons of Alternative 9 to NAA for the Feather River indicate no effect (0%), negligible effects
 13 ($< 5\%$), or reductions (-28%) in the percentage of cohorts exposed to all flow reduction categories
 14 which would have beneficial effects on spawning success (Table 11-9-69). These results indicate
 15 that project-related effects of Alternative 9 on flow would not have negative effects on Pacific
 16 lamprey ammocoete stranding in the Feather River.

1 **Table 11-9-69. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
 3 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	0	2
-85%	28	-3
-90%	-64	-28

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

4
 5 Comparisons for the American River at Nimbus Dam (Table 11-9-70) and at the confluence with the
 6 Sacramento River (Table 11-9-71) indicate negligible effects ($\leq 5\%$) and small (-9%) to substantial (-
 7 67%) decreases in exposure attributable to the project, compared to NAA. The small to substantial
 8 decreases in all the larger flow reduction categories for both locations would have beneficial effects
 9 on spawning success.

10 **Table 11-9-70. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 11 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 12 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	0	-1
-65%	1	-1
-70%	33	-5
-75%	75	-9
-80%	171	-29
-85%	196	-42
-90%	0	-67

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

13

1 **Table 11-9-71. Percent Difference between Model Scenarios in the Number of Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 3 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LL1	NAA vs. A9_LL1
-50%	0	0
-55%	0	0
-60%	1	0
-65%	0	-1
-70%	4	-4
-75%	20	-12
-80%	171	-8
-85%	142	-31
-90%	145	-42

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

4

5 To evaluate water temperature-related effects of Alternative 9 on Pacific lamprey ammocoetes, we
 6 examined the predicted number of ammocoete “cohorts” that experience water temperatures
 7 greater than 71.6°F for at least one day in the Sacramento River (because daily water temperature
 8 data are available) or for at least one month in the Feather, American, Stanislaus, and Trinity rivers
 9 over a 7 year period, the maximum likely duration of the ammocoete life stage (Moyle 2002). Each
 10 individual day or month starts a new “cohort” such that there are 18,244 cohorts for the Sacramento
 11 River, corresponding to 82 years of ammocoetes being “born” every day each year from January 1
 12 through August 31, and 593 cohorts for the other rivers using monthly data over the same period.

13 There would be differences in the number of ammocoete cohorts exposed to temperatures greater
 14 than 71.6°F in most of the rivers (Table 11-9-72). There would be 671 fewer cohorts (6% decrease)
 15 under Alternative 9 in the Sacramento River at Hamilton City, 79 more cohorts (70% increase)
 16 exposed under Alternative 9 in the Trinity River at Lewiston, but 56 fewer cohorts (18% decrease)
 17 exposed in the Trinity River at North Fork. In addition, there would be 31 more cohorts (6%
 18 increase) exposed under Alternative 9 in the Feather River below Thermalito Afterbay, and 57 more
 19 cohorts (102% increase) exposed in the Stanislaus River at Knights Ferry. Overall, the increases and
 20 decreases are expected to balance out within rivers such that there would be no overall effect on
 21 Pacific lamprey ammocoetes.

1 **Table 11-9-72. Differences (Percent Differences) between Model Scenarios in Pacific Lamprey**
 2 **Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F in at Least**
 3 **One Day or Month**

Location	EXISTING CONDITIONS	
	vs. A9_LLТ	NAA vs. A9_LLТ
Sacramento River at Keswick ^b	1,704 (NA)	-1 (-0.1%)
Sacramento River at Hamilton City ^b	10,584 (NA)	-671 (-6%)
Trinity River at Lewiston	192 (NA)	79 (70%)
Trinity River at North Fork	249 (NA)	-56 (-18%)
Feather River at Fish Barrier Dam	56 (NA)	0 (0%)
Feather River below Thermalito Afterbay	170 (45%)	31 (6%)
American River at Nimbus	353 (182%)	-14 (-2%)
American River at Sacramento River Confluence	159 (37%)	0 (0%)
Stanislaus River at Knights Ferry	113 (NA)	57 (102%)
Stanislaus River at Riverbank	530 (946%)	0 (0%)

NA = could not be calculated because the denominator was 0.

^a Positive values indicate a higher value in Alternative 9 than in EXISTING CONDITIONS or NAA.

^b Based on daily data; all other locations use monthly data; 1922–2003.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
 6 would not substantially reduce rearing habitat or substantially reduce the number of fish as a result
 7 of ammocoete mortality. There would be no substantial increases in redd dewatering risk in all
 8 locations and reduced risk in the American River. There would be increases and decreases in
 9 ammocoete exposure to elevated temperatures that are expected to balance out within rivers such
 10 that there would be no overall effect on Pacific lamprey ammocoetes.

11 **CEQA Conclusion:** In general, Alternative 9 would not affect the quantity and quality of Pacific
 12 lamprey rearing habitat relative to the NAA. Lower flows can reduce the instream area available for
 13 rearing and rapid reductions in flow can strand ammocoetes leading to mortality. Comparisons of
 14 Alternative 9 to Existing Conditions for the Sacramento River at Keswick indicate negligible changes
 15 ($\leq 5\%$) in ammocoete cohort exposure to flow reductions for all flow reduction categories with the
 16 exception of a small increase (7%) in cohorts exposed to 80% flow reduction events and a more
 17 substantial increase (73%) in cohorts exposed to 85% flow reductions (Table 11-9-66).
 18 Comparisons for the Sacramento River at Red Bluff indicate negligible effects ($< 5\%$) for all flow
 19 reduction categories, with the exception of small increases in exposure (13%) for 70% and 80%
 20 flow reduction events, and a more substantial increase (56 to 112 cohorts or 100%) for 85% flow
 21 reduction events. The occurrence of fairly substantial increases in exposure to a relatively large flow
 22 reduction event could have negative effects on ammocoete survival at both locations, but not to the
 23 extent that would be considered a biologically meaningful negative effect on rearing success.

24 Comparisons of Alternative 9 to Existing Conditions for the Trinity River indicate no effect (0%
 25 difference) for flow reductions from 50% to 70%, and increases ranging from 14% to 36% for the
 26 larger flow reduction categories (Table 11-9-68). Despite the prevalence of increased exposure risk
 27 to the higher flow reduction events, the percentage of cohorts exposed to stranding risk is relatively
 28 small compared to the total number of cohorts exposed to dewatering risks under Existing
 29 Conditions (for example, an increase from 346 to 470 cohorts for 36%) and therefore effects of

1 Alternative 9 are not expected to have biologically meaningful effects on spawning success in the
2 Trinity River.

3 In the Feather River, Alternative 9 would have no effect (0%), a moderate increase (28%) in
4 ammocoete cohorts exposed to flow reductions of 85%, and a substantial decrease (-65%) in
5 exposure to 90% flow reduction events (Table 11-9-69). Based on a single, moderate increase in
6 exposure to flow reductions, these results indicate that the effects of Alternative 9 on flow would not
7 have biologically meaningful negative effects on Pacific lamprey ammocoete cohort stranding in the
8 Feather River.

9 Comparisons for the American River at Nimbus Dam Table 11-9-70) and at the confluence with the
10 Sacramento River (Table 11-9-71) predict negligible effects (<5%) for the lower flow reduction
11 categories, and increased occurrence of flow reductions between 65% or 70% and 90% for
12 Alternative 9 compared to Existing Conditions; predicted increases range from 33% to 196% for
13 Nimbus Dam and from 20 to 171% for the confluence. These percentage increases are based on
14 increases on the order of 56 to 166 cohorts (196%) and 112 to 303 (171%) cohorts exposed to flow
15 reductions at Nimbus Dam, and 56 to 137 (145%) and 145 to 393 (171%) cohorts exposed to flow
16 reductions at the confluence. These persistent and substantial increases in exposures to larger flow
17 reduction events would have biologically meaningful effects on Pacific lamprey ammocoete cohort
18 stranding and therefore spawning success in the American River.

19 The number of Pacific lamprey ammocoete cohorts exposed to 71.6°F temperatures under
20 Alternative 9 would be higher than those under Existing Conditions in all the river locations (Table
21 11-9-72).

22 **Summary of CEQA Conclusion**

23 Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between
24 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
25 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
26 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Effects of
27 Alternative 9 on flow relative to Existing Conditions would have biologically meaningful, negative
28 effects in the American River through substantial increases in the number of ammocoete cohorts
29 exposed to a broad range of flow reductions (to 196%). Effects of Alternative 9 would not have
30 biologically meaningful effects on Pacific lamprey ammocoete stranding in the Sacramento River,
31 Trinity River, and the Feather River. Effects of Alternative 9 on water temperatures in the Feather
32 River would result in substantial increases in ammocoete cohorts exposed to elevated water
33 temperatures in all rivers evaluated, which would cause increased ammocoete mortality and reduce
34 spawning success.

35 These results are primarily caused by four factors: differences in sea level rise, differences in climate
36 change, future water demands, and implementation of the alternative. The analysis described above
37 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
38 alternative from those of sea level rise, climate change and future water demands using the model
39 simulation results presented in this chapter. However, the increment of change attributable to the
40 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
41 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
42 implementation period, which does include future sea level rise, climate change, and water
43 demands. Therefore, the comparison of results between the alternative and Existing Conditions in

1 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
2 effect of the alternative from those of sea level rise, climate change, and water demands.

3 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
4 term implementation period and Alternative 9 indicates that flows in the locations and during the
5 months analyzed above would generally be similar between Existing Conditions during the LLT and
6 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
7 found above would generally be due to climate change, sea level rise, and future demand, and not
8 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
9 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
10 result in a significant impact on rearing habitat for Pacific lamprey. This impact is found to be less
11 than significant and no mitigation is required.

12 **Impact AQUA-168: Effects of Water Operations on Migration Conditions for Pacific Lamprey**

13 In general, effects of Alternative 9 on Pacific lamprey migration conditions would be negligible
14 relative to the NAA.

15 After 5–7 years Pacific lamprey ammocoetes migrate downstream and become macrophthalmia once
16 they reach the Delta. Migration generally is associated with large flow pulses in winter months
17 (December through March) (USFWS unpublished data) meaning alterations in flow have the
18 potential to affect downstream migration conditions. The effects of Alternative 9 on seasonal
19 migration flows for Pacific lamprey macrophthalmia were assessed using CALSIM II flow output. Flow
20 rates along the migration pathways of Pacific lamprey during the likely migration period (December
21 through May) were examined for the Sacramento River at Rio Vista and Red Bluff, the Feather River
22 at the confluence with the Sacramento River, and the American River at the confluence with the
23 Sacramento River.

24 CALSIM flow data form the basis for the evaluation of adult lamprey migration flows for the January
25 to June migration period.

26 ***Sacramento River***

27 ***Juveniles***

28 The difference in mean monthly flow rate for the Sacramento River at Rio Vista for Alternative 9
29 compared to NAA for December to May indicates negligible effects (<5%) or decreases (to -28%) in
30 mean monthly flow for the entire migration period, with the exception of a single, small increase in
31 flow (9%) during May in critical years. Reductions in flow in drier water year types, when effects on
32 migration conditions would be most critical, would occur throughout the migration period (to -
33 28%) and would have negative effects on macrophthalmia migration conditions in the Sacramento
34 River at Rio Vista, compared to NAA.

35 For the Sacramento River at Red Bluff, results for Alternative 9 compared to NAA for December
36 through May indicate primarily negligible effects (<5%) on flow attributable to the project
37 throughout the migration period, with several isolated occurrences of increases in flow (to 18%)
38 that would have a small beneficial effect on migration conditions, and isolated, small decreases in
39 flow during January in dry (-7%) and critical years (-11%). These decreases would be isolated and
40 small in magnitude and would not have biologically meaningful effects on migration conditions.
41 These results indicate that the project-related effects on flow in the Sacramento River at Red Bluff
42 would not have biologically meaningful negative effects on migration conditions, compared to NAA.

1 **Adults**

2 For the Sacramento River at Red Bluff for January to June, effects of Alternative 9 on mean monthly
3 flow, compared to NAA consist mainly of negligible effects (<5%), with infrequent, small to
4 moderate increases in flow (to 18%) that would have beneficial effects on migration conditions, and
5 infrequent, small reductions in flow, during January in dry (-7%) and critical years (-11%). These
6 decreases in flow would be isolated occurrences and of small magnitude and would not have
7 biologically meaningful negative effects. These results indicate that the effects of Alternative 9 on
8 flow would not have negative effects on adult migration in the Sacramento River, compared to NAA.

9 **Feather River**

10 **Juveniles**

11 Comparisons for the Feather River at the confluence with the Sacramento River for December to
12 May indicate primarily negligible effects (<5%) with infrequent occurrence of small to moderate
13 increases in flow (to 25%) that would have beneficial effects on migration conditions, and two
14 isolated, small decreases in flow (to -9%) that would not have biologically meaningful effects on
15 migration conditions. These results indicate that Alternative 9 would not have biologically
16 meaningful negative effects on migration conditions in the Feather River, compared to NAA.

17 **Adults**

18 For the Feather River at the confluence with the Sacramento River, effects of Alternative 9 for
19 January to June indicate project-related effects consist primarily of negligible effects (<5%) with a
20 single occurrence of a small flow reduction during January in critical year (-9%) and increases
21 during April in dry years (7%) and during May in drier water years (to 25%) that would have
22 beneficial effects on migration conditions. These results indicate that effects of Alternative 9 on flow
23 would not have biologically meaningful negative effects on adult migration in the Feather River,
24 compared to NAA.

25 **American River**

26 **Juveniles**

27 Comparisons for the American River at the confluence with the Sacramento River for Alternative 9
28 compared to NAA for all December through May indicate project-related effects consist primarily of
29 negligible effects (<5%), with infrequent, small increases (to 12%) and decreases (-5%) in mean
30 monthly flows that would not have biologically meaningful effects on migration, and more
31 substantial increases in flow during May (to 30%), including in drier water years, which would have
32 beneficial effects on migration conditions. These results indicate that the effects of Alternative 9 on
33 flow would not have biologically meaningful negative effects on macrophthalmia migration in the
34 American River, compared to NAA.

35 **Adults**

36 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
37 River for January to June indicate predominantly negligible effects (<5%), with infrequent, small-
38 scale increases (to 12%) or decreases (to -5%) attributable to the project, and more substantial
39 increases in flow during May in drier years (to 30%) that would have beneficial effects on migration
40 conditions. These results indicate that project-related effects of Alternative 9 on flow would not

1 have biologically meaningful negative effects on adult migration conditions in the American River,
2 compared to NAA.

3 Overall, for macrophthalmia migration conditions, these results indicate that project-related effects of
4 Alternative 9 on flow consist primarily of negligible effects (<5%), small to moderate increases in
5 flow (depending on location, to 18% in the Sacramento River at Red Bluff, 25% in the Feather River,
6 and 30% in the American River) that would have beneficial effects on migration conditions, with
7 infrequent and/or small decreases in flow (to -11% in the Sacramento River at Red Bluff, to -9% in
8 the Feather River, and to -5% in the American River) that would not have biologically meaningful
9 negative effects on migration conditions. The exception to this is that Alternative 9 would cause
10 more persistent reductions in flow (to -28%) in the Sacramento River at Rio Vista throughout the
11 migration period, including in drier water years when effects of flow reductions would be more
12 critical for migration conditions, which would have negative effects on macrophthalmia migration
13 conditions at this location.

14 Overall, results for adult migration indicate that project-related effects of Alternative 9 on flow
15 would consist primarily of negligible effects (<5%), with relatively infrequent occurrence of small to
16 moderate increases in flow (to 18% in the Sacramento River, 25% in the Feather River, and 30% in
17 the American River) that would have beneficial effects on migration conditions, and infrequent,
18 small reductions in flow (to -11% in the Sacramento River, to -9% in the Feather River, and -5% in
19 the American River) that would not have biologically meaningful negative effects on adult migration,
20 compared to NAA.

21 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
22 would not substantially reduce the amount of suitable habitat or substantially interfere with the
23 movement of fish. Effects of Alternative 9 on mean monthly flow during the Pacific lamprey
24 macrophthalmia migration period in the Sacramento River at Rio Vista consists of persistent,
25 moderate flow reductions (to -28%) throughout the migration period that would have negative
26 effects on migration conditions at that location; however, consideration of the relatively small
27 magnitude of the flow reductions, and the fact that similar negative effects would not occur in any of
28 the other locations analyzed, the overall effect would not be adverse. The effects of Alternative 9 on
29 flow would not have biologically meaningful negative effects on macrophthalmia and adult migration
30 conditions in the Sacramento River at Red Bluff, the Feather River, and the American River (based
31 on a prevalence of negligible project-related effects and small-scale flow reductions, to -11%, that
32 would not have biologically meaningful effects).

33 **CEQA Conclusion:** In general, under Alternative 9 water operations, the quantity and quality of
34 Pacific lamprey migration habitat would not be affected relative to the CEQA baseline.

35 **Sacramento River**

36 *Juveniles*

37 Comparisons of mean monthly flow rates in the Sacramento River at Rio Vista for December to May
38 for Alternative 9 relative to Existing Conditions indicate predominantly moderate reductions in
39 mean monthly flow (to -23%) throughout the migration period in drier water years, and small
40 increases in flow in wetter years (to 13%) during January through March, and decreases in wetter
41 years for the remaining months of the migration period. The persistent, moderate decreases in flow
42 would affect migration conditions, but not to the extent that would be considered a biologically
43 meaningful effect.

1 Comparisons for the Sacramento River at Red Bluff for December to May for Alternative 9 relative to
2 Existing Conditions indicate primarily negligible effects (<5%), with infrequent, small increases in
3 flow (to 11% overall, with a more substantial increase during May in dry years, 23%) that would
4 have small beneficial effects on migration conditions, with limited occurrence of reductions in flow
5 during December in wet years (-8%), during March in below normal years (-11%), and during May
6 in wet years (-20%) when effects of flow reductions are less critical for migration conditions, which
7 collectively would not have biologically meaningful negative effects on migration conditions. These
8 results indicate that the effects of Alternative 9 on flow would not have biologically meaningful
9 effects on outmigrating macrophthalmia in the Sacramento River at Red Bluff.

10 *Adults*

11 Comparisons of mean monthly flow for the Sacramento River at Red Bluff during the Pacific lamprey
12 adult migration period from January through June indicate variable effects of Alternative 9, relative
13 to Existing Conditions, on mean monthly flow during January, with increases (to 26%) in wetter
14 years and decreases in drier years (to -28%); effects during February would consist of increases in
15 flow (to 27%) with the exception of a moderate decrease (-16%) in critical years; effects during
16 March and April would consist of negligible effects (<5%), increases in flow (to 14%) that would
17 have small beneficial effects, with a single small decrease (-9%) during April in above normal years;
18 and primarily reductions in flow (to -49%) during May and June for all but dry years during May
19 (increase of 18%) and below normal and dry years during June (negligible effects). Decreases in
20 drier water years when the effects of flow reductions would be more critical for migration
21 conditions include small (-12%) to moderate (-28%) reductions during January, followed by a
22 moderate reduction during February in critical years (-16%), followed by negligible project effects
23 during March and April, and small (-8%) to substantial (-48%) reductions during May and June
24 which constitute the end of the migration period. Based on a prevalence of flow reductions in drier
25 water years during 3 out of 6 months of the total migration period, these results indicate that the
26 effects of Alternative 9 on flow would have negative effects on adult migration conditions in the
27 Sacramento River.

28 *Feather River*

29 *Juveniles*

30 Comparisons for the Feather River at the confluence for December to May indicate variable effects
31 relative to Existing Conditions, by month and water year type, with decreases in mean monthly flow
32 during December for wet (-16%) and critical (-19%) water year types and small increases (to 9%) in
33 above and below normal years; primarily negligible effects (<5%) with isolated small-scale
34 increases (to 15%) and decreases (to -15%) in flow during January, February, and April; variable
35 effects during March with small increases in flow in wetter years (to 10%) and decreases in drier
36 years (to -15%); and variable effects during May with decreases in wetter years (to -27%) and
37 increases during drier years (to 29%). Effects throughout the migration period in drier water years,
38 when effects of flow changes would be most critical for migration conditions, consist primarily of
39 negligible effects (<5%), with moderate reductions during December (-19%), and small reductions
40 during March and June (to -7%). These would be partially offset by increases in flow in drier years
41 (to 29%) during May. Overall effects of Alternative 9 on flow are not expected to have biologically
42 meaningful negative effects on migration conditions in the Feather River.

1 **Adults**

2 Comparisons of mean monthly flow for the Feather River at the confluence with the Sacramento
3 River for January to June indicate effects of Alternative 9 on flow, relative to Existing Conditions,
4 consist entirely of small (6%) to substantial increases in flow (to 121%) for January through May
5 that would have beneficial effects on migration conditions, and decreases in flow during June (to -
6 47%) in all water years. The decreases in June would occur in the last month of the migration period
7 and would occur after a prolonged period of persistent, substantial increases in flow under
8 Alternative 9 in all water years. Therefore, the overall effects of Alternative 9 would be beneficial,
9 and the flow reductions in June would not have biologically meaningful negative effects on
10 migration conditions.

11 **American River**

12 *Juveniles*

13 Comparisons for the American River at the confluence with the Sacramento River for December to
14 May indicate variable effects of Alternative 9 relative to Existing Conditions, with decreases in mean
15 monthly flow during December (to -18%); variable effects during January, February and March with
16 primarily increases in wetter years (to 27%) and decreases in drier years (January and February, to
17 -28%); negligible effects or increases in flow during April (to 14%); and negligible effects with a
18 small decrease (-9%) and a small increase (12%) during May. Effects that would be most critical for
19 migration conditions consist of reductions in flow in drier water years; these would occur in
20 December (to -18%) and January (to -28%) at the start of the migration period, and would persist in
21 critical years during February (-16%). Negative effects of these reductions would be somewhat
22 offset by small increases in flow in dry years during April (12%) and May (18%), the last two
23 months of the migration period. The persistent, moderate decreases in drier water years during
24 January and February would have negative effects on migration conditions that would only be
25 partially offset by later increases. However, based on the limited duration compared to the entire
26 migration period in most water year types, and the magnitude of the flow reductions, effects are not
27 expected to have biologically meaningful negative effects on migration conditions in the American
28 River.

29 *Adults*

30 Comparisons of mean monthly flow for the American River at the confluence with the Sacramento
31 River for January to June indicate variable effects of Alternative 9, relative to Existing Conditions,
32 depending on the month and water year type, with effects during January through March consisting
33 primarily of negligible effects (<5%) and small-scale increases (to 15%) and decreases (to -15%) in
34 mean monthly flow. During May there would be decreases in wetter years (to -27%) when effects of
35 flow reductions would be less critical for migration conditions, and increases in drier years (to 29%)
36 that would have beneficial effects. During June there would be decreases for most water years (to -
37 31%) with relatively small effects (-8%) in drier water years that would not have biologically
38 meaningful negative effects on migration conditions. Despite the variability of these results, these
39 results indicate that overall effects of Alternative 9 on flow would not have biologically meaningful
40 negative effects on adult migration in the Feather River, compared to Existing Conditions.

41 Relative to Existing Conditions, the overall effects of Alternative 9 on flow during the adult migration
42 period, vary depending on location, month, and water year type. Effects in drier water years when
43 effects of flow reductions would be more critical for migration conditions would affect migration

1 conditions in the Sacramento River (based on a prevalence of small to moderate flow reductions
2 during one half of the migration period) and would not have biologically meaningful effects in the
3 Feather River and the American River, relative to Existing Conditions.

4 **Summary of CEQA Conclusion**

5 Collectively, the results of the Impact AQUA-168 CEQA analysis indicate that the difference between
6 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
7 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
8 the movement of fish, contrary to the NEPA conclusion set forth above. Impacts of Alternative 9 on
9 flow would have negative effects on adult migration conditions in the Sacramento River, based on
10 small to substantial reductions in flow, to -48%, in drier water years during three out of six months
11 of the migration period. Despite some variability in results, impacts of Alternative 9 on flow would
12 not have biologically meaningful negative effects on juvenile migration conditions in the
13 Sacramento, Feather, or American Rivers, or on adult migration in the Feather River and the
14 American River relative to Existing Conditions.

15 These results are primarily caused by four factors: differences in sea level rise, differences in climate
16 change, future water demands, and implementation of the alternative. The analysis described above
17 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
18 alternative from those of sea level rise, climate change and future water demands using the model
19 simulation results presented in this chapter. However, the increment of change attributable to the
20 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
21 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
22 implementation period, which does include future sea level rise, climate change, and water
23 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
24 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
25 effect of the alternative from those of sea level rise, climate change, and water demands.

26 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
27 term implementation period and Alternative 9 indicates that flows in the locations and during the
28 months analyzed above would generally be similar between Existing Conditions during the LLT and
29 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
30 found above would generally be due to climate change, sea level rise, and future demand, and not
31 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
32 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
33 result in a significant impact on migration conditions for Pacific lamprey. This impact is found to be
34 less than significant and no mitigation is required.

35 **Restoration Measures (CM2, CM4–CM7, and CM10)**

36 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
37 differences in restoration-related fish effects are anticipated anywhere in the affected environment
38 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
39 restoration measures described for Pacific lamprey under Alternative 1A (Impact AQUA-169
40 through Impact AQUA-171) also appropriately characterize effects under Alternative 9.

41 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

1 **Impact AQUA-169: Effects of Construction of Restoration Measures on Pacific Lamprey**

2 **Impact AQUA-170: Effects of Contaminants Associated with Restoration Measures on Pacific**
3 **Lamprey**

4 **Impact AQUA-171: Effects of Restored Habitat Conditions on Pacific Lamprey**

5 *NEPA Effects:* As described in Alternative 1A, none of these impact mechanisms would be adverse to
6 Pacific lamprey, and most would be at least slightly beneficial.

7 *CEQA Conclusion:* All of the impact mechanisms listed above would be at least slightly beneficial, or
8 less than significant, and no mitigation is required.

9 **Other Conservation Measures (CM12–CM19 and CM21)**

10 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
11 differences in other conservation-related fish effects are anticipated anywhere in the affected
12 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
13 effects of other conservation measures described for Pacific lamprey under Alternative 1A (Impact
14 AQUA-172 through Impact AQUA-180) also appropriately characterize effects under Alternative 9.

15 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

16 **Impact AQUA-172: Effects of Methylmercury Management on Pacific Lamprey (CM12)**

17 **Impact AQUA-173: Effects of Invasive Aquatic Vegetation Management on Pacific Lamprey**
18 **(CM13)**

19 **Impact AQUA-174: Effects of Dissolved Oxygen Level Management on Pacific Lamprey (CM14)**

20 **Impact AQUA-175: Effects of Localized Reduction of Predatory Fish on Pacific Lamprey**
21 **(CM15)**

22 **Impact AQUA-176: Effects of Nonphysical Fish Barriers on Pacific Lamprey (CM16)**

23 **Impact AQUA-177: Effects of Illegal Harvest Reduction on Pacific Lamprey (CM17)**

24 **Impact AQUA-178: Effects of Conservation Hatcheries on Pacific Lamprey (CM18)**

25 **Impact AQUA-179: Effects of Urban Stormwater Treatment on Pacific Lamprey (CM19)**

26 **Impact AQUA-180: Effects of Removal/Relocation of Nonproject Diversions on Pacific**
27 **Lamprey (CM21)**

28 *NEPA Effects:* The nine impact mechanisms have been determined to range from no effect, to no
29 adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified
30 for Alternative 1A.

31 *CEQA Conclusion:* The nine impact mechanisms have been determined to range from no effect, to no
32 adverse effect, or beneficial effects on Pacific lamprey for NEPA purposes, for the reasons identified
33 for Alternative 1A.

1 **River Lamprey**

2 **Construction and Maintenance of CM1**

3 River lamprey are present in the north, east, and south Delta. Table 11-6 illustrates the species and
4 life stages of river lamprey present in these areas during the in-water construction window
5 (expected to be June 1–October 31). Ammocoetes are present year-round in all of these areas. Adult
6 spawners may be migrating by construction sites for the intakes and barge landings from September
7 to October. Macrophthalmia (migrating juveniles) may be in the north and south Delta in June and
8 July.

9 **Impact AQUA-181: Effects of Construction of Water Conveyance Facilities on River Lamprey**

10 The potential effects of construction of water conveyance facilities on river lamprey under
11 Alternative 9 would be the same as those described for Pacific lamprey under Alternative 9 (see
12 Impact AQUA-163).

13 **NEPA Effects:** As concluded for Impact AQUA-163 for Pacific lamprey, environmental commitments
14 and mitigation measures would be available to avoid and minimize potential effects, and the effect
15 would not be adverse for river lamprey.

16 **CEQA Conclusion:** As described in Impact AQUA-163 for Pacific lamprey under Alternative 9, the
17 impact of the construction of water conveyance facilities on river lamprey under Alternative 9
18 would be less than significant except for construction noise associated with pile driving.
19 Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would reduce
20 that noise impact to less than significant.

21 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
22 **of Pile Driving and Other Construction-Related Underwater Noise**

23 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

24 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
25 **and Other Construction-Related Underwater Noise**

26 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

27 **Impact AQUA-182: Effects of Maintenance of Water Conveyance Facilities on River Lamprey**

28 Although the facilities involved in maintenance activities under Alternative 9 (screen and gates)
29 would differ from the intakes of Alternative 1A, the same types of effects would apply.

30 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-182, the impact would not be adverse
31 for river lamprey.

32 **CEQA Conclusion:** Although the facilities involved in maintenance activities under Alternative 9
33 (screen and gates) would differ from the intakes of Alternative 1A, the same types of effects
34 resulting from maintenance activities would apply. Consequently, as described in Alternative 1A,
35 Impact AQUA-182 for river lamprey, the impact of the maintenance of water conveyance facilities on
36 river lamprey would be less than significant and no mitigation would be required.

1 **Water Operations of CM1**

2 **Impact AQUA-183: Effects of Water Operations on Entrainment of River Lamprey**

3 ***Water Exports***

4 Entrainment of river lamprey at the SWP/CVP south Delta facilities would be substantially reduced
5 under Alternative 9 compared to the NAA. Screening at the north Delta intakes, at the DCC and at
6 Georgiana Slough, would exclude lamprey. The project adaptive management plan includes
7 monitoring of the new north Delta screens to determine their effectiveness and if they are not
8 meeting expectations additional measures (i.e., modifications to screens or other structural
9 components or changes in water diversion operations) may be implemented to improve screen
10 performance. This would be a beneficial impact on river lamprey. The screened intakes on the DCC
11 and Georgiana Slough would prevent Sacramento River basin lamprey from entering the interior
12 delta, thus reducing potential entrainment to agricultural diversions in the Delta compared to the
13 NAA.

14 ***Predation Associated with Entrainment***

15 Lamprey pre-screen predation loss at the south Delta facilities is assumed to be proportional to
16 entrainment loss. Due to the substantial reduction in lamprey predation at the SWP/CVP south Delta
17 facilities under Alternative 9, there would also be a reduction in predation loss.

18 ***NEPA Effects:*** The overall effect of entrainment and entrainment-related predation on lamprey is
19 considered beneficial.

20 ***CEQA Conclusion:*** As described above, annual entrainment losses of lamprey would be substantially
21 reduced under Alternative 9 relative to Existing Conditions. The impact of predation loss at the
22 north Delta would be unknown, since there is little available knowledge on their distribution and
23 abundance in the Delta. Overall the impact on River lamprey from water operations would be
24 considered beneficial. No mitigation would be required.

25 **Impact AQUA-184: Effects of Water Operations on Spawning and Egg Incubation Habitat for**
26 **River Lamprey**

27 In general, effects of Alternative 9 on river lamprey spawning habitat would be negligible relative to
28 the NAA based on primarily negligible effects on dewatering risk and only a small effect on critical
29 water temperatures in the Feather River.

30 Flow-related impacts to river lamprey spawning habitat were evaluated by estimating effects of flow
31 alterations on redd dewatering risk as described for Pacific lamprey with appropriate time-frames
32 for river lamprey incorporated into the analysis. The same locations were analyzed as for Pacific
33 lamprey: the Sacramento River at Keswick and Red Bluff, Trinity River downstream of Lewiston,
34 Feather River at Thermalito Afterbay, and American River at Nimbus Dam and at the confluence
35 with the Sacramento River. River lamprey spawn in these rivers between February and June so flow
36 reductions during those months have the potential to dewater redds, which could result in
37 incomplete development of the eggs to ammocoetes (the larval stage).

38 Dewatering risk to redd cohorts was characterized by the number of cohorts experiencing a month-
39 over-month reduction in flows (using CALSIM II outputs) of greater than 50%. There would be
40 negligible effects (<5%) in all locations (Table 11-9-73). These results indicate that project-related

1 effects of Alternative 9 on flow would not affect redd dewatering risk in the Sacramento River,
2 Trinity River, Feather River, and the American River, relative to the NAA.

3 **Table 11-9-73. Differences between Model Scenarios in Dewatering Risk of River Lamprey Redd**
4 **Cohorts^a**

Location	Comparison ^b	EXISTING CONDITIONS	
		vs. A9_LL1	NAA vs. A9_LL1
Sacramento River at Keswick	Difference	2	-1
	Percent Difference	6%	-3%
Sacramento River at Red Bluff	Difference	0	-2
	Percent Difference	0%	-5%
Trinity River downstream of Lewiston	Difference	-5	-3
	Percent Difference	-7%	-4%
Feather River Below Thermalito Afterbay	Difference	-10	0
	Percent Difference	-15%	0%
American River at Nimbus	Difference	12	3
	Percent Difference	22%	5%
American River at Sacramento River confluence	Difference	19	2
	Percent Difference	32%	3%

^a Difference and percent difference between model scenarios in the number of Pacific lamprey redd cohorts experiencing a month-over-month reduction in flows of greater than 50%.

^b Positive values indicate a higher value in Alternative 9 than under Existing Conditions or NAA).

5
6 River lamprey generally spawn between February and June (Beamish 1980; Moyle 2002). Using
7 Pacific lamprey as a surrogate, eggs are assumed to hatch in 18-49 days depending on water
8 temperature (Brumo 2006) and are, therefore, assumed to be present during roughly the same
9 period and locations as spawners. Moyle et al. (1995) indicate that river lamprey “adults need...
10 temperatures [that] do not exceed 25°C,” although there is no mention of thermal requirements for
11 eggs in this or any existing literature. Meeuwig et al. (2005) reported that, for Pacific lamprey eggs,
12 significant reductions in survival were observed at 22°C (71.6°F). Therefore, for this analysis, both
13 temperatures, 22°C (71.6°F) and 25°C (77°F), were used as upper thresholds of river lamprey eggs.
14 The analysis predicted the number of consecutive 49 day periods for the entire 82-year CALSIM
15 period during which at least one day exceeds 22°C (71.6°F) or 25°C (77°F) using daily data from
16 USRWQM. For other rivers, the analysis predicted the number of consecutive two-month periods
17 during which at least one month exceeds 22°C (71.6°F) or 25°C (77°F) using monthly averaged data
18 from the Bureau’s temperature model. Each individual day or month starts a new “egg cohort” such
19 that there are 12.320 cohorts for the Sacramento River, corresponding to 82 years of eggs being laid
20 every day each year from February 1 through June 30, and 405 cohorts for the other rivers using
21 monthly data over the same period. The incubation periods used in this analysis are conservative
22 and represent the extreme long end of the egg incubation period (Brumo 2006). Also, the utility of
23 the monthly average time step is limited because the extreme temperatures are masked; however,
24 no better analytical tools are currently available for this analysis. Spawning locations of river
25 lamprey are not well defined. Therefore, this analysis uses the widest range in which the species is
26 thought to spawn in each river.

1 For both thresholds, there would be few differences in egg cohort exposure between NAA and
 2 Alternative 9 among all sites (Table 11-9-74). The reduction of 14 cohorts (39% decrease) in the
 3 Sacramento River at Hamilton City for the 77°F threshold is negligible to the population considering
 4 the total number of cohorts is 12,320. In the Feather River below Thermalito Afterbay, there would
 5 be 9 more cohorts (24% increase) exposed to the 71.6°F threshold under Alternative 9 relative to
 6 NAA and no differences in cohorts at the 77°F threshold. Overall, these results indicate that there
 7 would be no differences in egg exposure to elevated temperatures under Alternative 9.

8 **Table 11-9-74. Differences (Percent Differences) between Model Scenarios in River Lamprey Egg**
 9 **Cohort Temperature Exposure**

Location	EXISTING CONDITIONS vs. A9_LL1	NAA vs. A9_LL1
71.6°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	326 (NA)	3 (1%)
Trinity River at Lewiston	0 (NA)	-1 (-100%)
Trinity River at North Fork	4 (NA)	-1 (-20%)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	38 (422%)	9 (24%)
American River at Nimbus	26 (520%)	1 (3%)
American River at Sacramento River Confluence	53 (189%)	-1 (-1%)
Stanislaus River at Knights Ferry	1 (NA)	1 (NA)
Stanislaus River at Riverbank	34 (3,400%)	0 (0%)
77°F Threshold		
Sacramento River at Keswick	0 (NA)	0 (NA)
Sacramento River at Hamilton City	22 (NA)	-14 (-39%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	0 (NA)	0 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	2 (NA)	0 (0%)
American River at Nimbus	4 (NA)	0 (0%)
American River at Sacramento River Confluence	11 (NA)	5 (83%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Difference and percent difference between model scenarios in the number of Pacific lamprey egg cohorts experiencing water temperatures above 71.6°F and 77°F F during February to June on at least one day during a 49-Day incubation period in the Sacramento River or for at least one month during a 2-month incubation period for each model scenario in other rivers. Positive values indicate a higher value in the proposed project than in EXISTING CONDITIONS or NAA.

10

11 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
 12 would not substantially reduce spawning habitat or substantially reduce the number of fish as a
 13 result of egg mortality. Alternative 9 would not affect river lamprey egg survival based on negligible
 14 project-related changes to risk of dewatering (≤5%) and only a small project-related effect (24%) on

1 increases in exposure to water temperatures above preferred thresholds in the Feather River below
2 Thermalito Afterbay that would not have biologically meaningful effects on egg mortality and
3 spawning success.

4 **CEQA Conclusion:** In general, under Alternative 9 water operations, the quantity and quality of river
5 lamprey spawning habitat would not be affected relative to the CEQA baseline.

6 Effects of Alternative 9 on flow reductions during the river lamprey spawning period from February
7 to June consist of no effect (0% difference) in the Sacramento River at Red Bluff and the Feather
8 River, decreases in redd cohort dewatering risk in the Trinity River (-7%) and the Feather River (-
9 15%) that would have beneficial effects on spawning success, a small increase (6%) in the
10 Sacramento River at Keswick that would not have biologically meaningful effects, and moderate
11 increases in the American River at Nimbus Dam (22%) and at the confluence with the Sacramento
12 River (32%) (Table 11-9-73) that would have moderate, negative effects on spawning conditions at
13 those locations.

14 In the Sacramento River at Hamilton City, there would be 326 more cohorts (could not calculate
15 relative difference due to division by 0) exposed to the 71.6°F threshold under Alternative 9 relative
16 to Existing Conditions, although this represents a very small proportion of the total number of
17 cohorts evaluated (12,320 cohorts)(Table 11-9-74) and, therefore, would not be biologically
18 meaningful. There would be no differences between Existing Conditions and Alternative 9 at either
19 location in the Trinity River. In the Feather River below Thermalito Afterbay, there would be 38
20 more cohorts (422% higher) exposed to the 71.6°F threshold under Alternative 9 relative to Existing
21 Conditions, although there would be no difference at the Fish Barrier Dam. At the two locations in
22 the American River, there would be 26 to 53 more cohorts (189% to 520% higher) exposed to the
23 71.6°F threshold under Alternative 9 relative to Existing Conditions. In the Stanislaus River at
24 Riverbank, there would be 34 more cohorts (3,400% higher) exposed to the 71.6°F threshold under
25 Alternative 9 relative to Existing Conditions, although there would be no difference at the Knights
26 Ferry. There would be no differences between Existing Conditions and Alternative 9 at any location
27 examined in exposure of egg cohorts to the 77°F threshold, except for increases of 22 cohorts in the
28 Sacramento River at Hamilton City and 11 cohorts in the American River at the confluence with the
29 Sacramento River.

30 **Summary of CEQA Conclusion**

31 Collectively, the results of the Impact AQUA-184 CEQA analysis indicate that the difference between
32 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
33 alternative could substantially reduce spawning habitat and substantially reduce the number of fish
34 as a result of egg mortality, contrary to the NEPA conclusion set forth above. Alternative 9 would
35 increase risk of redd dewatering in the American River (through increased egg cohort dewatering
36 exposure up to 32%) and would affect egg survival due to increases in water temperature in the
37 Feather River below Thermalito Afterbay, based on a substantial increase in egg cohorts exposed to
38 71.6°F (38 cohorts or 422%), and a small increase in the number of cohorts exposed to 77°F (from 0
39 to 2). Increased water temperatures would increase stress and reduce survival of lamprey eggs.

40 These results are primarily caused by four factors: differences in sea level rise, differences in climate
41 change, future water demands, and implementation of the alternative. The analysis described above
42 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
43 alternative from those of sea level rise, climate change and future water demands using the model
44 simulation results presented in this chapter. However, the increment of change attributable to the

1 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
2 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
3 implementation period, which does include future sea level rise, climate change, and water
4 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
5 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
6 effect of the alternative from those of sea level rise, climate change, and water demands.

7 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
8 term implementation period and Alternative 9 indicates that flows in the locations and during the
9 months analyzed above would generally be similar between Existing Conditions during the LLT and
10 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
11 found above would generally be due to climate change, sea level rise, and future demand, and not
12 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
13 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
14 result in a significant impact on river lamprey spawning habitat. This impact is found to be less than
15 significant and no mitigation is required.

16 **Impact AQUA-185: Effects of Water Operations on Rearing Habitat for River Lamprey**

17 In general, effects of Alternative 9 on river lamprey rearing habitat would be negligible relative to
18 the NAA, based on primarily negligible effects on stranding risk in the locations analyzed, and on
19 water temperatures in the Feather River. There would be a beneficial effect from substantial
20 reductions in dewatering risk in the Feather River and the American River.

21 Flow-related effects on river lamprey rearing habitat were evaluated by estimating effects of flow
22 alterations on ammocoete exposure, or stranding risk, as described for Pacific lamprey. Lower flows
23 can reduce the instream area available for rearing and rapid reductions in flow can strand
24 ammocoetes leading to mortality. Effects of Alternative 9 on flow were evaluated in the Sacramento
25 River at Keswick and Red Bluff, the Trinity River, Feather River, and the American River at Nimbus
26 Dam and at the confluence with the Sacramento River. As for Pacific lamprey, the analysis of river
27 lamprey ammocoete stranding was conducted by analyzing a range of month-over-month flow
28 reductions from CALSIM II outputs, using the range of 50%–90% in 5% increments. A cohort of
29 ammocoetes was assumed to be born every month during their spawning period (February through
30 June) and spend 5 years rearing upstream. Therefore, a cohort was considered stranded if at least
31 one month-over-month flow reduction was greater than the flow reduction at any time during the
32 period. Comparisons for the Sacramento River at Red Keswick of Alternative 9 to NAA indicate no
33 effect (0%) or negligible effects ($\leq 5\%$) attributable to the project in all flow reduction categories,
34 with the exception of small increases in exposure to 75% and 80% flow reduction events (9% and
35 5% respectively), and a moderate increase in exposure to 85% flow reduction events (23%) (Table
36 11-9-75). These are relatively small increases in exposure that are not expected to have biologically
37 meaningful negative effects on spawning success at this location.

1 **Table 11-9-75. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at**
 3 **Keswick**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	2	0
-60%	3	-1
-65%	-1	-2
-70%	0	0
-75%	2	9
-80%	17	5
-85%	77	23
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

4
 5 Comparisons for the Sacramento River at Red Bluff indicate negligible effects (<5%) for all flow
 6 reductions categories attributable to the project. These results indicate that project-related effects of
 7 Alternative 9 on flow would not affect risk of ammocoete exposure and mortality in the Sacramento
 8 River at Red Bluff (Table 11-9-76).

9 **Table 11-9-76. Percent Difference between Model Scenarios in the Number of River Lamprey**
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Sacramento River at Red**
 11 **Bluff**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	6	3
-60%	8	1
-65%	3	2
-70%	13	4
-75%	18	-3
-80%	10	0
-85%	100	0
-90%	NA	NA

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

12
 13 Comparisons for the Trinity River indicate no effect (0%) or negligible effects (<5%) for all flow
 14 reduction events attributable to the project. These results indicate that project-related effects of
 15 Alternative 9 on flow would not affect risk of ammocoete exposure and mortality in the Trinity
 16 River. (Table 11-9-77).

1 **Table 11-9-77. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Trinity River at Lewiston**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	32	0
-80%	34	-4
-85%	26	-4
-90%	56	2

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

3
 4 Comparisons in the Feather River (Table 11-9-78 indicate no effect (0%), a single small increase
 5 (6%) that would not have biologically meaningful negative effects, and two decreases (-5% and -
 6 32%) in exposure to flow reduction events that would have beneficial effects. These results indicate
 7 that project-related effects of Alternative 9 on flow would have beneficial effects on spawning
 8 conditions in the Feather River.

9 **Table 11-9-78. Percent Difference between Model Scenarios in the Number of River Lamprey**
 10 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, Feather River at Thermalito**
 11 **Afterbay**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
-50%	0	0
-55%	0	0
-60%	0	0
-65%	0	0
-70%	0	0
-75%	0	0
-80%	-1	6
-85%	25	-5
-90%	-62	-32

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

12
 13 Comparisons for the American River at Nimbus Dam (Table 11-9-79) and at the confluence with the
 14 Sacramento River (Table 11-9-80) indicate negligible effects (<5%) or decreases in exposure (to -
 15 67% at Nimbus Dam, to -43% at the confluence) attributable to the project for all flow reduction
 16 categories. Decreased risk of dewatering would have beneficial effects on spawning conditions for
 17 both locations. These results indicate that project-related effects of Alternative 9 on flow would have
 18 beneficial effects on spawning conditions in the American River.

1 **Table 11-9-79. Percent Difference between Model Scenarios in the Number of River Lamprey**
 2 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at Nimbus**
 3 **Dam**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	-1	-1
-60%	0	-4
-65%	3	-4
-70%	47	-7
-75%	102	-11
-80%	220	-33
-85%	200	-46
-90%	0	-67

NA = could not be calculated because the denominator was 0.

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

4

5 **Table 11-9-80. Relative Difference between Model Scenarios in the Number of River Lamprey**
 6 **Ammocoete Cohorts Exposed to Month-over-Month Flow Reductions, American River at the**
 7 **Confluence with the Sacramento River**

Percent Flow Reduction	Percent Difference ^a	
	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
-50%	0	0
-55%	0	0
-60%	3	-1
-65%	1	-3
-70%	13	-8
-75%	32	-14
-80%	197	-12
-85%	178	-35
-90%	164	-43

^a Negative values indicate reduced cohort exposure, a benefit of Alternative 9.

8

9 Because the thermal tolerance of river lamprey ammocoetes is unknown, the thermal tolerance of
 10 Pacific lamprey ammocoetes of 22°C (71.6°F) and of river lamprey adults of 25°C (77°F) (Moyle et
 11 al. 1995) was used. River lamprey ammocoetes rear upstream for 3–5 years (Moyle 2002). To be
 12 conservative, this analysis assumed a maximum ammocoete duration of 5 years. Each individual day
 13 or month starts a new “cohort” such that there are 18,730 cohorts for the Sacramento River,
 14 corresponding to 82 years of ammocoetes being “born” every day each year from January 1 through
 15 August 31, and 380 cohorts for the other rivers using monthly data over the same period.

16 In most locations, the number of ammocoete cohorts exposed to each threshold under Alternative 9
 17 would be similar to or lower than those under NAA (Table 11-9-81). Biologically meaningful

1 exceptions includes the Trinity River at Lewiston, Feather River below Thermalito Afterbay, and
 2 Stanislaus River at Knights Ferry for the 71.6°F threshold, and the Sacramento River at Hamilton
 3 City and Feather River below Thermalito Afterbay for the 77°F threshold. In all cases, there would
 4 be another location within the river that would have similar or lower exceedances under Alternative
 5 9.

6 **Table 11-9-81. Differences (Percent Differences) between Model Scenarios in River Lamprey**
 7 **Ammocoete Cohorts Exposed to Temperatures in the Feather River Greater than 71.6°F and 77°F**
 8 **in at Least One Month**

Location	EXISTING CONDITIONS	
	vs. A9_LLT	NAA vs. A9_LLT
71.6°F Threshold		
Sacramento River at Keswick ^b	1,217 (NA)	-1 (-0.1%)
Sacramento River at Hamilton City ^b	8,787 (NA)	-708 (-7%)
Trinity River at Lewiston	90 (NA)	40 (80%)
Trinity River at North Fork	135 (NA)	-25 (-16%)
Feather River at Fish Barrier Dam	25 (NA)	0 (0%)
Feather River below Thermalito Afterbay	150 (79%)	20 (6%)
American River at Nimbus	235 (261%)	-10 (-3%)
American River at Sacramento River Confluence	135 (55%)	0 (0%)
Stanislaus River at Knights Ferry	50 (NA)	25 (100%)
Stanislaus River at Riverbank	335 (1,340%)	0 (0%)
77°F Threshold		
Sacramento River at Keswick ^b	0 (NA)	0 (NA)
Sacramento River at Hamilton City ^b	1,502 (NA)	451 (30%)
Trinity River at Lewiston	0 (NA)	0 (NA)
Trinity River at North Fork	25 (NA)	25 (NA)
Feather River at Fish Barrier Dam	0 (NA)	0 (NA)
Feather River below Thermalito Afterbay	75 (NA)	35 (88%)
American River at Nimbus	200 (NA)	-20 (-9%)
American River at Sacramento River Confluence	240 (NA)	10 (4%)
Stanislaus River at Knights Ferry	0 (NA)	0 (NA)
Stanislaus River at Riverbank	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a Positive values indicate a higher value in Alternative 9 than in EXISTING CONDITIONS or NAA.

^b Based on daily data; all other locations use monthly data; 1922–2003.

9

10 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
 11 would not substantially reduce rearing habitat or substantially reduce the number of fish as a result
 12 of ammocoete mortality. Project-related effects of Alternative 9 on flow reductions that would be
 13 harmful for ammocoete survival consist entirely of negligible effects (<5%), a single, small-scale
 14 increase in dewatering exposure (6%) in one location that would not have biologically meaningful
 15 negative effects, and reductions in exposure (to -32% in the Feather River and to -67% in the
 16 American River) that would have beneficial effects by reducing dewatering risk. Exposure to
 17 elevated water temperature would generally not differ between NAA and Alternative 9.

1 **CEQA Conclusion:** In general, under Alternative 9 water operations, the quantity and quality of river
2 lamprey rearing habitat would not be affected relative to the CEQA baseline.

3 Lower flows can reduce the instream area available for rearing and rapid reductions in flow can
4 strand ammocoetes leading to mortality. Comparison of potential for ammocoete stranding under
5 Alternative 9 relative to Existing Conditions for the Sacramento River at Keswick indicates negligible
6 effects (<5%) for ammocoete cohort exposures to flow reductions from 50% to 75%, a moderate
7 increase in exposure (17%) to 89% flow reduction events, and a more substantial increase in
8 exposure (77%) to 85% flow reduction events (Table 11-9-75). There would be no change for 90%
9 flow reduction events because all values are zero. Comparisons for the Sacramento River at Red
10 Bluff indicate similar results with negligible effects (<5%) and small to moderate increases (to 18%)
11 in exposure for 50% to 80% flow reduction categories, and a more substantial increases in exposure
12 (from 25 to 50 cohorts or 100%) in the 85% flow reduction category (Table 11-9-76). Based on the
13 prevalence of small-scale effects with only a single flow reduction category with more substantial
14 increases in dewatering risk at each location, effects of Alternative 9 on flow are not expected to
15 have biologically meaningful negative effects on spawning success in the Sacramento River.

16 Comparisons for the Trinity River indicate no effect (0%) for flow reduction categories from 50% to
17 70%, and increases ranging from 26% to 56% for the higher flow reduction categories (Table 11-9-
18 77). The substantial and persistent increases in dewatering exposure would affect spawning success
19 in the Trinity River.

20 Comparisons for the Feather River indicate no effect (0%) or negligible effects (<5%) in frequency of
21 exposure to all flow reduction categories from 50% to 80%, a moderate increase in exposure (25%)
22 to 85% flow reduction events, and a substantial decrease (-62%) in exposure to 90% flow reduction
23 events (Table 11-9-78). The substantial reduced ammocoete cohort exposure to the largest flow
24 reduction category would have beneficial effects on spawning success and overall Alternative 9
25 would not have any negative effects in the Feather River.

26 Comparisons for the American River indicate no effect (0%) or negligible effects (<5%) in
27 ammocoete exposure to 50% through 65% flow reduction events, and substantial increases in
28 frequency of occurrence to the larger flow reduction categories, with increases of 47% to 220%
29 (from 50 to 160 cohorts) in ammocoete cohorts exposed flow reduction events at Nimbus Dam
30 (Table 11-9-79) and increases of 13% to 197% (from 71 to 211 cohorts) for the confluence (Table
31 11-9-80). These persistent and substantial increases in ammocoete cohort exposure to flow
32 reductions would have negative effects on spawning success in the American River.

33 The number of ammocoete cohorts exposed to 71.6°F under Alternative 9 would be higher than
34 those under Existing Conditions in all locations examined (Table 11-9-81). The number of
35 ammocoete cohorts exposed to 77°F under Alternative 9 would be similar at all locations except the
36 Sacramento River at Hamilton City, Trinity River at North Fork, Feather River below Thermalito
37 Afterbay and at both locations in the American River.

38 **Summary of CEQA Conclusion**

39 Collectively, the results of the Impact AQUA-185 CEQA analysis indicate that the difference between
40 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
41 alternative could substantially reduce rearing habitat and substantially reduce the number of fish as
42 a result of ammocoete mortality, contrary to the NEPA conclusion set forth above. Impacts of
43 Alternative 9 would affect ammocoete cohort stranding through increases in flow reductions in the

1 Trinity River (to 56%) and the American River (to 220%). Effects in the Sacramento River would
2 include moderate increases in exposure to some flow reduction events but not to the extent that
3 would cause biologically meaningful negative effects; effects in the Feather River would be beneficial
4 by reducing dewatering events and therefore stranding potential. Exposure to elevated water
5 temperatures would increase in all rivers evaluated under Alternative 9 relative to NAA.

6 These results are primarily caused by four factors: differences in sea level rise, differences in climate
7 change, future water demands, and implementation of the alternative. The analysis described above
8 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
9 alternative from those of sea level rise, climate change and future water demands using the model
10 simulation results presented in this chapter. However, the increment of change attributable to the
11 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
12 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
13 implementation period, which does include future sea level rise, climate change, and water
14 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
15 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
16 effect of the alternative from those of sea level rise, climate change, and water demands.

17 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
18 term implementation period and Alternative 9 indicates that flows in the locations and during the
19 months analyzed above would generally be similar between Existing Conditions during the LLT and
20 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
21 found above would generally be due to climate change, sea level rise, and future demand, and not
22 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
23 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
24 result in a significant impact on rearing habitat for river lamprey. This impact is found to be less
25 than significant and no mitigation is required.

26 **Impact AQUA-186: Effects of Water Operations on Migration Conditions for River Lamprey**

27 In general, effects of Alternative 9 on river lamprey migration conditions would be negligible
28 relative to the NAA based on primarily negligible effects on mean monthly flow in the locations
29 analyzed. There would be beneficial effects from small to moderate increases in flow in some
30 locations; this effect would generally be somewhat offset by small flow reductions in other months
31 leading to a net conclusion of negligible effects.

32 ***Macrophthalmia***

33 After 3 to 5 years river lamprey ammocoetes migrate downstream and become macrophthalmia once
34 they reach the Delta. River lamprey migration generally occurs September through November
35 (USFWS unpublished data). The effects of water operations on seasonal migration flows for river
36 lamprey macrophthalmia were assessed using CALSIM II flow output. Flow rates along the likely
37 migration pathways of river lamprey during the likely migration period (September through
38 November) were examined to predict how Alternative 9 may affect migration flows for outmigrating
39 macrophthalmia.

40 Analyses were conducted for the Sacramento River at Red Bluff, Feather River at the confluence with
41 the Sacramento River, and the American River at the confluence with the Sacramento River.

1 *Sacramento River*

2 Comparisons for the Sacramento River at Red Bluff for September through November for Alternative
3 9 relative to NAA indicate primarily negligible effects (<5%) throughout the migration period, with
4 occasional, small increases in flow (to 9%) during September and November in some water years,
5 and decreases during October in above normal (-10%), below normal (-13%), and critical years (-
6 10%) that would not be a magnitude or frequency in the migration period to result in biologically
7 meaningful effects. These results indicate that effects of Alternative 9 on flow would not have
8 biologically meaningful negative effects on macrophthalmia migration conditions in the Sacramento
9 River, relative to the NAA.

10 *Feather River*

11 Comparisons for the Feather River at the confluence with the Sacramento River for September
12 through November for Alternative 9 compared to NAA indicate negligible effects (<5%) during
13 September in all water years, and negligible effects or small decreases in flow (to -12%) during
14 October and November with the exception of a small increase (10%) during November in dry years.
15 Reductions in flow in drier water years when they would have the greatest effect on migration
16 conditions are limited to isolated and/or small decreases that are not expected to have biologically
17 meaningful negative effects on migration conditions in the Feather River, relative to the NAA.

18 *American River*

19 Comparisons for the American River at the confluence with the Sacramento River for September
20 through November for Alternative 9 compared to NAA indicate negligible effects (<5%) or small
21 increases in flow (to 13%) during September, decreases in most water years during October (to -
22 18%) with the exception of a small increase (12%) in dry years, and negligible effects (≤5%) or
23 increases (to 20%) during November. Project-related effects in drier years when effects of flow
24 reductions would be most critical for migration conditions consist of negligible or beneficial effects
25 (increases to 20%), with the exception of small decreases during October (-15% in below normal
26 years, -10% in critical years) that would be infrequent and of small magnitude and therefore not
27 expected to cause biologically meaningful negative effects on migration conditions, compared to the
28 NAA.

29 **Adults**

30 Effects of Alternative 9 on flow during the adult migration period, September through November,
31 would be the same as described for the macrophthalmia migration period, September through
32 November, above.

33 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because it
34 would not substantially reduce the amount of suitable habitat or substantially interfere with the
35 movement of fish. Project-related effects of Alternative 9 on mean monthly flow during September
36 through November in drier water years consist primarily of negligible effects (<5%), small to
37 moderate increases in flow (to 20%) that would have beneficial effects on migration conditions, and
38 infrequent, small decreases in flow (to -15%) that would not have negative effects on migration
39 conditions, compared to NAA.

40 **CEQA Conclusion:** In general, under Alternative 9 water operations, the quantity and quality of river
41 lamprey migration habitat would be reduced relative to the CEQA baseline. Differences between the
42 anticipated future conditions under this alternative and Existing Conditions (the CEQA “baseline” or

1 point of comparison) are largely attributable to sea level rise and climate change, and not to the
2 operational scenarios. As a result, the differences between Alternative 9 (which is under LLT
3 conditions that include future sea level rise and climate change) and the CEQA baseline (Existing
4 Conditions) may therefore either overstate the effects of Alternative 9 or indicate significant effects
5 that are largely attributable to sea level rise and climate change, and not to Alternative 9.

6 ***Macrophthalmia***

7 *Sacramento River*

8 Comparisons for the Sacramento River at Red Bluff for September through November for Alternative
9 9 relative to Existing Conditions indicate variable effects during September, with increases in mean
10 monthly flow for wetter water year types (43 to 64%) and decreases for drier water year types (to -
11 25%). Alternative 9 would have negligible effects (<5%) or small reductions in flow (to -11%)
12 during October, and would result in primarily increases in mean monthly flow during November (to
13 22%). The occurrence of moderate reductions in flow during September in drier water years,
14 followed by a further small reduction during October in critical years, would affect migration
15 conditions for a substantial portion of the migration period in drier water years in the Sacramento
16 River.

17 *Feather River*

18 Comparisons for the Feather River at the confluence with the Sacramento River for September
19 through November for Alternative 9 relative to Existing Conditions indicate variable effects, with
20 substantial increases in mean monthly flow during September in wetter water years (to 146%), and
21 reductions (to -33%) in drier years; primarily reductions in flow (to -23%) during October, and
22 negligible effects (<5%) or reductions in flow (to -21%) during November. Effects in drier water
23 years when effects of flow reductions would be most critical for migration conditions consist of
24 small to moderate reductions during September and October with the exception of a small increase
25 (13%) during September in below normal years, and negligible effects or a small decrease (-6%)
26 during November. The occurrence of small to moderate reductions in flow during September in
27 drier water years, followed by a further moderate reduction during October in critical years, would
28 affect migration conditions for a substantial portion of the migration period in drier water years in
29 the Feather River.

30 *American River*

31 Comparisons for the American River at the confluence with the Sacramento River for September
32 through November indicate primarily reductions in mean monthly flow throughout the migration
33 period in all water year types, ranging from -6% to -52%, including in drier water year types when
34 effects on migration conditions would be more critical (to -52%). These results indicate Alternative
35 9 would have negative effects on migration conditions in the American River.

36 ***Adults***

37 Effects of Alternative 9 on flow during the adult migration period, September through November,
38 would be the same as described for the macrophthalmia migration period, September through
39 November, above.

1 **Summary of CEQA Conclusion**

2 Collectively, the results of the Impact AQUA-186 CEQA analysis indicate that the difference between
3 the CEQA baseline and Alternative 9 could be significant because, under the CEQA baseline, the
4 alternative could substantially reduce the amount of suitable habitat and substantially interfere with
5 the movement of fish, contrary to the NEPA conclusion set forth above. This is based on a
6 predominance of small to substantial (to -33%) reductions in mean monthly flow during September
7 and October in drier water year types in the Sacramento River and the Feather River, and small to
8 substantial reductions in flow for all months and all water year types, including drier water years (to
9 -52%), in the American River.

10 These results are primarily caused by four factors: differences in sea level rise, differences in climate
11 change, future water demands, and implementation of the alternative. The analysis described above
12 comparing Existing Conditions to Alternative 9 does not partition the effect of implementation of the
13 alternative from those of sea level rise, climate change and future water demands using the model
14 simulation results presented in this chapter. However, the increment of change attributable to the
15 alternative is well informed by the results from the NEPA analysis, which found this effect to be not
16 adverse. In addition, CALSIM modeling has been conducted for Existing Conditions in the LLT
17 implementation period, which does include future sea level rise, climate change, and water
18 demands. Therefore, the comparison of results between the alternative and Existing Conditions in
19 the LLT, both of which include sea level rise, climate change, and future water demands, isolates the
20 effect of the alternative from those of sea level rise, climate change, and water demands.

21 The additional comparison of CALSIM flow outputs between Existing Conditions in the late long-
22 term implementation period and Alternative 9 indicates that flows in the locations and during the
23 months analyzed above would generally be similar between Existing Conditions during the LLT and
24 Alternative 9. This indicates that the differences between Existing Conditions and Alternative 9
25 found above would generally be due to climate change, sea level rise, and future demand, and not
26 the alternative. As a result, the CEQA conclusion regarding Alternative 9, if adjusted to exclude sea
27 level rise and climate change, is similar to the NEPA conclusion, and therefore would not in itself
28 result in a significant impact on rearing habitat for river lamprey. This impact is found to be less
29 than significant and no mitigation is required.

30 **Restoration Measures (CM2, CM4–CM7, and CM10)**

31 Alternative 9 has the same restoration measures as Alternative 1A. Because no substantial
32 differences in restoration-related fish effects are anticipated anywhere in the affected environment
33 under Alternative 9 compared to those described in detail for Alternative 1A, the fish effects of
34 restoration measures described for river lamprey under Alternative 1A (Impact AQUA-187 through
35 AQUA-189) also appropriately characterize effects under Alternative 9.

36 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

37 **Impact AQUA-187: Effects of Construction of Restoration Measures on River Lamprey**

38 **Impact AQUA-188: Effects of Contaminants Associated with Restoration Measures on River**
39 **Lamprey**

40 **Impact AQUA-189: Effects of Restored Habitat Conditions on River Lamprey**

1 **NEPA Effects:** As described in Alternative 1A, none of these impact mechanisms would be adverse to
2 river lamprey, and most would be at least slightly beneficial.

3 **CEQA Conclusion:** All of the impact mechanisms listed above would be at least slightly beneficial,
4 or less than significant, and no mitigation is required.

5 **Other Conservation Measures (CM12–CM19 and CM21)**

6 Alternative 9 has the same other conservation measures as Alternative 1A. Because no substantial
7 differences in other conservation-related fish effects are anticipated anywhere in the affected
8 environment under Alternative 9 compared to those described in detail for Alternative 1A, the fish
9 effects of other conservation measures described for river lamprey under Alternative 1A (Impact
10 AQUA-190 through Impact AQUA-198) also appropriately characterize effects under Alternative 9.

11 The following impacts are those presented under Alternative 1A that are identical for Alternative 9.

12 **Impact AQUA-190: Effects of Methylmercury Management on River Lamprey (CM12)**

13 **Impact AQUA-191: Effects of Invasive Aquatic Vegetation Management on River Lamprey** 14 **(CM13)**

15 **Impact AQUA-192: Effects of Dissolved Oxygen Level Management on River Lamprey (CM14)**

16 **Impact AQUA-193: Effects of Localized Reduction of Predatory Fish on River Lamprey (CM15)**

17 **Impact AQUA-194: Effects of Nonphysical Fish Barriers on River Lamprey (CM16)**

18 **Impact AQUA-195: Effects of Illegal Harvest Reduction on River Lamprey (CM17)**

19 **Impact AQUA-196: Effects of Conservation Hatcheries on River Lamprey (CM18)**

20 **Impact AQUA-197: Effects of Urban Stormwater Treatment on River Lamprey (CM19)**

21 **Impact AQUA-198: Effects of Removal/Relocation of Nonproject Diversions on River Lamprey** 22 **(CM21)**

23 **NEPA Effects:** The nine impact mechanisms have been determined to range from no effect, to no
24 adverse effect, or beneficial effects on river lamprey for NEPA purposes, for the reasons identified
25 for Alternative 1A.

26 **CEQA Conclusion:** The nine impact mechanisms would be considered to range from no impact, to
27 less than significant, or beneficial on river lamprey, for the reasons identified for Alternative 1A, and
28 no mitigation is required.

29 **Non-Covered Aquatic Species of Primary Management Concern**

30 **Construction and Maintenance of CM1**

31 The effects of construction and maintenance of CM1 under Alternative 9 would be similar for all
32 non-covered species; therefore, the analysis below is combined for all non-covered species instead
33 of analyzed by individual species.

1 **Impact AQUA-199: Effects of Construction of Water Conveyance Facilities on Non-Covered**
2 **Aquatic Species of Primary Management Concern**

3 Refer to the description of Alternative 9 at the beginning of Section 11.3.4.16 and Alternative 9,
4 Impact AQUA-1 under delta smelt for a discussion of the effects of construction of water conveyance
5 facilities. That discussion under delta smelt addresses the type, magnitude and range of impact
6 mechanisms that are relevant to the aquatic environment and aquatic species. The discussion there
7 is also relevant to non-covered species of primary management concern.

8 **NEPA Effects:** As concluded for Alternative 9, Impact AQUA-1, environmental commitments and
9 mitigation measures would be available to avoid and minimize potential effects, and the effects
10 would not be adverse for non-covered aquatic species of primary management concern.

11 **CEQA Conclusion:** As described in Impact AQUA-1 under Alternative 9 for delta smelt, the impact of
12 the construction of water conveyance facilities on non-covered species of primary management
13 concern would not be significant except potentially for construction noise associated with pile
14 driving. Implementation of Mitigation Measure AQUA-1a and Mitigation Measure AQUA-1b would
15 reduce that noise impact to less than significant.

16 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
17 **of Pile Driving and Other Construction-Related Underwater Noise**

18 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

19 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
20 **and Other Construction-Related Underwater Noise**

21 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

22 **Impact AQUA-200: Effects of Maintenance of Water Conveyance Facilities on Non-Covered**
23 **Aquatic Species of Primary Management Concern**

24 Refer to Alternative 9, Impact AQUA-2 under delta smelt for a discussion of the effects of
25 maintenance of water conveyance facilities. The discussion there is also relevant to non-covered
26 species of primary management concern.

27 **NEPA Effects:** As concluded in Alternative 9, Impact AQUA-2, the effects would not be adverse.

28 **CEQA Conclusion:** As described above, these impacts would be less than significant.

29 **Water Operations of CM1**

30 The effects of water operations of CM1 under Alternative 9 includes a detailed analysis of the
31 following species:

- 32 ● Striped Bass
- 33 ● American Shad
- 34 ● Threadfin Shad
- 35 ● Largemouth Bass
- 36 ● Sacramento tule perch

- 1 • Sacramento-San Joaquin roach – California species of special concern
- 2 • Hardhead – California species of special concern

3 **Impact AQUA-201: Effects of Water Operations on Entrainment of Non-Covered Aquatic**
4 **Species of Primary Management Concern**

5 ***Striped Bass***

6 Under Existing Conditions, striped bass are observed in salvage operations of the south Delta
7 facilities throughout the year, with the majority of juvenile striped bass entrainment occurring
8 during the summer (May through July). Under Alternative 9, juvenile entrainment at the proposed
9 north Delta SWP/CVP diversions at Georgiana Slough and the DCC and the alternate NBA intake on
10 the Sacramento River would be reduced due to fish screens designed to exclude fish larger than 15
11 mm, which would greatly reduce entrainment at the south Delta facilities. Larvae could be
12 vulnerable to entrainment at the north Delta diversions as they are transported past from spawning
13 areas upstream.

14 Agricultural diversions are potential sources of entrainment for small fish such as larval and juvenile
15 striped bass. Reduction or consolidation of up to 12% of these diversions from the ROAs would not
16 increase entrainment and may provide a minor benefit. Furthermore, decommissioning of
17 agricultural diversions may also reduce entrainment of striped bass. Also, restoration activities as
18 part of the conservation measures should increase the amount of habitat for young striped bass (e.g.
19 inshore rearing habitat), and increase their food supply. The expectation is that these habitat
20 changes would result in at least a minor improvement in production of juvenile striped bass.

21 ***NEPA Effects:*** Overall, the effect of Alternative 9 operations on striped bass entrainment would not
22 be adverse and may benefit the species due to reductions in south Delta entrainment.

23 ***CEQA Conclusion:*** The impact of water operations on entrainment of striped bass would be the
24 same as described immediately above. The changes in facilities and operations under Alternative 9
25 would reduce entrainment losses at the south Delta facilities. The impact would be less than
26 significant and no mitigation would be required.

27 ***American Shad***

28 American shad eggs and larvae would be vulnerable to entrainment at the proposed north SWP/CVP
29 Delta diversions at Georgiana Slough and DCC and the alternate NBA intake on the Sacramento River
30 as these life stages are passively transported downstream to the north Delta. The majority of
31 spawning takes place upstream of the Delta, so only limited numbers of American shad eggs and
32 larvae would be exposed to entrainment risk at the north Delta intakes.

33 American shad entrainment losses to the south Delta facilities would be substantially reduced
34 because fish screens on these north Delta intakes would exclude juvenile and adult American shad
35 from the water conveyance channel. Reduction or consolidation of agricultural diversions in ROAs
36 would not increase entrainment and may provide a modest benefit.

37 ***NEPA Effects:*** Overall, the effect on American shad would not be adverse, and would provide some
38 benefit.

39 ***CEQA Conclusion:*** The impact of water operations on entrainment of American shad would be the
40 same as described immediately above. The changes in facilities and operations under Alternative 9

1 would reduce entrainment losses at the south Delta facilities. The impact would be less than
2 significant and no mitigation would be required.

3 ***Threadfin Shad***

4 Threadfin shad have a limited distribution in the Delta and are most abundant in the southern Delta.
5 Threadfin shad are also the most common species collected at the export facilities, although there
6 are no significant results for an effect of summer exports on the population (Baxter et al. 2010).
7 Under Alternative 9, entrainment would be reduced for threadfin shad in the Old River fish corridor
8 and San Joaquin River, but would likely increase for those fish in Middle River and associated
9 sloughs. Entrainment of juvenile and adult threadfin shad from the north Delta would be reduced
10 under Alternative 9 by screening the north Delta diversion intakes at DCC and Georgiana Slough, but
11 this is not a region of high abundance. Decommissioning or consolidation of agricultural diversions
12 in Delta ROAs, particularly the south Delta, may reduce entrainment of threadfin shad.

13 ***NEPA Effects:*** The overall effect would not be adverse because overall entrainment would be
14 expected to be reduced.

15 ***CEQA Conclusion:*** The impact of water operations on entrainment of threadfin shad would be the
16 same as described immediately above. The changes in operations under Alternative 9 would reduce
17 entrainment risk and may benefit the threadfin shad population. The impact would be less than
18 significant and no mitigation would be required.

19 ***Largemouth Bass***

20 Since largemouth bass are predominantly found in the south and central portions of the Delta,
21 largemouth bass would be most vulnerable to entrainment to south Delta facilities. Entrainment to
22 the south Delta facilities would be reduced under Alternative 9 because water conveyance channel
23 leading to the south Delta intakes would be screened. As discussed for Alternative 1A (Impact
24 AQUA-201) few larval largemouth bass would be vulnerable to entrainment to north Delta and
25 alternative NBA intake since they are not expected to readily occur there. Decommissioning
26 agricultural diversions could reduce entrainment of largemouth bass since they hold in shallow
27 water habitats where most agricultural diversions are sited.

28 ***NEPA Effects:*** Overall entrainment would be reduced under Alternative 9 and there would be a
29 benefit for the species.

30 ***CEQA Conclusion:*** The impact of water operations on largemouth bass would be as described
31 immediately above. Entrainment under Alternative 9 would be reduced and would be beneficial to
32 the largemouth bass. The impact would be less than significant and no mitigation would be required.

33 ***Sacramento Tule Perch***

34 Sacramento tule perch entrainment is documented in small numbers to the SWP/CVP south Delta
35 facilities under the NAA. Entrainment would be reduced under Alternative 9 because of the
36 separation of the fish passage channel from San Joaquin River through Old River to Franks Tract)
37 from the screened water conveyance channels leading into the south Delta facilities. Because
38 Sacramento tule perch are viviparous, newly born Sacramento tule perch would be large enough to
39 be effectively screened at the proposed north Delta facilities. Reduction or consolidation of
40 agricultural diversions under the Plan would decrease potential entrainment into these agricultural
41 intakes.

1 **NEPA Effects:** Overall the effect of Alternative 9 would not be adverse because of the potential
2 reduction of entrainment.

3 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would
4 be the same as described immediately above. Entrainment under Alternative 9 would potentially be
5 reduced and would be beneficial to Sacramento tule perch. The impact would be less than significant
6 and no mitigation would be required.

7 **Sacramento-San Joaquin Roach**

8 The effect of water operations on entrainment of Sacramento-San Joaquin roach under Alternative 9
9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a
10 detailed discussion, please see Alternative 1A, Impact AQUA-201.

11 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

12 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento-San Joaquin roach
13 would be the same as described immediately above. The impacts would be less than significant.

14 **Hardhead**

15 The effect of water operations on entrainment of hardhead under Alternative 9 would be similar to
16 that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed discussion,
17 please see Alternative 1A, Impact AQUA-201.

18 **NEPA Effects:** As concluded in Alternative 1A, Impact AQUA-201, the effects would not be adverse.

19 **CEQA Conclusion:** The impact of water operations on entrainment of hardhead would be the same
20 as described immediately above. The impacts would be less than significant.

21 **California Bay Shrimp**

22 The effect of water operations on entrainment of California bay shrimp under Alternative 9 would
23 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-201). For a detailed
24 discussion, please see Alternative 1A, Impact AQUA-201.

25 **NEPA Effects:** California bay shrimp do not occur in the vicinity of the DCC gates and the Georgiana
26 Slough screened diversion so there would be an effect.

27 **CEQA Conclusion:** The impact of water operations on entrainment of California bay shrimp would
28 be the same as described immediately above. There would be no impact.

29 **Impact AQUA-202: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 30 **Non-Covered Aquatic Species of Primary Management Concern**

31 **Striped Bass**

32 In general, Alternative 9 would slightly improve the quality and quantity of upstream habitat
33 conditions for striped bass relative to the NAA.

34 **Flows**

35 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
36 Clear Creek were examined during the April through June striped bass spawning, embryo

1 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
2 habitat available for spawning, egg incubation, and rearing.

3 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
4 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
5 *utilized in the Fish Analysis*).

6 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
7 greater than flows under NAA during April through June (Appendix 11C, *CALSIM II Model Results*
8 *utilized in the Fish Analysis*).

9 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows
10 under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results*
11 *utilized in the Fish Analysis*).

12 In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than
13 flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in*
14 *the Fish Analysis*).

15 In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows
16 under NAA, regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
17 *Analysis*).

18 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
19 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
20 flows relative to the NAA.

21 *Water Temperature*

22 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
23 bass spawning, embryo incubation, and initial rearing during April through June was examined in
24 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
25 range could lead to reduced spawning success and increased egg and larval stress and mortality.
26 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

27 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
28 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
29 there would be no temperature related effects in these rivers during the April through June period.

30 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the
31 range would be similar to or lower than the percentage under NAA in all water years except above
32 normal years (17% increase) and dry years (17% increase) (Table 11-9-82). These are relatively
33 infrequent and small magnitude increases in unsuitable temperature exposures and are not
34 expected to have biologically meaningful negative effects.

1 **Table 11-9-82. Difference and Percent Difference in the Percentage of Months during April–June in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F**
 3 **to 68°F Water Temperature Range for Striped Bass Spawning, Embryo Incubation, and Initial**
 4 **Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLТ	NAA vs. A9_LLТ
Wet	-12 (-29%)	0 (0%)
Above Normal	-15 (-45%)	3 (17%)
Below Normal	-10 (-36%)	0 (0%)
Dry	-19 (-63%)	2 (17%)
Critical	-17 (-67%)	-6 (-67%)
All	-14 (-44%)	0 (0%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

5
 6 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 7 Alternative 9 would not cause a substantial reduction in striped bass spawning, incubation, or initial
 8 rearing habitat. Flows in all rivers examined during the April through June spawning, incubation,
 9 and initial rearing period under Alternative 9 would generally be similar to or greater than flows
 10 under the NAA. The percentage of months outside the 59°F to 68°F water temperature range would
 11 generally be lower under Alternative 9 than under the NAA with the exception of moderate
 12 increases for two water year types that would not have biologically meaningful negative effects.

13 **CEQA Conclusion:** In general, Alternative 9 would not affect the quality and quantity of upstream
 14 habitat conditions for striped bass relative to Existing Conditions.

15 **Flows**

16 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 17 Clear Creek were examined during the April through June striped bass spawning, embryo
 18 incubation, and initial rearing period. Lower flows could reduce the quantity and quality of instream
 19 habitat available for spawning, egg incubation, and rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A9_LLТ would generally be similar to or
 21 greater than flows under Existing Conditions during April through June, except in wet years during
 22 May (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 In the Trinity River below Lewiston Reservoir, flows under A9_LLТ would generally be similar to or
 24 greater than flows under Existing Conditions during April through June, except in critical years
 25 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

26 In Clear Creek at Whiskeytown Dam, flows under A9_LLТ would always be similar to flows under
 27 Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM*
 28 *II Model Results utilized in the Fish Analysis*).

29 In the Feather River at Thermalito Afterbay, flows under A9_LLТ would generally be similar to or
 30 greater than flows under Existing Conditions during April through June, except in wet years during
 31 May and June (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
 32 *the Fish Analysis*). The flow reductions in wetter water years would not have biologically meaningful
 33 negative effects on habitat conditions, compared to Existing Conditions.

1 In the American River at Nimbus Dam, flows under A9_LLTT would generally be similar to or greater
2 than flows under Existing Conditions during April except in above normal years (7% lower), and
3 generally similar to or lower than flows under Existing Conditions during May and June (to 42%
4 lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results*
5 *utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more
6 critical for habitat conditions, are limited to below normal years during May (19% lower) and
7 critical years during June (42% lower). Despite the moderate to substantial magnitude, these are
8 isolated flow reductions that would not be expected to have biologically meaningful negative effects
9 on spawning.

10 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
11 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
12 moderate reductions in flows during the period relative to Existing Conditions.

13 *Water Temperature*

14 The percentage of months outside of the 59°F to 68°F suitable water temperature range for striped
15 bass spawning, embryo incubation, and initial rearing during April through June was examined in
16 the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures outside this
17 range could lead to reduced spawning success and increased egg and larval stress and mortality.
18 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

19 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
20 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
21 there would be no temperature related effects in these rivers during the April through June period.

22 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLTT outside of
23 the 59°F to 68°F suitable water temperature range for striped bass spawning, embryo incubation,
24 and initial rearing during April through June would be substantially lower than the percentage
25 under Existing Conditions in all water years (Table 11-9-82).

26 Collectively, these results indicate that the impact would not be significant because Alternative 9
27 would not cause a substantial reduction in spawning, incubation, and initial rearing habitat of
28 striped bass. Therefore, no mitigation is necessary. Flows in all rivers except the San Joaquin and
29 Stanislaus rivers during the April through June spawning, incubation, or initial rearing period under
30 Alternative 9 would generally be similar to or greater than flows under Existing Conditions. Flows in
31 the San Joaquin and Stanislaus rivers would be lower under Alternative 9, although this effect would
32 not be biologically meaningful to striped bass. The percentage of months outside the 59°F to 68°F
33 water temperature range would be lower under Alternative 9 than under Existing Conditions.

34 *American Shad*

35 In general, Alternative 9 would slightly improve the quality and quantity of upstream habitat
36 conditions for American shad relative to the NAA.

37 *Flows*

38 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
39 Clear Creek were examined during the April through June American shad adult migration and
40 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
41 quality for spawning.

1 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
2 greater than flows under NAA during April through June in all water year types (Appendix 11C,
3 *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
5 greater than flows under NAA during April through June in all water year types (Appendix 11C,
6 *CALSIM II Model Results utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows
8 under NAA during April through June in all water year types (Appendix 11C, *CALSIM II Model Results*
9 *utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than
11 flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in*
12 *the Fish Analysis*).

13 In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows
14 under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
15 *Analysis*).

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
17 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
18 flows relative to the NAA.

19 *Water Temperature*

20 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
21 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
22 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
23 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
24 were not modeled in the San Joaquin River or Clear Creek.

25 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
26 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
27 there would be no temperature related effects in these rivers during the April through June period.

28 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the
29 60°F to 70°F water temperature range would be similar to the percentage under NAA for all water
30 year types (Table 11-9-83).

1 **Table 11-9-83. Difference and Percent Difference in the Percentage of Months during April–June in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 60°F**
 3 **to 70°F Water Temperature Range for American Shad Adult Migration and Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-4 (-8%)	1 (3%)
Above Normal	9 (25%)	0 (0%)
Below Normal	7 (23%)	0 (0%)
Dry	4 (10%)	-2 (-4%)
Critical	6 (15%)	0 (0%)
All	3 (7%)	0 (0%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 Alternative 9 would not cause a substantial reduction in American shad spawning or adult
 7 migration. Flows in all rivers examined during the April through June adult migration and spawning
 8 period under Alternative 9 would generally be similar to or greater than flows under the NAA. The
 9 percentage of months outside the 60°F to 70°F water temperature range would be similar under
 10 Alternative 9 to the NAA.

11 **CEQA Conclusion:** In general, Alternative 9 would not affect the quality and quantity of upstream
 12 habitat conditions for American shad relative to Existing Conditions.

13 *Flows*

14 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 15 Clear Creek were examined during the April through June American shad adult migration and
 16 spawning period. Lower flows could reduce migration ability and instream habitat quantity and
 17 quality for spawning.

18 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
 19 greater than flows under Existing Conditions during April through June, except in wet years during
 20 May (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

21 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
 22 greater than flows under Existing Conditions during April through June, except in critical years
 23 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

24 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under
 25 Existing Conditions during April through June regardless of water year type (Appendix 11C, *CALSIM*
 26 *II Model Results utilized in the Fish Analysis*).

27 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
 28 greater than flows under Existing Conditions during April through June, except in wet years during
 29 May and June (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in*
 30 *the Fish Analysis*). The flow reductions in wetter water years would not have biologically meaningful
 31 negative effects on habitat conditions.

1 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
2 than flows under Existing Conditions during April except in above normal years (7% lower), and
3 generally similar to or lower than flows under Existing Conditions during May and June (to 42%
4 lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results*
5 *utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would be more
6 critical for habitat conditions, are limited to below normal years during May (19% lower) and
7 critical years during June (42% lower). Despite the moderate to substantial magnitude, these are
8 isolated flow reductions that would not be expected to have biologically meaningful negative effects
9 on spawning.

10 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
11 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
12 moderate reductions in flows during the period relative to Existing Conditions.

13 *Water Temperature*

14 The percentage of months outside of the 60°F to 70°F water temperature range for American shad
15 adult migration and spawning during April through June was examined in the Sacramento, Trinity,
16 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
17 reduced spawning success and increased adult migrant stress and mortality. Water temperatures
18 were not modeled in the San Joaquin River or Clear Creek.

19 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
20 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
21 there would be no temperature related effects in these rivers during the April through June period.

22 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of
23 the 60°F to 70°F water temperature range would be greater than the percentage under Existing
24 Conditions (from 10% to 25% greater) in all water years except critical years (8% higher) (Table
25 11-9-83).

26 Collectively, these results indicate that the impact would not be significant because Alternative 9
27 would not cause a substantial reduction in American shad adult migration and spawning habitat,
28 and no mitigation is necessary. Flows in all rivers examined, except the San Joaquin and Stanislaus
29 rivers, during the April through June adult migration and spawning period under Alternative 9
30 would generally be similar to or greater than flows under Existing Conditions. Flows in the San
31 Joaquin and Stanislaus rivers would be lower under Alternative 9, although this effect would be
32 biologically meaningful to American shad. The percentage of months outside the 60°F to 70°F water
33 temperature range would be greater under Alternative 9 than under Existing Conditions for all but
34 wet water years, but the magnitude of the increases (to 25%) would not be expected to result in
35 biologically meaningful negative effects.

36 *Threadfin Shad*

37 In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for
38 threadfin shad relative to the NAA.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during April through August threadfin shad spawning period. Lower
4 flows could reduce the quantity and quality of instream habitat available for spawning.

5 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
6 greater than flows under NAA during April through August, and except in above normal years during
7 August (7% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
9 greater than flows under NAA during April through August spawning period in all water year types
10 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows
12 under NAA during April through August in all water year types (Appendix 11C, *CALSIM II Model
13 Results utilized in the Fish Analysis*).

14 In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than
15 flows under NAA regardless of water year type, except in dry (10% lower) and critical (13% lower)
16 years during July. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

17 In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows
18 under NAA regardless of water year type, except in wet and critical years during July (to 23% lower)
19 and in dry and critical years during August (8% and 9% lower, respectively) (Appendix 11C, *CALSIM
20 II Model Results utilized in the Fish Analysis*). These are relatively isolated, small-magnitude flow
21 reductions that would not be expected to have biologically meaningful negative effects.

22 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
23 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
24 flows relative to the NAA.

25 *Water Temperature*

26 The percentage of months below 68°F water temperature threshold for the April through August
27 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
28 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
29 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
30 Creek.

31 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
32 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
33 there would be no temperature-related effects in these rivers throughout the year.

34 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT below
35 68°F would be similar to or lower than those under NAA in all water years (to 8% lower) (Table 11-
36 9-84).

1 **Table 11-9-84. Difference and Percent Difference in the Percentage of Months during April–August**
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the 68°F**
 3 **Water Temperature Threshold for Threadfin Shad Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-13 (-21%)	0 (0%)
Above Normal	-27 (-36%)	2 (4%)
Below Normal	-24 (-35%)	0 (0%)
Dry	-33 (-45%)	-3 (-8%)
Critical	-30 (-46%)	-2 (-5%)
All	-24 (-35%)	-1 (-2%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 Alternative 9 would not cause a substantial reduction in spawning habitat. Flows in all rivers
 7 examined during the April through August spawning period under Alternative 9 would generally be
 8 similar to or greater than flows under the NAA. There would be relatively infrequent, small-magnitude
 9 flow reductions for some months and water year types that would not have a biologically
 10 meaningful effect on threadfin shad. The percentage of months below the spawning temperature
 11 threshold would be lower under Alternative 9 relative to the NAA in the Feather River and there are
 12 no temperature-related effects in any other rivers.

13 **CEQA Conclusion:** In general, Alternative 9 would not affect the quality and quantity of upstream
 14 habitat conditions for threadfin shad relative to Existing Conditions.

15 **Flows**

16 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 17 Clear Creek were examined during April through August spawning period. Lower flows could reduce
 18 the quantity and quality of instream habitat available for spawning.

19 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
 20 greater than flows under Existing Conditions during April through August, except in wet years
 21 during May (19% lower), in critical years during July (9% lower), and in wet (7% lower) and critical
 22 years (13% lower) during August Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 23 *Analysis*).

24 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
 25 greater than flows under Existing Conditions during April through August, except in critical years
 26 during May (6% lower), in wet (14% lower) and critical years (6% lower) during July, and in critical
 27 years during August (33% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 28 *Analysis*). These are isolated and/or relatively small-magnitude flow reductions and would not have
 29 biologically meaningful negative effects.

30 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under
 31 Existing Conditions during April through August regardless of water year type except in critical
 32 years during August (17% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 33 *Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
2 greater than flows under Existing Conditions during April through August, except in wet years
3 during May and June (35% and 21% lower, respectively), in dry (12% lower) and critical years
4 (32% lower) during July, and in dry years (34% lower) during August (Appendix 11C, *CALSIM II*
5 *Model Results utilized in the Fish Analysis*). The flow reductions in wetter water years would not have
6 biologically meaningful negative effects on habitat conditions, and reductions in drier water years
7 would be relatively isolated and not expected to have biologically meaningful negative effects.

8 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
9 than flows under Existing Conditions during April except in above normal years (7% lower), and
10 generally similar to or lower than flows under Existing Conditions during May through August (to
11 43% lower) except in dry years during May (19% greater) and in critical years during July (11%
12 greater) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flow reductions would
13 be fairly persistent during May through August, including in drier water year types when effects
14 would be more critical for habitat conditions, and would have a localized effect on spawning
15 conditions.

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
17 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
18 moderate reductions in flows during the period relative to Existing Conditions.

19 *Water Temperature*

20 The percentage of months below 68°F water temperature threshold for the April through August
21 adult threadfin shad spawning period was examined in the Sacramento, Trinity, Feather, American,
22 and Stanislaus rivers. Water temperatures below this threshold could delay or prevent successful
23 spawning in these areas. Water temperatures were not modeled in the San Joaquin River or Clear
24 Creek.

25 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
26 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
27 there would be no temperature-related effects in these rivers during the April through November
28 period.

29 In the Feather River below Thermalito Afterbay, the percentage of months below the 68°F water
30 temperature threshold for threadfin shad spawning under A9_LLT would be 21% to 46% lower than
31 the percentage under Existing Conditions, depending on water year type (Table 11-9-84).

32 Collectively, these results indicate that the impact would not be significant because Alternative 9
33 would not cause a substantial reduction in habitat, and no mitigation is necessary. Flows in all rivers
34 examined during the April through August spawning period under Alternative 9 would generally be
35 similar to or greater than flows under Existing Conditions, with the exception of relatively
36 infrequent and small-magnitude flow reductions in some months and water year types for most
37 locations. There would be more persistent flow reductions for a greater portion of the spawning
38 period in the American River (May through August, to 43% lower, including in drier water year
39 types) but based on the fact that this would occur at a single location it is not expected to have
40 biologically meaningful negative effects on the threadfin shad population. The percentage of months
41 outside all temperature thresholds are lower under Alternative 9 than under Existing Conditions,
42 indicating that there would be a net temperature-related benefit of Alternative 9 to threadfin shad.

1 **Largemouth Bass**

2 In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for
3 largemouth bass relative to the NAA.

4 *Flows*

5 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
6 Clear Creek were examined during the March through June largemouth bass spawning period.
7 Lower flows could reduce the quantity and quality of instream spawning habitat.

8 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
9 greater than flows under NAA in all water year types (Appendix 11C, *CALSIM II Model Results utilized*
10 *in the Fish Analysis*).

11 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
12 greater than flows under NAA during April through June, in all water year types (Appendix 11C,
13 *CALSIM II Model Results utilized in the Fish Analysis*).

14 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows
15 under NAA during March through June in all water year types (Appendix 11C, *CALSIM II Model*
16 *Results utilized in the Fish Analysis*).

17 In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than
18 flows under NAA regardless of water year type except in dry years during March (7% lower)
19 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

20 In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows
21 under NAA regardless of water year type during March through June (Appendix 11C, *CALSIM II*
22 *Model Results utilized in the Fish Analysis*).

23 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
24 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
25 flows relative to the NAA.

26 *Water Temperature*

27 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
28 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
29 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
30 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
31 Creek.

32 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
33 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
34 there would be no temperature-related effects in these rivers during the March through June period.

35 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the
36 range would be similar, only slightly greater (to 6%), or lower (14% lower), than the percentage
37 under NAA (Table 11-9-85). These inconsistent and small-magnitude changes would not be
38 expected to have biologically meaningful negative effects.

1 **Table 11-9-85. Difference and Percent Difference in the Percentage of Months during March–June**
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the**
 3 **59°F to 75°F Water Temperature Range for Largemouth Bass Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-9 (-16%)	0 (0%)
Above Normal	-11 (-23%)	2 (6%)
Below Normal	-11 (-24%)	0 (0%)
Dry	-17 (-35%)	1 (5%)
Critical	-15 (-33%)	-4 (-14%)
All	-12 (-25%)	0 (0%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4

5 **NEPA Effects:** This effect is not adverse.

6 **CEQA Conclusion:** In general, Alternative 9 would reduce the quality and quantity of upstream
 7 habitat conditions for largemouth bass relative to Existing Conditions. This would be a significant
 8 impact. This impact is a result of the specific reservoir operations and resulting flows associated
 9 with this alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the
 10 flows) to the extent necessary to reduce this impact to a less-than-significant level would
 11 fundamentally change the alternative, thereby making it a different alternative than that which has
 12 been modeled and analyzed. As a result, this impact is significant and unavoidable because there is
 13 no feasible mitigation available.

14 **Flows**

15 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 16 Clear Creek were examined during the March through June largemouth bass spawning period.
 17 Lower flows could reduce the quantity and quality of instream spawning habitat.

18 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
 19 greater than flows under Existing Conditions during March through June, except in below normal
 20 years during March (11% lower) and in wet years during May (19% lower) (Appendix 11C, *CALSIM*
 21 *II Model Results utilized in the Fish Analysis*).

22 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
 23 greater than flows under Existing Conditions during March through June, except in critical years
 24 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

25 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under
 26 Existing Conditions during March through June regardless of water year type (Appendix 11C,
 27 *CALSIM II Model Results utilized in the Fish Analysis*).

28 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
 29 greater than flows under Existing Conditions during April through June, except in below normal and
 30 dry years during March (39% and 18% lower, respectively), and in wet years during May and June
 31 (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 32 *Analysis*). The flow reductions are relatively isolated and/or occur in wetter water years and would
 33 not be expected to have biologically meaningful negative effects on habitat conditions.

1 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
2 than flows under Existing Conditions during March and April except in above normal years during
3 April (7% lower), and generally similar to or lower than flows under Existing Conditions during May
4 and June (to 42% lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II*
5 *Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would
6 be more critical for habitat conditions, are limited to below normal years during May (19% lower)
7 and critical years during June (42% lower). Despite the moderate to substantial magnitude, these
8 are isolated flow reductions that would not be expected to have biologically meaningful negative
9 effects on spawning.

10 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
11 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
12 moderate reductions in flows during the period relative to Existing Conditions.

13 *Water Temperature*

14 The percentage of months outside of the 59°F to 75°F suitable water temperature range for
15 largemouth bass spawning during March through June was examined in the Sacramento, Trinity,
16 Feather, American, and Stanislaus rivers. Water temperatures outside this range could lead to
17 reduced spawning success. Water temperatures were not modeled in the San Joaquin River or Clear
18 Creek.

19 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
20 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
21 there would be no temperature-related effects in these rivers during the March through June period.

22 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of
23 the 59°F to 75°F water temperature range for largemouth bass spawning would be substantially
24 lower than the percentage under Existing Conditions in all water years (Table 11-9-85).

25 *Sacramento Tule Perch*

26 The effects of water operations on spawning habitat for Sacramento tule perch under Alternative 9
27 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-202). For a
28 detailed discussion, please see Alternative 1A, Impact AQUA-202.

29 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-202, the effects would not be adverse.

30 **CEQA Conclusion:** The impact of water operations on entrainment of Sacramento tule perch would
31 be the same as described immediately above. The impacts would be less than significant.

32 *Sacramento-San Joaquin Roach – California Species of Special Concern*

33 In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for
34 Sacramento-San Joaquin Roach relative to the NAA.

35 *Flows*

36 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
37 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
38 period. Lower flows could reduce the quantity and quality of instream habitat available for
39 spawning.

1 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
2 greater than flows under NAA during April through June in all water year types (Appendix 11C,
3 *CALSIM II Model Results utilized in the Fish Analysis*).

4 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
5 greater than flows under NAA during April through June in all water year types (Appendix 11C,
6 *CALSIM II Model Results utilized in the Fish Analysis*).

7 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows
8 under NAA during March through June in all water year types (Appendix 11C, *CALSIM II Model*
9 *Results utilized in the Fish Analysis*).

10 In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than
11 flows under NAA regardless of water year type except in dry years during March (7% lower)
12 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

13 In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows
14 under NAA regardless of water year type during March through June (Appendix 11C, *CALSIM II*
15 *Model Results utilized in the Fish Analysis*).

16 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
17 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
18 flows relative to the NAA.

19 *Water Temperature*

20 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
21 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
22 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
23 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
24 River or Clear Creek.

25 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
26 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
27 there would be no temperature-related effects in these rivers during the March through June period.

28 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures
29 would be below the 60.8°F water temperature threshold for roach spawning initiation under
30 A9_LLT would be similar to or lower than the percentage under NAA in all water years (Table 11-9-
31 86).

1 **Table 11-9-86. Difference and Percent Difference in the Percentage of Months during March–June**
 2 **in Which Water Temperatures in the Feather River below Thermalito Afterbay Fall below the**
 3 **60.8°F Water Temperature Threshold Range for the Initiation of Sacramento–San Joaquin Roach**
 4 **Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-13 (-19%)	0 (0%)
Above Normal	-7 (-13%)	0 (0%)
Below Normal	-5 (-11%)	0 (0%)
Dry	-14 (-26%)	-3 (-7%)
Critical	-15 (-26%)	0 (0%)
All	-11 (-19%)	-1 (-1%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

5

6 **NEPA Effects:** This effect would not be adverse.

6

7 **CEQA Conclusion:** In general, Alternative 9 would reduce the quality and quantity of upstream
 8 habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

7

8

9 *Flows*

9

10 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 11 Clear Creek were examined during the March through June Sacramento-San Joaquin roach spawning
 12 period. Lower flows could reduce the quantity and quality of instream habitat available for
 13 spawning.

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11

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14 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
 15 greater than flows under Existing Conditions during March through June, except in below normal
 16 years during March (11% lower) and in wet years during May (19% lower) (Appendix 11C, *CALSIM*
 17 *II Model Results utilized in the Fish Analysis*).

14

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18 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
 19 greater than flows under Existing Conditions during March through June, except in critical years
 20 during May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

18

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21 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under
 22 Existing Conditions during March through June regardless of water year type (Appendix 11C,
 23 *CALSIM II Model Results utilized in the Fish Analysis*).

21

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24 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
 25 greater than flows under Existing Conditions during April through June, except in below normal and
 26 dry years during March (39% and 18% lower, respectively), and in wet years during May and June
 27 (35% and 21% lower, respectively) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
 28 *Analysis*). The flow reductions are relatively isolated and/or occur in wetter water years and would
 29 not be expected to have biologically meaningful negative effects on habitat conditions.

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30 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
 31 than flows under Existing Conditions during March and April except in above normal years during
 32 April (7% lower), and generally similar to or lower than flows under Existing Conditions during May

30

31

32

1 and June (to 42% lower) except in dry years during May (19% greater) (Appendix 11C, *CALSIM II*
2 *Model Results utilized in the Fish Analysis*). Flow reductions in drier water years, when effects would
3 be more critical for habitat conditions, are limited to below normal years during May (19% lower)
4 and critical years during June (42% lower). Despite the moderate to substantial magnitude, these
5 are isolated flow reductions that would not be expected to have biologically meaningful negative
6 effects on spawning.

7 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
8 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
9 moderate reductions in flows during the period relative to Existing Conditions.

10 *Water Temperature*

11 The percentage of months below the 60.8°F water temperature threshold for Sacramento-San
12 Joaquin roach spawning initiation during March through June was examined in the Sacramento,
13 Trinity, Feather, American, and Stanislaus rivers. Water temperatures below this threshold could
14 delay or prevent spawning initiation. Water temperatures were not modeled in the San Joaquin
15 River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
17 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
18 there would be no temperature-related effects in these rivers during the March through June period.

19 In the Feather River below Thermalito Afterbay, the percentage of months in which temperatures
20 would be below the 60.8°F water temperature threshold for roach spawning initiation under
21 A9_LLT would be lower than the percentage under Existing Conditions in all water years (Table 11-
22 9-86).

23 ***Hardhead – California Species of Special Concern***

24 In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for
25 hardhead relative to the NAA.

26 *Flows*

27 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
28 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
29 could reduce the quantity and quality of instream habitat available for spawning.

30 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
31 greater than flows under NAA during April and May, in all water year types (Appendix 11C, *CALSIM*
32 *II Model Results utilized in the Fish Analysis*).

33 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
34 greater than flows under NAA during April and May in all water year types (Appendix 11C, *CALSIM II*
35 *Model Results utilized in the Fish Analysis*).

36 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would be similar to or greater than flows
37 under NAA during April and May in all water year types (Appendix 11C, *CALSIM II Model Results*
38 *utilized in the Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A9_LLT would be similar to or greater than
2 flows under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in*
3 *the Fish Analysis*).

4 In the American River at Nimbus Dam, flows under A9_LLT would be similar to or greater than flows
5 under NAA regardless of water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
6 *Analysis*).

7 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
8 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
9 flows relative to the NAA.

10 *Water Temperature*

11 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
12 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
13 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
14 spawning success and increased egg and larval stress and mortality. Water temperatures were not
15 modeled in the San Joaquin River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
17 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
18 there would be no temperature-related effects in these rivers throughout the year.

19 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the
20 range would generally be similar to or lower than the percentage under NAA in all water year types
21 (Table 11-9-87).

22 **Table 11-9-87. Difference and Percent Difference in the Percentage of Months during April–May in**
23 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 59°F**
24 **to 64°F Water Temperature Range for Hardhead Spawning^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	4 (6%)	2 (3%)
Above Normal	-9 (-14%)	0 (0%)
Below Normal	18 (42%)	-4 (-6%)
Dry	-8 (-15%)	-3 (-6%)
Critical	-8 (-15%)	-8 (-18%)
All	0 (0%)	-2 (-3%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

25

26 **NEPA Effects:** This effect would not be adverse.

27 **CEQA Conclusion:** In general, Alternative 9 would reduce the quality and quantity of upstream
28 spawning habitat conditions for hardhead relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the April through May hardhead spawning period. Lower flows
4 could reduce the quantity and quality of instream habitat available for spawning.

5 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
6 greater than flows under Existing Conditions during April and May, except in wet years during May
7 (19% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

8 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
9 greater than flows under Existing Conditions during April and May, except in critical years during
10 May (6% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

11 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would always be similar to flows under
12 Existing Conditions during April and May regardless of water year type (Appendix 11C, *CALSIM II*
13 *Model Results utilized in the Fish Analysis*).

14 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
15 greater than flows under Existing Conditions during April and May, except in wet years during May
16 (35% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The flow
17 reductions in wetter water years would not have biologically meaningful negative effects on habitat
18 conditions.

19 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
20 than flows under Existing Conditions during April except in above normal years (7% lower), and
21 generally similar to or lower than flows under Existing Conditions during May (to 33% lower)
22 except in dry years during May (19% greater) (Appendix 11C, *CALSIM II Model Results utilized in the*
23 *Fish Analysis*). Flow reductions in drier water years, when effects would be more critical for habitat
24 conditions, are limited to below normal years during May (19% lower) and would not be expected
25 to have biologically meaningful negative effects on spawning.

26 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
27 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
28 moderate reductions in flows during the period relative to Existing Conditions.

29 *Water Temperature*

30 The percentage of months outside of the 59°F to 64°F suitable water temperature range for
31 hardhead spawning during April through May was examined in the Sacramento, Trinity, Feather,
32 American, and Stanislaus rivers. Water temperatures outside this range could lead to reduced
33 spawning success and increased egg and larval stress and mortality. Water temperatures were not
34 modeled in the San Joaquin River or Clear Creek.

35 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
36 would be the same as those under Alternative 1A. For a discussion of the topic see the analysis for
37 Alternative 1A.

38 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of
39 the 59°F to 64°F water temperature range for hardhead spawning would be similar to or lower than
40 the percentage under Existing Conditions in all water years except wet (6% higher) and below
41 normal years (42% higher) (Table 11-9-87).

1 **California Bay Shrimp**

2 **NEPA Effects:** The effect of water operations on spawning habitat of California bay shrimp under
3 Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
4 AQUA-202). For a detailed discussion, please see Alternative 1A, Impact AQUA-202. The effects
5 would not be adverse.

6 **CEQA Conclusion:** The impact of water operations on spawning habitat of California bay shrimp
7 would be the same as described immediately above. The impacts would be less than significant.

8 **Impact AQUA-203: Effects of Water Operations on Rearing Habitat for Non-Covered Aquatic**
9 **Species of Primary Management Concern**

10 **Striped Bass**

11 The discussion under Alternative 9, Impact AQUA-202 for striped bass also addresses the embryo
12 incubation and initial rearing period. That analysis indicates that there is no adverse effect on
13 striped bass rearing during that period.

14 **NEPA Effects:** Other effects of water operations on rearing habitat for striped bass under Alternative
15 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). The
16 effects would not be adverse.

17 **CEQA Conclusion:** As described above the impacts on striped bass rearing habitat would be less
18 than significant.

19 **American Shad**

20 The effects of water operations on rearing habitat for American shad under Alternative 9 would be
21 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

22 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

23 **CEQA Conclusion:** As described above the impacts on American shad rearing habitat would be less
24 than significant.

25 **Threadfin Shad**

26 The effects of water operations on rearing habitat for threadfin shad under Alternative 9 would be
27 similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203).

28 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-203, the effects would not be adverse.

29 **CEQA Conclusion:** As described above the impacts on threadfin shad rearing habitat would be less
30 than significant.

31 **Largemouth Bass**

32 *Juveniles*

33 *Flows*

34 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
35 Clear Creek were examined during the April through November juvenile largemouth bass rearing

1 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
2 rearing.

3 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater
4 than flows under NAA for the entire period regardless of water year type, except in above normal
5 years during August (7% lower), and in above normal, below normal, and critical years during
6 October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These
7 are relatively isolated, small flow reductions that would not have biologically meaningful negative
8 effects.

9 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would be similar to or greater
10 than flows under NAA during the April through November period except in critical years during
11 August (11% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

12 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
13 than flows under NAA for April through November for all water year types, except in critical years
14 during September (13% lower)(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

15 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
16 greater than flows under NAA for April through June and August, and similar to or lower (up to
17 15%) than flows under NAA during July and September through November (Appendix 11C, *CALSIM
18 II Model Results utilized in the Fish Analysis*). Flow reductions during these months in drier water
19 years, when effects would be more critical for habitat conditions, would be inconsistent from month
20 to month and/or of small magnitude and would not be expected to have biologically meaningful
21 negative effects.

22 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
23 than flows under NAA during April through June, September, and November, and would be similar
24 to or lower than flows under NAA during July, August, and October (up to 23% lower) (Appendix
25 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These are relatively infrequent and low-
26 magnitude flow reductions and would not have biologically meaningful negative effects.

27 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
28 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
29 flows relative to the NAA.

30 *Water Temperature*

31 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
32 rearing during April through November was examined in the Sacramento, Trinity, Feather,
33 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
34 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
35 temperatures were not modeled in the San Joaquin River or Clear Creek.

36 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
37 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
38 there would be no temperature-related effects in these rivers during the April through November
39 period.

1 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 88°F under
2 NAA or A9_LL T (Table 11-9-88). As a result, there would be no difference in the percentage of
3 months in which the 88°F water temperature threshold is exceeded between Alternative 9 and NAA.

4 **Table 11-9-88. Difference and Percent Difference in the Percentage of Months during April–**
5 **November in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed**
6 **the 88°F Water Temperature Threshold for Juvenile Largemouth Bass Rearing^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LL T	NAA vs. A9_LL T
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

7

8 *Adults*

9 *Flows*

10 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
11 Clear Creek were examined during year-round adult largemouth bass rearing period. Lower flows
12 could reduce the quantity and quality of instream habitat available for adult rearing.

13 In the Sacramento River upstream of Red Bluff, flows under A9_LL T would be similar to or greater
14 than flows under NAA except in dry and critical years during January (to 11% lower), in above
15 normal years during August (7% lower), and above normal, below normal, and critical years during
16 October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These
17 are relatively isolated and small-magnitude flow reductions that would not have biologically
18 meaningful negative effects.

19 In the Trinity River below Lewiston Reservoir, flows under A9_LL T would generally be similar to or
20 greater than flows under NAA throughout the year except for isolated, small flow reductions in
21 below normal years during February (28% lower), and in critical years during August (11% lower)
22 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically
23 meaningful effects.

24 In Clear Creek at Whiskeytown Dam, flows under A9_LL T would generally be similar to or greater
25 than NAA throughout the year, except in below normal years during March (6% lower) and in
26 critical years during August (13% lower).

27 In the Feather River at Thermalito Afterbay, flows under A9_LL T would generally be similar to or
28 greater than flows under NAA during April through June and August, and similar to or lower than
29 flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results*
30 *utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most

critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-magnitude reductions that would not have biologically meaningful negative effects.

In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater than flows under NAA during January through June, September, November, and December, and similar to or lower than flows under NAA during July, August, and October (to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of relatively small magnitude and would not be consistent by water year type from month to month and therefore, would not have biologically meaningful negative effects.

Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in flows relative to the NAA.

Water Temperature

The percentage of months above the 86°F water temperature threshold for year-round adult largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not modeled in the San Joaquin River or Clear Creek.

Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that there would be no temperature-related effects in these rivers during the year-round period.

In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under NAA or A9_LLT (Table 11-9-89). As a result, there would be no difference in the percentage of months in which the 86°F water temperature threshold is exceeded between Alternative 9 and NAA.

Table 11-9-89. Difference and Percent Difference in the Percentage of Months Year-Round in Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed the 86°F Water Temperature Threshold for Adult Largemouth Bass Survival^a

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

NEPA Effects: Collectively, these results indicate that the effect would not be adverse because Alternative 9 would not cause a substantial reduction in juvenile and adult rearing or spawning habitat. Flows in all rivers examined during the year under Alternative 9 are generally similar to or greater than flows under the NAA in most months. Flows are generally lower in the Feather River

1 high-flow channel during July through December, and in the American River below Nimbus Dam
2 during the summer months, although the flow reductions would be of relatively small magnitude
3 and would not be consistent month to month within each water year type, and therefore would not
4 have biologically meaningful negative effects on the largemouth bass population. The percentage of
5 months outside all temperature thresholds examined in the Feather River under Alternative 9 are
6 generally similar to or lower than under the NAA, and there are no temperature-related effects in
7 any other rivers examined.

8 **CEQA Conclusion:** In general, Alternative 9 would reduce the quality and quantity of upstream
9 habitat conditions for largemouth bass relative to Existing Conditions.

10 *Juveniles*

11 *Flows*

12 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
13 Clear Creek were examined during the April through November juvenile largemouth bass rearing
14 period. Lower flows could reduce the quantity and quality of instream habitat available for juvenile
15 rearing.

16 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
17 greater than flows under Existing Conditions in all months but August and October with some
18 exceptions (up to 25% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
19 Flows during August and October under A9_LLT would be up to 13% lower than flows under
20 Existing Conditions. Flow reductions in drier water years throughout the rearing period would
21 occur in dry years during September (25% lower) and in critical years during August, September,
22 and October (to 18% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
23 These are relatively infrequent, isolated and small-magnitude flow reductions that would not have
24 biologically meaningful negative effects on juvenile rearing success.

25 In the Trinity River below Lewiston Reservoir, flows under A9_LLT during April through July would
26 generally be similar to or greater than flows under Existing Conditions with the exception of a few
27 isolated, small flow reductions (up to 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
28 *the Fish Analysis*). Flows under A9_LLT during August through November would be similar to or up
29 to 41% lower than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized*
30 *in the Fish Analysis*). Reductions in drier water year types would occur consistently in critical years
31 for August through November (to 41%), which would have a localized effect on rearing conditions in
32 that specific water year type.

33 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
34 than flows under Existing Conditions throughout the April through November period, except in
35 critical years during August through November (6% to 38% lower) (Appendix 11C, *CALSIM II Model*
36 *Results utilized in the Fish Analysis*).

37 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
38 greater than flows under Existing Conditions during April through June and August through
39 September, with a few exceptions in wetter water years, and generally lower (up to 32% lower)
40 during July, October, and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
41 *Analysis*). Moderate to substantial flow reductions (to 56% lower) would occur in some drier water
42 year types during July through November, and would have a localized effect on rearing conditions in
43 drier water years.

1 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or lower
2 than flows under Existing Conditions during April through November (to 42% lower) with very few
3 exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Moderate to
4 substantial flow reductions would occur in drier water year types, when effects on habitat
5 conditions would be most critical, during June to September and November, and would affect habitat
6 conditions for this time-frame in drier water years.

7 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
8 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
9 moderate reductions in flows during the period relative to Existing Conditions.

10 *Water Temperature*

11 The percentage of months above the 88°F water temperature threshold for juvenile largemouth bass
12 rearing during April through November was examined in the Sacramento, Trinity, Feather,
13 American, and Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and
14 quality of instream habitat available for juvenile rearing and increased stress and mortality. Water
15 temperatures were not modeled in the San Joaquin River or Clear Creek.

16 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
17 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
18 there would be no temperature-related effects in these rivers during the April through November
19 period.

20 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 88°F
21 water temperature threshold for year-round juvenile largemouth bass occurrence under Existing
22 Conditions or A9_LLT (Table 11-9-88). As a result, there would be no difference in the percentage of
23 months in which the 88°F water temperature threshold is exceeded between Alternative 9 and
24 Existing Conditions.

25 *Adults*

26 *Flows*

27 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
28 Clear Creek were examined during the year-round adult largemouth bass rearing period. Lower
29 flows could reduce the quantity and quality of instream habitat available for adult rearing.

30 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
31 greater than flows under Existing Conditions during all months with a few isolated exceptions (up to
32 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

33 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
34 greater than flows under Existing Conditions throughout the year with relatively small, isolated flow
35 reductions, and more moderate reductions in critical years during August through December (up to
36 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM
37 II Model Results utilized in the Fish Analysis*).

38 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
39 than flows under Existing Conditions throughout the year, except in critical years during August,
40 September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the
41 Fish Analysis*).

1 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
2 lower than flows under Existing Conditions during January, February, drier water year types during
3 March and July through September (to 56% lower), and most water year types during October
4 through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
5 *Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and
6 would be fairly persistent for July through December, affecting rearing conditions during that time-
7 frame.

8 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
9 than flows under Existing Conditions during January in wetter water year types, and during
10 February through April, and would be similar to or lower than flows under Existing Conditions
11 during January in drier water years (to 17% lower) and during May through December in most
12 water years (to 44% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
13 This would include moderate to substantial flow reductions in drier water year types for much of
14 this time-frame that would affect rearing conditions.

15 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
16 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
17 moderate reductions in flows during the period relative to Existing Conditions.

18 *Water Temperature*

19 The percentage of months above the 86°F water temperature threshold for year-round adult
20 largemouth bass rearing period was examined in the Sacramento, Trinity, Feather, American, and
21 Stanislaus rivers. Elevated water temperatures could lead to reduced quantity and quality of adult
22 rearing habitat and increased stress and mortality of rearing adults. Water temperatures were not
23 modeled in the San Joaquin River or Clear Creek.

24 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
25 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
26 there would be no temperature-related effects in these rivers during the April through November
27 period.

28 In the Feather River below Thermalito Afterbay, water temperatures would not exceed the 86°F
29 water temperature range for year-round adult largemouth bass occurrence under Existing
30 Conditions or A9_LLT (Table 11-9-89). As a result, there would be no difference in the percentage of
31 months in which the 86°F water temperature threshold is exceeded between Alternative 9 and
32 Existing Conditions.

33 Collectively, these results indicate that the impact would be significant because Alternative 9 would
34 cause a substantial reduction in largemouth bass habitat. Flows would be substantially lower during
35 the majority of the juvenile and adult rearing periods in the American River and in the Feather River.
36 There would be substantial reductions for a portion of the rearing periods in the Trinity River that
37 would contribute to regional effects. The percentages of years outside all temperature thresholds
38 are generally lower under Alternative 9 than under Existing Conditions. This impact is a result of the
39 specific reservoir operations and resulting flows associated with this alternative. Applying
40 mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent necessary to
41 reduce this impact to a less-than-significant level would fundamentally change the alternative,
42 thereby making it a different alternative than that which has been modeled and analyzed. As a
43 result, this impact is significant and unavoidable because there is no feasible mitigation available.

1 The NEPA and CEQA conclusions differ for this impact statement because they were determined
2 using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA
3 and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These
4 baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water
5 years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-
6 term implementation period, whereas the CEQA conclusion assumes existing climate conditions.
7 Therefore, differences in model outputs between the Existing Conditions and Alternative 9 are due
8 primarily to both the alternative and future climate change.

9 **Sacramento Tule Perch**

10 In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for
11 Sacramento tule perch relative to the NAA.

12 *Flows*

13 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
14 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
15 reduce the quantity and quality of instream habitat available for rearing.

16 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater
17 than flows under NAA except in dry and critical years during January (to 11% lower), in above
18 normal years during August (7% lower), and above normal, below normal, and critical years during
19 October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These
20 are relatively isolated and small-magnitude flow reductions that would not have biologically
21 meaningful negative effects.

22 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
23 greater than flows under NAA throughout the year except for isolated, small flow reductions in
24 below normal years during February (28% lower), and in critical years during August (11% lower)
25 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically
26 meaningful effects.

27 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
28 than flows under NAA throughout the year, except in below normal years during March (6% lower)
29 and in critical years during August (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in*
30 *the Fish Analysis*).

31 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
32 greater than flows under NAA during April through June and August, and similar to or lower than
33 flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results*
34 *utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most
35 critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-
36 magnitude reductions that would not have biologically meaningful negative effects.

37 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
38 than flows under NAA during January through June, September, November, and December, and
39 similar to or lower than flows under NAA during July, August, and October (to 18% lower)
40 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of
41 relatively small magnitude and would not be consistent by water year type from month to month
42 and therefore, would not have biologically meaningful negative effects.

1 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
2 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
3 flows relative to the NAA.

4 *Water Temperature*

5 The percentage of months exceeding water temperature thresholds of 72°F and 75°F for the year-
6 round occurrence of all life stages of Sacramento tule perch was examined in the Sacramento,
7 Trinity, Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds
8 could lead to reduced rearing habitat quantity and quality and increased stress and mortality. Water
9 temperatures were not modeled in the San Joaquin River or Clear Creek.

10 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
11 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
12 there would be no temperature-related effects in these rivers throughout the year.

13 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLTP exceeding
14 the 72°F threshold would be similar to (below normal and critical years), lower than (dry years), or
15 higher than the percentage under NAA by up to 50% depending on water year type (Table 11-9-90).
16 Although relative differences in wet and above normal years are large due to small values, the
17 absolute differences in percent exceedance are only 1%, and do not represent biologically
18 meaningful effects to Sacramento tule perch.

19 The percentage of months under A9_LLTP exceeding the 75°F threshold would be similar to the
20 percentage under NAA in all water year except dry and critical years (50% and 17% higher,
21 respectively) (Table 11-9-90). Although the relative differences in dry and critical years are large
22 due to small values, the absolute differences in percent exceedance are only 1% and do not
23 represent biologically meaningful effects to Sacramento tule perch.

1 **Table 11-9-90. Difference and Percent Difference in the Percentage of Months Year-Round in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay Exceed 72°F and 75°F**
 3 **Water Temperature Thresholds for Sacramento Tule Perch Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
72°F Threshold		
Wet	0.3 (14%)	1 (25%)
Above Normal	2 (NA)	1 (50%)
Below Normal	3 (NA)	0 (0%)
Dry	5 (NA)	-0.5 (-10%)
Critical	11 (267%)	1 (5%)
All	3 (262%)	0 (6%)
75°F Threshold		
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	2 (NA)	1 (50%)
Critical	8 (1,100%)	1 (17%)
All	2 (1,500%)	0 (25%)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4
 5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 Alternative 9 would not cause a substantial reduction in rearing habitat. Flows in all rivers examined
 7 during the year under Alternative 9 are generally similar to or greater than flows under the NAA in
 8 most months. Flows are generally lower in the Feather River high-flow channel during July through
 9 December, and in the American River below Nimbus Dam during the summer months, although the
 10 flow reductions would be of relatively small magnitude and would not be consistent month-to-
 11 month within each water year type, and therefore would not have biologically meaningful negative
 12 effects on hardhead. The percentages of years outside all temperature thresholds under Alternative
 13 9 are generally similar to the percentages under the NAA.

14 **CEQA Conclusion:** In general, Alternative 9 would reduce the quality and quantity of upstream
 15 habitat conditions for Sacramento tule perch relative to Existing Conditions.

16 **Flows**

17 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 18 Clear Creek were examined during year-round Sacramento tule perch presence. Lower flows could
 19 reduce the quantity and quality of instream habitat available for rearing.

20 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
 21 greater than flows under Existing Conditions during all months with a few isolated exceptions (up to
 22 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

23 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
 24 greater than flows under Existing Conditions throughout the year with relatively small, isolated flow

1 reductions, and more moderate reductions in critical years during August through December (up to
2 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM*
3 *II Model Results utilized in the Fish Analysis*).

4 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
5 than flows under Existing Conditions throughout the year, except in critical years during August,
6 September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
7 *Fish Analysis*).

8 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
9 lower than flows under Existing Conditions during January, February, drier water year types during
10 March and July through September (to 56% lower), and most water year types during October
11 through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
12 *Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and
13 would be fairly persistent for July through December, affecting rearing conditions during that time-
14 frame.

15 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
16 than flows under Existing Conditions during January in wetter water year types, and during
17 February through April, and would be similar to or lower than flows under Existing Conditions
18 during January in drier water years (to 17% lower) and during May through December in most
19 water years (to 44% lower) Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*. This
20 would include moderate to substantial flow reductions in drier water year types for much of this
21 time-frame that would affect rearing conditions.

22 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
23 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
24 moderate reductions in flows during the period relative to Existing Conditions.

25 *Water Temperature*

26 The percentage of months exceeding water temperatures of 72°F and 75°F for the year-round
27 occurrence of all life stages of Sacramento tule perch was examined in the Sacramento, Trinity,
28 Feather, American, and Stanislaus rivers. Water temperatures exceeding these thresholds could lead
29 to reduced rearing habitat quality and increased stress and mortality. Water temperatures were not
30 modeled in Clear Creek or the San Joaquin River.

31 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
32 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
33 there would be no temperature-related effects in these rivers during the year.

34 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT exceeding
35 72°F would be similar to the percentage under Existing Conditions in all water years except wet
36 (14% higher) and critical years (267% higher) (Table 11-9-90). These values correspond to
37 relatively low absolute increases of 0.3% and 11%, respectively, and would not have biologically
38 meaningful negative effects on Sacramento tule perch.

39 The percentage of months under A9_LLT exceeding 75°F relative to the percentage under Existing
40 Conditions would be similar to the percentage under Existing Conditions except in critical years
41 when it would be 1,100% higher (Table 11-9-90). This large percentage increase corresponds to a

1 relatively small absolute percent increase, 8%, and would not have biologically meaningful negative
2 effects.

3 Collectively, these results indicate that the impact would be significant because Alternative 9 would
4 cause a substantial reduction in Sacramento tule perch habitat. Flows would be substantially lower
5 during the majority of the juvenile and adult rearing periods in the American River and in the
6 Feather River, with substantial reductions for a portion of the rearing periods in the Trinity River
7 contributing to regional effects. The percentages of years outside both temperature thresholds are
8 generally lower or only slightly higher under Alternative 9 than under Existing Conditions. This
9 impact is a result of the specific reservoir operations and resulting flows associated with this
10 alternative. Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to
11 the extent necessary to reduce this impact to a less-than-significant level would fundamentally
12 change the alternative, thereby making it a different alternative than that which has been modeled
13 and analyzed. As a result, this impact is significant and unavoidable because there is no feasible
14 mitigation available.

15 The NEPA and CEQA conclusions differ for this impact statement because they were determined
16 using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLТ with
17 NAA, and the CEQA conclusion was based on the comparison of A9_LLТ with Existing Conditions.
18 These baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal
19 water years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the
20 late long-term implementation period, whereas the CEQA conclusion assumes existing climate
21 conditions. Therefore, differences in model outputs between Existing Conditions and Alternative 9
22 are due primarily to both the alternative and future climate change.

23 ***Sacramento-San Joaquin Roach***

24 In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for
25 Sacramento-San Joaquin roach relative to the NAA.

26 *Flows*

27 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
28 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
29 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
30 rearing.

31 In the Sacramento River upstream of Red Bluff, flows under A9_LLТ would be similar to or greater
32 than flows under NAA except in dry and critical years during January (to 11% lower), in above
33 normal years during August (7% lower), and above normal, below normal, and critical years during
34 October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These
35 are relatively isolated and small-magnitude flow reductions that would not have biologically
36 meaningful negative effects.

37 In the Trinity River below Lewiston Reservoir, flows under A9_LLТ would generally be similar to or
38 greater than flows under NAA throughout the year except for isolated, small flow reductions in
39 below normal years during February (28% lower), and in critical years during August (11% lower)
40 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically
41 meaningful effects.

1 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
2 than NAA throughout the year, except in below normal years during March (6% lower) and in
3 critical years during August (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
4 *Analysis*).

5 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
6 greater than flows under NAA during April through June and August, and similar to or lower than
7 flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results*
8 *utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most
9 critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-
10 magnitude reductions that would not have biologically meaningful negative effects.

11 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
12 than flows under NAA during January through June, September, November, and December, and
13 similar to or lower than flows under NAA during July, August, and October (to 18% lower)
14 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of
15 relatively small magnitude and would not be consistent by water year type from month to month
16 and therefore, would not have biologically meaningful negative effects.

17 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
18 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
19 flows relative to the NAA.

20 *Water Temperature*

21 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
22 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
23 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced rearing
24 habitat quality and increased stress and mortality. Water temperatures were not modeled in the San
25 Joaquin River or Clear Creek.

26 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
27 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
28 there would be no temperature-related effects in these rivers throughout the year.

29 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F under
30 NAA or A9_LLT (Table 11-9-91). As a result, there would be no difference in the percentage of
31 months in which the 86°F water temperature threshold is exceeded between Alternative 9 and NAA.

1 **Table 11-9-91. Difference and Percent Difference in the Percentage of Months Year-Round in**
 2 **Which Water Temperatures in the Feather River below Thermalito Afterbay at Exceed the 86°F**
 3 **Water Temperature Range for Sacramento-San Joaquin Roach Survival^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	0 (NA)	0 (NA)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)
All	0 (NA)	0 (NA)

NA = could not be calculated because the denominator was 0.

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

4
 5 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
 6 Alternative 9 would not cause a substantial reduction in spawning and juvenile and adult
 7 Sacramento-San Joaquin roach rearing habitat. Flows under Alternative 9 in all rivers examined
 8 throughout the year are generally similar to or greater than flows under the NAA, except for
 9 relatively infrequent/isolated, small to moderate flow reductions that would not be biologically
 10 meaningful to the roach population. The percentage of months outside temperature thresholds
 11 would be similar to or lower under Alternative 9 than under the NAA.

12 **CEQA Conclusion:** In general, Alternative 9 would reduce the quality and quantity of upstream
 13 habitat conditions for Sacramento-San Joaquin roach relative to Existing Conditions.

14 **Flows**

15 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
 16 Clear Creek were examined during the year-round juvenile and adult Sacramento-San Joaquin roach
 17 rearing period. Lower flows could reduce the quantity and quality of instream habitat available for
 18 rearing.

19 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would generally be similar to or
 20 greater than flows under Existing Conditions during all months with a few isolated exceptions (up to
 21 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

22 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
 23 greater than flows under Existing Conditions throughout the year with relatively small, isolated flow
 24 reductions, and more moderate reductions in critical years during August through December (up to
 25 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM*
 26 *II Model Results utilized in the Fish Analysis*).

27 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
 28 than flows under Existing Conditions throughout the year, except in critical years during August,
 29 September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the*
 30 *Fish Analysis*).

31 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
 32 lower than flows under Existing Conditions during January, February, drier water year types during

1 March and July through September (to 56% lower), and most water year types during October
2 through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish*
3 *Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and
4 would be fairly persistent for July through December, affecting rearing conditions during that time-
5 frame.

6 In the American River at Nimbus Dam, flows under A9_LL1T would generally be similar to or greater
7 than flows under Existing Conditions during January in wetter water year types, and during
8 February through April, and would be similar to or lower than flows under Existing Conditions
9 during January in drier water years (to 17% lower) and during May through December in most
10 water years (to 44% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
11 This would include moderate to substantial flow reductions in drier water year types for much of
12 this time-frame that would affect rearing conditions.

13 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
14 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
15 moderate reductions in flows during the period relative to Existing Conditions.

16 *Water Temperature*

17 The percentage of months above the 86°F water temperature threshold for year-round juvenile and
18 adult Sacramento-San Joaquin roach rearing period was examined in the Sacramento, Trinity,
19 Feather, American, and Stanislaus rivers. Elevated water temperatures could lead to reduced
20 quantity and quality of adult rearing habitat and increased stress and mortality of rearing adults.
21 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

22 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
23 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
24 there would be no temperature-related effects in these rivers during the April through November
25 period.

26 In the Feather River below Thermalito Afterbay, water temperatures would not exceed 86°F water
27 temperature threshold for Sacramento-San Joaquin roach occurrence under Existing Conditions or
28 A9_LL1T (Table 11-9-91). As a result, there would be no difference in the percentage of months in
29 which the 86°F water temperature threshold is exceeded between Alternative 9 and Existing
30 Conditions.

31 Collectively, these results indicate that the impact would be significant because Alternative 9 would
32 cause a substantial reduction in Sacramento-San Joaquin roach habitat. Flows would be
33 substantially lower during the majority of the juvenile and adult rearing periods in the American
34 River and in the Feather River, with substantial reductions for a portion of the rearing periods in the
35 Trinity River contributing to regional effects. The percentages of years outside both temperature
36 thresholds are generally lower under Alternative 9 than under Existing Conditions. This impact is a
37 result of the specific reservoir operations and resulting flows associated with this alternative.
38 Applying mitigation (e.g., changing reservoir operations in order to alter the flows) to the extent
39 necessary to reduce this impact to a less-than-significant level would fundamentally change the
40 alternative, thereby making it a different alternative than that which has been modeled and
41 analyzed. As a result, this impact is significant and unavoidable because there is no feasible
42 mitigation available.

1 The NEPA and CEQA conclusions differ for this impact statement because they were determined
2 using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA
3 and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These
4 baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water
5 years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-
6 term implementation period, whereas the CEQA conclusion assumes existing climate conditions.
7 Therefore, differences in model outputs between Existing Conditions and Alternative 9 are due
8 primarily to both the alternative and future climate change.

9 **Hardhead**

10 In general, Alternative 9 would not affect the quality and quantity of upstream habitat conditions for
11 hardhead relative to the NAA.

12 *Flows*

13 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
14 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
15 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
16 adult rearing.

17 In the Sacramento River upstream of Red Bluff, flows under A9_LLT would be similar to or greater
18 than flows under NAA except in dry and critical years during January (to 11% lower), in above
19 normal years during August (7% lower), and above normal, below normal, and critical years during
20 October (to 13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These
21 are relatively isolated and small-magnitude flow reductions that would not have biologically
22 meaningful negative effects.

23 In the Trinity River below Lewiston Reservoir, flows under A9_LLT would generally be similar to or
24 greater than flows under NAA throughout the year except for isolated, small flow reductions in
25 below normal years during February (28% lower), and in critical years during August (11% lower)
26 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) that would not have biologically
27 meaningful effects.

28 In Clear Creek at Whiskeytown Dam, flows under A9_LLT would generally be similar to or greater
29 than NAA throughout the year, except in below normal years during March (6% lower) and in
30 critical years during August (13% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
31 Analysis*).

32 In the Feather River at Thermalito Afterbay, flows under A9_LLT would generally be similar to or
33 greater than flows under NAA during April through June and August, and similar to or lower than
34 flows under NAA during the rest of the year (to 22% lower) (Appendix 11C, *CALSIM II Model Results
35 utilized in the Fish Analysis*). Flow reductions in drier water year types, when effects would be most
36 critical for habitat conditions, would consist of relatively inconsistent, isolated and/or small-
37 magnitude reductions that would not have biologically meaningful negative effects.

38 In the American River at Nimbus Dam, flows under A9_LLT would generally be similar to or greater
39 than flows under NAA during January through June, September, November, and December, and
40 similar to or lower than flows under NAA during July, August, and October (to 18% lower)
41 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These flow reductions are of

1 relatively small magnitude and would not be consistent by water year type from month to month
2 and therefore, would not have biologically meaningful negative effects.

3 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
4 under Alternative 1A. The analysis for Alternative 1A indicates that there would be no differences in
5 flows relative to the NAA.

6 *Water Temperature*

7 The percentage of months outside of the 65°F to 82.4°F suitable water temperature range for
8 juvenile and adult hardhead rearing was examined in the Sacramento, Trinity, Feather, American,
9 and Stanislaus rivers. Water temperatures outside this range could lead to reduced rearing habitat
10 quality and increased stress and mortality. Water temperatures were not modeled in the San
11 Joaquin River or Clear Creek.

12 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
13 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that
14 there would be no temperature-related effects in these rivers throughout the year.

15 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside the
16 range would be similar to or lower than the percentage under NAA in all water years (Table 11-9-
17 92).

18 **Table 11-9-92. Difference and Percent Difference in the Percentage of Months Year-Round in**
19 **Which Water Temperatures in the Feather River below Thermalito Afterbay Are outside the 65°F**
20 **to 82.4°F Water Temperature Range for Juvenile and Adult Hardhead Occurrence^a**

Water Year Type	EXISTING CONDITIONS vs. A9_LLT	NAA vs. A9_LLT
Wet	-4 (-5%)	-1 (-1%)
Above Normal	-5 (-7%)	-1 (-1%)
Below Normal	-9 (-13%)	2 (3%)
Dry	-6 (-9%)	0.9 (1%)
Critical	-7 (-10%)	0 (0%)
All	-6 (-8%)	0.2 (0%)

^a A negative value indicates a benefit (reduction in percentage of months outside suitable range) of the alternative.

21
22 **NEPA Effects:** Collectively, these results indicate that the effect would not be adverse because
23 Alternative 9 would not cause a substantial reduction in spawning and juvenile and adult hardhead
24 rearing. Flows in all rivers examined during the year under Alternative 9 are generally similar to or
25 greater than flows under the NAA in most months. Flows are generally lower in the Feather River
26 high-flow channel during July through December, and in the American River below Nimbus Dam
27 during the summer months, although the flow reductions would be of relatively small magnitude
28 and would not be consistent month to month within each water year type, and therefore would not
29 have biologically meaningful negative effects on hardhead. The percentages of years outside all
30 temperature thresholds are generally lower under Alternative 9 than under the NAA.

31 **CEQA Conclusion:** In general, Alternative 9 would reduce the quality and quantity of upstream
32 habitat conditions for hardhead relative to Existing Conditions.

1 *Flows*

2 Flow rates in the Sacramento, Trinity, Feather, American, San Joaquin, and Stanislaus rivers and in
3 Clear Creek were examined during the year-round juvenile and adult hardhead rearing period.
4 Lower flows could reduce the quantity and quality of instream habitat available for juvenile and
5 adult rearing.

6 In the Sacramento River upstream of Red Bluff, flows under A9_LLTP would generally be similar to or
7 greater than flows under Existing Conditions during all months with a few isolated exceptions (up to
8 21% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

9 In the Trinity River below Lewiston Reservoir, flows under A9_LLTP would generally be similar to or
10 greater than flows under Existing Conditions throughout the year with relatively small, isolated flow
11 reductions, and more moderate reductions in critical years during August through December (up to
12 41% lower) that would affect rearing conditions for that specific time-frame (Appendix 11C, *CALSIM
13 II Model Results utilized in the Fish Analysis*).

14 In Clear Creek at Whiskeytown Dam, flows under A9_LLTP would generally be similar to or greater
15 than flows under Existing Conditions throughout the year, except in critical years during August,
16 September, and November (6% to 38% lower) (Appendix 11C, *CALSIM II Model Results utilized in the
17 Fish Analysis*).

18 In the Feather River at Thermalito Afterbay, flows under A9_LLTP would generally be similar to or
19 lower than flows under Existing Conditions during January, February, drier water year types during
20 March and July through September (to 56% lower), and most water year types during October
21 through December (to 27% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish
22 Analysis*). Flow reductions in drier water years would be more critical for habitat conditions and
23 would be fairly persistent for July through December, affecting rearing conditions during that time-
24 frame.

25 In the American River at Nimbus Dam, flows under A9_LLTP would generally be similar to or greater
26 than flows under Existing Conditions during January in wetter water year types, and during
27 February through April, and would be similar to or lower than flows under Existing Conditions
28 during January in drier water years (to 17% lower) and during May through December in most
29 water years (to 44% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).
30 This would include moderate to substantial flow reductions in drier water year types for much of
31 this time-frame that would affect rearing conditions.

32 Flow rates in the San Joaquin and Stanislaus rivers under Alternative 9 would be the same as those
33 under Alternative 1A. The analysis for Alternative 1A indicates that there would be small to
34 moderate reductions in flows during the period relative to Existing Conditions.

35 *Water Temperature*

36 The percentage of months in which year-round in-stream temperatures would be outside of the
37 65°F to 82.4°F suitable water temperature range for juvenile and adult hardhead rearing was
38 examined in the Sacramento, Trinity, Feather, American, and Stanislaus rivers. Water temperatures
39 outside this range could lead to reduced rearing habitat quality and increased stress and mortality.
40 Water temperatures were not modeled in the San Joaquin River or Clear Creek.

41 Water temperatures in the Sacramento, Trinity, American, and Stanislaus rivers under Alternative 9
42 would be the same as those under Alternative 1A. The analysis for Alternative 1A indicates that

1 there would be no temperature-related effects in these rivers during the April through November
2 period.

3 In the Feather River below Thermalito Afterbay, the percentage of months under A9_LLT outside of
4 the 65°F to 82.4°F water temperature range for juvenile and adult hardhead occurrence would be
5 similar to or lower than the percentage under Existing Conditions in all water years (Table 11-9-92).

6 Collectively, these results indicate that the impact would be significant because Alternative 9 would
7 cause a substantial reduction in hardhead habitat. Flows would be substantially lower during the
8 majority of the juvenile and adult rearing periods in the American River and in the Feather River,
9 with substantial reductions for a portion of the rearing periods in the Trinity River contributing to
10 regional effects. The percentages of years outside both temperature thresholds are generally lower
11 under Alternative 9 than under Existing Conditions. This impact is a result of the specific reservoir
12 operations and resulting flows associated with this alternative. Applying mitigation (e.g., changing
13 reservoir operations in order to alter the flows) to the extent necessary to reduce this impact to a
14 less-than-significant level would fundamentally change the alternative, thereby making it a different
15 alternative than that which has been modeled and analyzed. As a result, this impact is significant and
16 unavoidable because there is no feasible mitigation available.

17 The NEPA and CEQA conclusions differ for this impact statement because they were determined
18 using two unique baselines. The NEPA conclusion was based on the comparison of A9_LLT with NAA
19 and the CEQA conclusion was based on the comparison of A9_LLT with Existing Conditions. These
20 baselines differ in two ways. First, the NAA includes the Fall X2 standard in wet above normal water
21 years, whereas Existing Conditions do not. Second, the NAA is assumed to occur during the late long-
22 term implementation period, whereas the CEQA conclusion assume existing climate conditions.
23 Therefore, differences in model outputs between the Existing Conditions and Alternative 9 are due
24 primarily to both the alternative and future climate change.

25 ***California Bay Shrimp***

26 The effect of water operations on rearing habitat of California bay shrimp under Alternative 9 would
27 be similar to that described for Alternative 1A (see Alternative 1A, Impact AQUA-203). For a detailed
28 discussion, please see Alternative 1A, Impact AQUA-203.

29 ***NEPA Effects:*** As concluded for Alternative 1A, Impact AQUA-203, these effects would not be
30 adverse.

31 ***CEQA Conclusion:*** As described above the impacts on rearing habitat of California bay shrimp would
32 be less than significant.

33 **Impact AQUA-204: Effects of Water Operations on Migration Conditions for Non-Covered** 34 **Aquatic Species of Primary Management Concern**

35 ***Striped Bass***

36 Striped bass adults migrate into the Delta and upstream starting in March and peaking in April and
37 May. Conditions for adult striped bass migrating to spawning habitat would not be affected under
38 Alternative 9 because average monthly flows in the lower Sacramento River downstream of the
39 north Delta intakes would be similar to NAA (-3% to 7%). Several operable barriers would be
40 installed to provide safe fish migration corridors and to isolate water conveyance corridors (at head
41 of Old River and San Joaquin River, sloughs and canals between Old River and Middle River,

1 locations at the mouth of Old River, and near the lower Mokelumne River). The physical isolation of
2 the water conveyance corridor on the Middle River from the fish migration corridor on Old River
3 may interfere with the movement patterns of highly mobile striped bass to and from the south and
4 east Delta. The degree of isolation would depend on timing and duration of barrier closure. The
5 operable nature of the barriers would reduce impacts to migration conditions. Most barriers would
6 be operated to pass high flows, which would maintain periodic connectivity among Delta regions.
7 Alternative 9 would affect some movement corridors within the Delta, but the effect would not be
8 adverse to the striped bass population.

9 **NEPA Effects:** Overall, the effect on striped bass migration under Alternative 9 would not be adverse
10 because the similarity in flow conditions in the north Delta and barrier operations to allow periodic
11 connectivity.

12 **CEQA Conclusion:** Impacts would be as described immediately above. Flows in the north Delta
13 would be similar on average to Existing Conditions during the striped bass migration to spawning
14 habitat upstream in the Sacramento River. Also, the barriers isolating the Middle River from the Old
15 River would alter movement corridors for striped bass in the central and south Delta. Overall, the
16 impact would be less than significant. No mitigation would be required.

17 **American Shad**

18 Flows in the Sacramento River below the north Delta diversion facilities would be similar to NAA
19 from March-May. Flows from the San Joaquin River at Vernalis would be unchanged. Sacramento
20 River flows are highly variable inter-annually, and American shad are still able to migrate upstream
21 the Sacramento River during lower flow years. The effect of isolating the Middle River water
22 conveyance corridor would affect movement patterns of American shad in a manner similar to that
23 described above for striped bass.

24 **NEPA Effects:** Overall, the effect of Alternative 9 on American shad migration would not be adverse
25 under Alternative 9.

26 **CEQA Conclusion:** Impacts would be as described immediately above. Flows downstream of the
27 north Delta intakes and the south Delta would be similar to Existing Conditions. The isolation of the
28 Middle River from the Old River would alter some movement pathways within the Delta. Overall,
29 Alternative 9 would not substantially interfere with the migration of American shad. Therefore, the
30 impact would be less than significant. No mitigation would be required.

31 **Threadfin Shad**

32 **NEPA Effects:** Threadfin shad are semi-anadromous, moving between freshwater and brackish
33 water habitats. Threadfin shad found in the Delta do not actively migrate upstream to spawn. The
34 effect of isolating the Middle River water conveyance corridor would affect local movement patterns
35 of threadfin shad in a manner similar to that described for striped bass under Alternative 9 (Impact
36 AQUA-204), and would reduce potential entrainment loss. Overall the effect would not be adverse

37 **CEQA Conclusion:** Flows downstream of the north Delta intakes and the south Delta would be
38 similar to Existing Conditions. The isolation of the Middle River from the Old River would alter
39 threadfin shad movements in the same way as for striped bass (refer to Alternative 9, Impact AQUA-
40 204 for striped bass), but would reduce the potential for incidental entrainment loss at the south
41 Delta facilities. Overall, Alternative 9 would not substantially interfere with the migration of

1 threadfin shad. Therefore the impact would be less than significant. No mitigation would be
2 required

3 ***Largemouth Bass***

4 ***NEPA Effects:*** Alternative 9 operations would not adversely affect migration conditions for
5 largemouth bass because this a resident species remains close to vegetated nearshore habitat and
6 does not use the Delta as migration corridor.

7 ***CEQA Conclusion:*** As described immediately above, the impact of Alternative 9 operations on
8 migration would is considered less than significant because largemouth bass do not migrate within
9 the Delta. No mitigation would be required.

10 ***Sacramento Tule Perch***

11 ***NEPA Effects:*** Similar to largemouth bass, Sacramento tule perch are a non-migratory species and do
12 not use the Delta as a migration corridor as they are a resident Delta species. There would be no
13 effect.

14 ***CEQA Conclusion:*** As described immediately above, flow changes would not affect Sacramento tule
15 perch movements within the Delta. No mitigation would be required.

16 ***Sacramento-San Joaquin Roach***

17 ***NEPA Effects:*** For Sacramento-San Joaquin roach the overall flows and temperature in upstream
18 rivers during migration to their spawning grounds would be similar to those described under
19 Alternative 9, Impact AQUA-202 for spawning. As described there, the flows would slightly improve
20 the upstream conditions relative to the NAA. These conditions would not be adverse.

21 ***CEQA Conclusion:*** As described immediately above, the impacts of water operations on migration
22 conditions for Sacramento-San Joaquin roach would not be significant and no mitigation is required.

23 ***Hardhead***

24 ***NEPA Effects:*** For hardhead the overall flows and temperature in upstream rivers during migration
25 to their spawning grounds would be similar to those described under Alternative 9, Impact AQUA-
26 202 for spawning. As described there, the flows would slightly improve the upstream conditions
27 relative to the NAA. These conditions would not be adverse.

28 ***CEQA Conclusion:*** As described immediately above, the impacts of water operations on migration
29 conditions for hardhead would not be significant and no mitigation is required.

30 ***California Bay Shrimp***

31 ***NEPA Effects:*** The effect of water operations on migration conditions of California bay shrimp under
32 Alternative 9 would be similar to that described for Alternative 1A (see Alternative 1A, Impact
33 AQUA-204). For a detailed discussion, please see Alternative 1A, Impact AQUA-204. The effects
34 would not be adverse.

35 ***CEQA Conclusion:*** As described above the impacts on migration conditions of California bay shrimp
36 would be less than significant.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 The effects of restoration measures under Alternative 9 would be similar for all non-covered
3 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by
4 individual species.

5 **Impact AQUA-205: Effects of Construction of Restoration Measures on Non-Covered Aquatic**
6 **Species of Primary Management Concern**

7 The potential effects of the construction of restoration measures on non-covered species of primary
8 management concern under Alternative 9, would be similar to those described in detail for
9 Alternative 1A (see Alternative 1A, Impact AQUA-7).

10 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-7, the effects would not be adverse.

11 *CEQA Conclusion:* As described immediately above, the impacts of the construction of restoration
12 measures would be less than significant.

13 **Impact AQUA-206: Effects of Contaminants Associated with Restoration Measures on Non-**
14 **Covered Aquatic Species of Primary Management Concern**

15 The potential effects of contaminants associated with habitat restoration measures, on non-covered
16 species of primary management concern under Alternative 9, would be similar to those described in
17 detail under Alternative 1A (see Alternative 1A, Impact AQUA-8).

18 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-8, these effects would not be adverse.

19 *CEQA Conclusion:* As described immediately above, the impacts of contaminants associated with
20 restoration measures would be less than significant.

21 **Impact AQUA-207: Effects of Restored Habitat Conditions on Non-Covered Aquatic Species of**
22 **Primary Management Concern**

23 *NEPA Effects:* The potential effects of restored habitat conditions on non-covered species of primary
24 management concern under Alternative 9, would be similar to those described in detail for delta
25 smelt under Alternative 1A (see Alternative 1A, Impact AQUA-8). In addition, see Alternative 1A,
26 Impact AQUA-207 for a discussion of the minor differences in effects on non-covered species of
27 primary management concern. The effects range from slightly beneficial to beneficial.

28 *CEQA Conclusion:* As described immediately above, the impacts of restored habitat conditions
29 would range from slightly beneficial to beneficial.

30 **Impact AQUA-208: Effects of Methylmercury Management on Non-Covered Aquatic Species of**
31 **Primary Management Concern (CM12)**

32 The potential effects of methylmercury management on non-covered species of primary
33 management concern under Alternative 9, would be similar to those described in detail for delta
34 smelt under Alternative 1A (see Alternative 1A, Impact AQUA-10).

35 *NEPA Effects:* As concluded for Alternative 1A, Impact AQUA-10, these effects would not be adverse.

36 *CEQA Conclusion:* As described immediately above, the impacts of methylmercury management
37 would be less than significant.

1 **Impact AQUA-209: Effects of Invasive Aquatic Vegetation Management on Non-Covered**
2 **Aquatic Species of Primary Management Concern (CM13)**

3 **NEPA Effects:** The potential effects of invasive aquatic vegetation management on non-covered
4 species of primary management concern under Alternative 9, would be similar to those described in
5 detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-11) except for
6 predatory species (striped bass and largemouth bass) and Sacramento tule perch. Invasive aquatic
7 vegetation provides hiding habitat for predatory fish which improves their hunting success.
8 Sacramento tule perch also use the cover of aquatic vegetation in the Sacramento and San Joaquin
9 rivers and in Suisun marsh. Consequently, reducing the amount of invasive aquatic habitat will
10 negatively affect these predatory species and Sacramento tule perch. However, this control will not
11 substantially reduce the ability of the predatory species to hunt and there will still be many other
12 habitats in which the predatory species can successfully hunt and in which Sacramento tule perch
13 will thrive. The effect on them will not be adverse.

14 **CEQA Conclusion:** Refer to Impact AQUA-11 under delta smelt for a discussion of the effects of
15 invasive aquatic vegetation management on non-covered species of primary management concern.
16 Although there are minor differences, the effects are similar, except for predatory species (striped
17 bass and largemouth bass) and Sacramento tule perch. Invasive aquatic vegetation provides hiding
18 habitat for predatory fish which improves their hunting success. Sacramento tule perch use the
19 cover of aquatic vegetation in the Sacramento and San Joaquin rivers and in Suisun marsh.
20 Consequently, reducing the amount of invasive aquatic habitat will negatively affect the predatory
21 species and Sacramento tule perch. However, this control will not substantially reduce the ability of
22 the predatory species to hunt and there will still be many other habitats in which the predatory
23 species can successfully hunt and in which Sacramento tule perch will thrive. Therefore the effect on
24 them will not be significant and no mitigation is required.

25 **Other Conservation Measures (CM12–CM19 and CM21)**

26 The effects of other conservation measures under Alternative 9 would be similar for all non-covered
27 species; therefore, the analysis below is combined for all non-covered species instead of analyzed by
28 individual species.

29 **Impact AQUA-210: Effects of Dissolved Oxygen Level Management on Non-Covered Aquatic**
30 **Species of Primary Management Concern (CM14)**

31 The potential effects of dissolved oxygen management on non-covered species of primary
32 management concern under Alternative 9, would be similar to those described in detail for delta
33 smelt under Alternative 1A (see Alternative 1A, Impact AQUA-12).

34 **NEPA Effects:** As concluded for Alternative 1A, these effects would be beneficial.

35 **CEQA Conclusion:** As described immediately above, the impacts of oxygen level management would
36 be beneficial.

37 **Impact AQUA-211: Effects of Localized Reduction of Predatory Fish on Non-Covered Aquatic**
38 **Species of Primary Management Concern (CM15)**

39 Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the effects of
40 predatory fish (striped bass and largemouth bass) and predator management on non-predatory fish.
41 The purpose of predatory fish management is to reduce the numbers of predatory fish and to reduce

1 their hunting success. This management will have negative effects on predatory fish. However, the
2 numbers of predatory fish are high and the extent of the habitats in which they hunt is extensive.

3 **NEPA Effects:** The effects of this management will not be adverse.

4 **CEQA Conclusion:** Refer to Alternative 1A, Impact AQUA-13 under delta smelt for a discussion of the
5 effects of predatory fish and predator management on non-predatory fish. The purpose of predatory
6 fish management is to reduce the numbers of predatory fish and to reduce their hunting success.
7 This management will have negative effects on predatory fish. However, the numbers of predatory
8 fish are high and the extent of the habitats in which they hunt is extensive. Therefore the effects of
9 this management will not be significant. No mitigation is required.

10 **Impact AQUA-212: Effects of Nonphysical Fish Barriers on Non-Covered Aquatic Species of**
11 **Primary Management Concern (CM16)**

12 **NEPA Effects:** The potential effects of nonphysical fish barriers on non-covered species of primary
13 management concern under Alternative 9, would be similar to those described in detail for delta
14 smelt under Alternative 1A (see Alternative 1A, Impact AQUA-14). The effects would be similar
15 except for Sacramento-San Joaquin roach and hardhead which are unlikely to be present in their
16 vicinity. The effects would not be adverse.

17 **CEQA Conclusion:** As described immediately above, the impacts of nonphysical fish barriers would
18 be less than significant.

19 **Impact AQUA-213: Effects of Illegal Harvest Reduction on Non-Covered Aquatic Species of**
20 **Primary Management Concern (CM17)**

21 The potential effects of illegal harvest reduction on non-covered species of primary management
22 concern under Alternative 9 would be similar to those described in detail for delta smelt under
23 Alternative 1A (see Alternative 1A, Impact AQUA-15).

24 **NEPA Effects:** As concluded for Alternative 1A, Impact AQUA-15, the effects would not be adverse.

25 **CEQA Conclusion:** As described immediately above, the impacts of illegal harvest reduction would
26 be less than significant.

27 **Impact AQUA-214: Effects of Conservation Hatcheries on Non-Covered Aquatic Species of**
28 **Primary Management Concern (CM18)**

29 The potential effects of conservation hatcheries on non-covered species of primary management
30 concern under Alternative 9 would be similar to those described in detail for delta smelt under
31 Alternative 1A (see Alternative 1A, Impact AQUA-16).

32 **NEPA Effects:** For a detailed discussion, please see Alternative 1A, Impact AQUA-16. There would be
33 no effect.

34 **CEQA Conclusion:** As described immediately above, conservation hatcheries would have not impact.

1 **Impact AQUA-215: Effects of Urban Stormwater Treatment on Non-Covered Aquatic Species**
2 **of Primary Management Concern (CM19)**

3 The potential effects of stormwater treatment on non-covered species of primary management
4 concern under Alternative 9, would be similar to those described in detail for delta smelt under
5 Alternative 1A (see Alternative 1A, Impact AQUA-17).

6 **NEPA Effects:** For a detailed discussion, please see Alternative 1A, Impact AQUA-17. These effects
7 would be beneficial.

8 **CEQA Conclusion:** As described immediately above, the impacts of stormwater management would
9 be beneficial.

10 **Impact AQUA-216: Effects of Removal/Relocation of Nonproject Diversions on Non-Covered**
11 **Aquatic Species of Primary Management Concern (CM21)**

12 **NEPA Effects:** The potential effects of removal/relocation of nonproject diversions under
13 Alternative 9, on non-covered species of primary management concern, would be similar to those
14 described in detail for delta smelt under Alternative 1A (see Alternative 1A, Impact AQUA-18). The
15 effects would be similar except for Sacramento-San Joaquin roach, hardhead and Sacramento perch
16 which are unlikely to be present near these diversions. The effects would not be adverse.

17 **CEQA Conclusion:** As described immediately above, the impacts of removal/relocation of nonproject
18 diversions would be less than significant.

19 **Upstream Reservoirs**

20 **Impact AQUA-217: Effects of Water Operations on Reservoir Coldwater Fish Habitat**

21 **NEPA Effects:** Similar to the description for Alternative 1A, this effect would not be adverse because
22 coldwater fish habitat in the CVP and SWP upstream reservoirs under Alternative 9 would not be
23 substantially reduced when compared to the No Action Alternative.

24 **CEQA Conclusion:** Similar to the description for Alternative 1A, Alternative 9 would reduce the
25 quantity of coldwater fish habitat in the CVP and SWP as shown in Table 11-1A-102. There would be
26 a greater than 5% increase (5 years) for several of the reservoirs, which could result in a significant
27 impact. These results are primarily caused by four factors: differences in sea level rise, differences in
28 climate change, future water demands, and implementation of the alternative. The analysis
29 described above comparing Existing Conditions to Alternative 9 does not partition the effect of
30 implementation of the alternative from those of sea level rise, climate change and future water
31 demands using the model simulation results presented in this chapter. However, the increment of
32 change attributable to the alternative is well informed by the results from the NEPA analysis, which
33 found this effect to be not adverse. As a result, the CEQA conclusion regarding Alternative 9, if
34 adjusted to exclude sea level rise and climate change, is similar to the NEPA conclusion, and
35 therefore would not in itself result in a significant impact on coldwater habitat in upstream
36 reservoirs. This impact is found to be less than significant and no mitigation is required.

11.3.5 Cumulative Effects on Fish and Aquatic Resources

Under CEQA, cumulative impacts are defined as two or more related past, present, and reasonably foreseeable future projects and programs, that when considered together, are considerable or that compound or increase other environmental impacts. Cumulative impacts consist of impacts which are created as a result of the combination of the proposed project with other projects that would cause related impacts. The CEQA cumulative impacts focus is on whether the proposed project's incremental contribution to any other significant impact is cumulatively considerable and thus significant in and of itself.

The Council of Environmental Quality (CEQ) regulations defines cumulative impacts as the impact on environment, human, and community resources that results from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or persons undertakes such actions. Cumulative Impacts can result from individually minor but collectively significant actions taking place over time (40 Code of Federal Regulations [CFR] 1508.7, 1508.25.)

11.3.5.1 Assessment Methodology

The cumulative effects analysis for fish and aquatic resources addresses the potential for the action alternatives to act in combination with other past, present, and probable future projects or programs to create a cumulatively significant adverse impact. The geographic scope of the cumulative analysis for each of the covered and non-covered species varies, depending on the potential for other projects or programs to influence individuals that rely on the BDCP Plan Area for some stage of their life history. While these areas extend beyond the Plan Area, the primary focus for these resource effects is the Delta Region, where BDCP conservation and operational efforts are concentrated, and areas upstream of the Delta where operational effects would be the primary mechanism to affect aquatic habitat conditions. For some species, such as anadromous fish, the analysis area extends well beyond the Plan Area. Other fish species whose individuals do not range beyond the Plan Area, such as Delta smelt, the geographic range of the cumulative analysis has been limited to this smaller area.

When the effects of the changes in aquatic habitat or species resources under the alternatives are considered in connection with the potential effects of projects listed in Chapter 3, *Description of Alternatives*, the potential effects range from beneficial to potentially adverse cumulative effects on fish and aquatic resources.

The projects and programs that have been considered as part of the cumulative analysis have been drawn primarily from a list developed for this EIR/EIS and contained in Appendix 3D. This list was compiled in part by reviewing the projects addressed in the cumulative impacts analysis for the Delta Land Use and Resource Management Plan (Delta Protection Commission 2010). The list was augmented by reviewing the alternatives development information presented in Appendix 3A, *Identification of Water Conveyance Alternatives, Conservation Measure 1*, and other recent environmental documents for Delta-area projects, Central Valley diversion-related projects, and by coordinating with local, state, and federal agencies that are sponsoring activities in the Delta area or on other areas within the relevant range of individual fish species. The list of past, present and probable future projects has been evaluated to determine which may have effects on aquatic

1 habitats and species that occur within the Plan Area. The list of projects relevant to fish and aquatic
2 resources is contained in Table 11-13. This analysis is qualitative in nature.

3 A determination of the potential adverse effects of each individual alternative was used to assess
4 whether implementation of the alternatives would contribute to an adverse cumulative effect on the
5 fish and aquatic resources of the Plan Area. Based on the analyses presented in earlier parts of this
6 chapter, the alternatives would often have a beneficial effect on many of the aquatic resources in the
7 Plan Area. However, there are many instances where the alternatives would have adverse effects on
8 fish and aquatic resources. While construction and restoration activities in the near-term period of
9 the alternatives would temporarily or permanently alter the available habitat for the covered
10 species, the near-, mid- and long-term conservation actions would replace, enhance and in most
11 cases expand habitat for these species. The potential construction-related adverse effects of
12 implementing the alternatives are limited to short-term losses. The potential operation-related
13 adverse effects of implementing the alternatives can be either short-term or long-term, varying
14 among the specific types of effects and alternatives.

15 While the modeling of operations included several projects in addition to the action alternatives,
16 there are some known future projects that were not included. Those projects are addressed
17 qualitatively in this cumulative analysis. Similarly, there are numerous projects that would entail
18 construction and maintenance activities, extending through portions of the same time period as
19 BDCP, which are also addressed in this cumulative analysis. The specific programs, projects and
20 policies that are considered in combination with the BDCP are identified below for each relevant
21 impact category based on the potential to contribute to a BDCP impact that could be considered
22 cumulatively considerable.

23 Many of the projects and programs included in the cumulative effect analysis, would be similar to
24 those included in the action alternatives, and would have similar potential effects. These effects
25 would also be similar between the different covered species. Therefore, the following assessment
26 addresses all the covered species as a group, for the most part, rather than individual species.

27 When the effects of the BDCP on fish and aquatic resources are considered in connection with the
28 potential effects of projects listed in Table 11-14, the combined effects range from beneficial to
29 potentially adverse. There are elements of the BDCP that will have negative effects (construction
30 and, in some situations, operations) and others that will have positive effects (conservation and
31 restoration). The cumulative analysis looks at the whole of these actions.

1 **Table 11-13. Effects on Covered Fish Species from the Plans, Policies, and Programs Included in the**
 2 **Cumulative Effects Analysis**

Agency	Programs, Projects, and Policies	Comments
Department of Fish and Game	California Aquatic Invasive Species Draft Rapid Response Plan	Program under development. Draft Plan issued in 2007.
Department of Fish and Game	Fremont Landing Conservation Bank	Project completed.
Department of Fish and Game	Fish Screen Project at Sherman and Twitchell Islands	Program included in Delta Initiatives List.
Department of Parks and Recreation	Central Valley Vision	Implementation Plan completed in 2009.
Department of Water Resources	North Delta Flood Control and Ecosystem Restoration Project	Completed in 2012.
Department of Water Resources	Dutch Slough Tidal Marsh Restoration Project	Project implementation began in 2012. Estimated completion in 2016.
Department of Water Resources	State Water Project Contract Extension	
Contra Costa Water District, U.S. Bureau of Reclamation, and Department of Water Resources	Los Vaqueros Reservoir Expansion Project	Project completed in 2012.
Davis, Woodland, and University of California, Davis	Davis-Woodland Water Supply Project	Project under development. Final EIR in 2009. Specific design and operations criteria not identified.
Northeastern San Joaquin County Groundwater Banking Authority	Eastern San Joaquin Integrated Conjunctive Use Program	Final Programmatic EIR in 2011.
University of California, Davis, California Department of Water Resources, Department of Fish and Game, U.S. Fish and Wildlife Service, and U.S. Bureau of Reclamation	Delta Smelt Permanent Refuge	Program under development to develop a permanent facility, possibly at the proposed FWS Science Center at Rio Vista.
U.S. Bureau of Reclamation	Delta-Mendota Canal/California Aqueduct Intertie	Project completed in 2012.
U.S. Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Grassland Bypass Project, 2010–2019	Final EIS/EIR in 2009.
U.S. Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Agricultural Drainage Selenium Management Program	Program under development. Draft EIS/EIR in 2008.

Agency	Programs, Projects, and Policies	Comments
Water Forum and U.S. Bureau of Reclamation	Lower American River Flow Management Standard	Program under development. Draft EIR in 2010. Recommendations included in NMFS Biological Opinion.
West Sacramento Area Flood Control Agency and U.S. Army Corps of Engineers	West Sacramento Levee Improvements Program	Program under development. Construction initiated in several areas. Further environmental and engineering documentation required for future projects.
California Department of Fish and Game	Calhoun Cut/Lindsey Slough Restoration	Increase intertidal marsh habitat and adjacent riparian habitat on 927 acres in Cache Slough ROA.
California Department of Fish and Game	Ecosystem Restoration Program Conservation Strategy	Created in 2000. Ongoing program to preserve, restore, and enhance terrestrial natural communities and ecosystems in the San Francisco Bay and Sacramento-San Joaquin Delta. Protected and restored more than 150,000 acres of habitat, including 3,900 acres and 59 miles of riparian and riverine aquatic habitat (as of 2010) after 7 of the planned 30 years of the project.
California Department of Fish and Game	Lower Sherman Island Wildlife Area Land Management Plan	Ongoing program. Directs habitat and species management on 3,100 acres of marsh and open water.
California Department of Fish and Game	Yolo Bypass Wildlife Area Land Management Plan	Ongoing program. Provides for multiple use management of 16,000 acres of mixed agricultural, grassland and managed wetland habitats.
California Department of Water Resources	Central Valley Flood Protection Plan	Proposes significant expansion of flood protection features in the study area, including expansion of the Yolo Bypass.
California Department of Water Resources	Delta Levees Flood Protection Program	Ongoing program. Includes modification to Delta levees within the Sacramento-San Joaquin Delta and portions of the Suisun Marsh. The project works with 60 reclamation districts and strives to complete levee rehabilitation projects with no net loss of habitat in the Delta.
California Department of Water Resources	FloodSAFE California	Promotes public safety through integrated flood management while protecting environmental resources; emphasizes action in the Delta.
California Department of Water Resources	Levee Repair-Levee Evaluation Program	Ongoing program. Upgrading levees along the Sacramento and San Joaquin Rivers and Delta; 1,600 miles of levees included in Central Valley.
California Department of Water Resources and MOA Partners	Lower Yolo Restoration Project	In Cache Slough ROA, reintroduce tidal action to half of 3,408-acre Yolo Ranch.

Agency	Programs, Projects, and Policies	Comments
Contra Costa Water District	Contra Costa Canal Fish Screen Project	Completed in 2011. Designed to restore Delta ecosystems. Minor terrestrial impact at fish screen sites.
Contra Costa Water District, U.S. Bureau of Reclamation, and California Department of Water Resources	Contra Costa Water District Middle River Intake and Pump Station (Alternative Intake Project)	Completed in 2010. Resulted in permanent conversion of 6–8 acres of rural agricultural land. Features about 12,000 feet of pipe across Victoria Island and under Old River.
National Marine Fisheries Service, U.S. Bureau of Reclamation, and Department of Water Resources	Biological Opinion (BiOp) on the Long-Term Operations of the Central Valley Project and State Water Project	Ongoing program. Action area consists of the Oroville Reservoir, Feather River downstream of Oroville, Sacramento River downstream of Feather River, Sacramento-San Joaquin Delta, and adjacent habitats that are dependent on or influenced by waterways. Designed to conserve freshwater, estuarine, nearshore, and offshore sites. Includes 8,000-acre tidal wetland restoration requirement.
Reclamation District 2093	Liberty Island Conservation Bank	Under implementation. Permits and approvals acquired in 2009. Project site is on northern tip of Liberty Island. Over 160 acres in the project site with about 50 proposed to be converted to open water channels, emergent marsh wetland, and riparian habitat. Focuses on Delta fish habitat but will restore 2.7 acres of riparian habitat.
Sacramento Area Flood Control Agency, Central Valley Flood Protection Board, and U.S. Army Corps of Engineers	Central Valley Flood Management Program	Ongoing program. Supports flood management planning in Sacramento and San Joaquin Valleys. To be updated every 5 years with first update to be completed in 2017. Combined total of about 2.2 million acres of land within the Central Valley.
Semi Tropic Water District	Delta Wetlands	Flood storage and habitat conservation project on three Delta islands.
U.S. Army Corps of Engineers	CALFED Levee Stability Program	Includes maintaining and improving levee stability in the Delta. Long-term strategy will include ecosystem restoration. Partially funds McCormack-Williamson Tract Restoration in Cosumnes-Mokelumne ROA; 1,500 acres of tidal and floodplain restoration.
U.S. Bureau of Reclamation	Delta Mendota Canal/California Aqueduct Intertie	Construction completed in April 2012. Includes construction of a pump and 500-foot pipeline between the two canals near the Jones Pumping Plant. No special-status plant community affected.

Agency	Programs, Projects, and Policies	Comments
U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Department of Water Resources and Department of Fish and Game	San Joaquin River Restoration Program	Initiated in 2006. Ongoing program; 150 miles of the river is planned for restoration, including within the BDCP Plan Area.
U.S. Fish and Wildlife Service	Recovery Plan for Sacramento-San Joaquin Delta Native Fishes	Includes developing additional shallow water habitat, riparian vegetation zones and tidal marsh to restore wetland habitats throughout the Bay-Delta ecosystem.
U.S. Army Corps of Engineers	Sacramento River Bank Protection Project	Provides erosion control to levees of the federally authorized flood control project along the Sacramento River and its tributaries. Ongoing program with NOA/NOP for an additional 80,000 linear feet issued in 2009.

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2

Cumulative Effects of No Action

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Effects of Past, Present and Reasonably Foreseeable Projects and Programs

4

The current conditions of study area aquatic resources are the byproduct of past and ongoing human activity and natural processes. The present range and condition of natural communities, covered and noncovered species are described in Section 11.1, *Environmental Setting/Affected Environment*. A brief synopsis of general environmental conditions and their evolution in the study area is presented in Section 11.1.4, *Ecological Processes and Functions* and Section 11.1.5, *Stressors*. This discussion provides a context of current hydrodynamic conditions within the Delta.

9

The various projects and programs listed in Table 11-13 will have cumulative effects on the existing biological resources of the study area over the next 50 years. The most relevant elements of these projects and programs are their ability to modify hydrodynamics in the study area. Many of the projects and programs that would occur under the No Action Alternative in a cumulative scenario would be similar to those included in the BDCP alternatives and would have similar potential effects. These effects would also be similar between the different covered species. For any projects implemented under the NAA that include in-water construction and maintenance activities, there would be the potential to stress, injure, or kill covered fish species through direct or indirect effects, and the potential to alter spawning, rearing and/or migration habitat of covered fish species through direct loss or modification. However, these effects would be mitigated through the environmental permitting processes and project-specific AMMs, BMPs, environmental commitments and/or mitigation measures and there would be no expected adverse effect on covered or non-covered species.

23

Implementation of south Delta export pumping restrictions under the USFWS (2008) and NMFS (2009) BiOps would continue in the No Action Alternative in a cumulative scenario in addition to other improvements in SWP/CVP facilities and operations which would be expected to occur. As a result, effects on covered and non-covered species as a result of entrainment or on spawning and egg incubation, rearing or migration habitat would not be adverse.

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11.3.5.2 Covered Fish Species

Construction and Maintenance of CM1

Impact AQUA-CUM1: Effects of Construction of Facilities on Covered Fish Species

The potential exposure of covered fish species to the cumulative effects of constructing the proposed project and the other projects listed in Table 11-13 include increased turbidity, accidental spills, disturbance of contaminated sediment, underwater noise, fish stranding, in-water work activities, loss of spawning, rearing or migration habitat, and predation. The construction and maintenance activities occurring under the cumulative effects analysis, would have similar effects on all the covered fish species; therefore, the analysis below is combined for all the covered species instead of analyzed by individual species.

Turbidity

As described in detail under Alternative 1A, in-water and nearshore construction and maintenance activities have the potential to generate and release suspended sediments to the water column, altering aquatic habitat conditions the covered species, as well as other fish species occurring in the area.

Construction and maintenance of projects or programs under the Cumulative Effects analysis (Table 11-13), such as the Battle Creek Salmon and Steelhead Restoration Project which would involve substantial in-channel and near-channel construction activities (e.g., dredging, dam removal, bank restructuring), would result in the temporary generation and release of suspended sediments to the water column, and other potential construction-related water quality effects. Similarly, routine construction activities that may occur from urbanization and infrastructure to accommodate population growth would generally be anticipated to involve relatively dispersed, temporary, and intermittent land disturbances across the affected environment. Further, certain maintenance activities, such as levee repair and maintenance, could result in temporary increases in water turbidity. Erosion of disturbed soils and associated sediment load would potentially enter surface water bodies. Increased suspended sediments would temporarily increase water column turbidity, altering habitat conditions in the Plan Area for fish and other aquatic species. However, adverse effects on fish from increases in turbidity during in- or near-water construction and maintenance activities would be minimized through adherence to applicable federal, state, and local regulations. In addition, project-specific designs, BMPs, and environmental commitments would be required to avoid, prevent, or minimize turbidity (e.g., implementation of site-specific erosion and sediment control plans). Each project would also require its own separate environmental compliance process.

As described in Chapter 8, *Water Quality*, water conveyance operations under the NAA would alter the magnitude and timing of water releases from reservoirs upstream of the Delta as well as alter downstream river flows relative to Existing Conditions. Delta turbidity levels are affected by turbidity in Delta inflows (and associated sediment load), and the influence of tidal actions in the Delta, as they relate to re-suspension of sediments. Overall however, the cumulative effects of turbidity would be similar to Existing Conditions, as many of the projects listed in Table 11-13 are on-going, completed, or very similar to activities that already periodically occur in the Plan Area. Therefore, because no significant cumulative changes in turbidity are expected to occur in the long-term upstream of the Delta, in the Plan Area or in the SWP/CVP Export Service Areas, covered fish species would not be adversely affected by turbidity changes.

1 **Accidental Spills**

2 As described in detail under Alternative 1A, in-water and nearshore construction and maintenance
3 activities increase the potential for accidental spills entering the area waterways. Potential
4 construction-related water quality effects associated with the proposed project and other
5 construction projects associated with program actions occurring under the NAA, may include the
6 inadvertent release of construction-related chemicals (e.g., fuels, solvents, and oils) and
7 construction-related wastes (e.g., concrete, asphalt, cleaning agents, paint, and trash) to surface
8 waters, which would result in localized water quality degradation. This could in turn result in
9 adverse effects on covered fish species through direct injury and mortality or delayed effects on
10 growth and survival, depending on the nature and extent of the spill and the contaminants involved.
11 Generally, though, adverse effects on fish from inadvertent spills would be avoided through
12 adherence to applicable federal, state, and local regulations, project-specific design, BMPs, and
13 environmental commitments intended to avoid, prevent or minimize hazardous spills and
14 construction-related hazards and/or mitigate for such occurrences (e.g., spill prevention and control
15 plans and hazardous materials management plans). Each project implemented through the NAA
16 would require its own separate environmental compliance process.

17 **Disturbance of Contaminated Sediments**

18 Sediment in many locations throughout the Plan Area has been affected by historical and current
19 urban discharges (e.g., hydrocarbons, metals, and PCBs), agricultural runoff containing persistent
20 pesticides (e.g., organochlorines), and mercury from historic mining. Projects and programs
21 implemented through the NAA (see Table 11-13) that require in-water construction activities or
22 sediment-disturbing maintenance activities (e.g., periodic channel dredging) have the potential to
23 disturb and re-suspend contaminated sediments, which could result in direct and indirect effects on
24 covered fish species. However, appropriate BMPs are expected to be implemented to minimize the
25 disturbance and redistribution of these sediments, and because the duration of these activities
26 would typically be limited, it is unlikely that exposure would be prolonged and therefore the
27 potential for adverse effects on fish related to toxicants is minimal. Further, exposure of covered fish
28 species to any disturbed contaminated sediments would be minimized by project permit restrictions
29 on in-water work that would limit times to those when covered fish species are least abundant in
30 the construction or maintenance area. Therefore the effect would not be adverse.

31 **Underwater Noise**

32 With the exception of the proposed project, very few projects identified in Table 11-13 would
33 require the installation of extensive in-channel structures where the use of pile driving is necessary
34 (e.g., cofferdams and diversion intakes). Therefore, the potential for adverse cumulative effects on
35 covered fish species would be minimized. As described in detail for Alternative 1A, the effects of
36 exposure to loud underwater noise can range from temporary hearing loss to physical injury
37 sufficient to cause direct mortality or increased predation risks. The degree of effect is a function of
38 the intensity of the sound, the distance from the source, the duration of exposure, the size of the fish
39 exposed (smaller fish are more sensitive), and the species-specific sensitivity.

40 Implementation of Mitigation Measures AQUA-1a and AQUA-1b under the proposed project (see
41 Impact AQUA-1, Alternative 1A) would effectively avoid and minimize adverse effects from impact
42 pile driving. Similar measures are also expected to be required for other projects constructed in the
43 Plan Area, when unmitigated construction noise levels could exceed the potential disturbance or
44 injury thresholds. Therefore, the cumulative effects on covered fish species would be minimized or

1 avoided through project-specific AMMs, BMPs, environmental commitments and/or mitigation
2 measures, which could include seasonal timing restrictions on in-water activities; the use of
3 vibratory pile drivers when possible; the use of noise attenuation devices; and limitations on the
4 duration of impact pile driving activities. In addition, the chance of any individual fish being exposed
5 to more than one project identified in Table 11-13 would be unlikely. Therefore the cumulative
6 effect would not be adverse.

7 **Fish Stranding and Direct Injury**

8 As discussed above, for underwater noise, few projects are expected to require extensive cofferdam
9 construction, and most projects can be implemented in a manner to eliminate or minimize fish
10 stranding effects. In addition, fish would likely avoid the noise and activity of in-water construction
11 and/or maintenance activities. However, direct injury and potential effects of fish stranding would
12 be minimized by implementation of project-specific AMMs, BMPs, environmental commitments
13 and/or mitigation measures, which could include seasonal timing restrictions on in-water activities,
14 and implementation of species-specific fish rescue and salvage plans. As a result, effects would not
15 be adverse.

16 **Loss of Spawning, Rearing, or Migration Habitat**

17 In-water construction and maintenance activities of programs and projects implemented through
18 the late long-term period could temporarily or permanently alter habitat conditions for covered fish
19 species in the vicinity of these activities and thereby adversely affect spawning, rearing and/or
20 migration habitat. For example, any activities that occurs in a species' migration corridor has the
21 potential to affect the behavior (i.e., through a change in migration route within the channel, delay
22 from a noise deterrent, artificial light sources, etc.). Cofferdams used during in-water construction to
23 isolate the work areas, temporarily reduce the width of riverine habitat available to fish for
24 migration and rearing in the area. Further, in-water maintenance activities such as dredging and
25 riprap placement can reduce habitat values. For example, dredging decreases the number of
26 macroinvertebrates in the dredged area, which can cause a temporary loss of prey resources for
27 benthic feeders such as splittail, green sturgeon, and juvenile Chinook salmon.

28 The fish species affected and the severity or magnitude of any adverse effects on spawning, rearing
29 or migration habitat would depend on several factors including the seasonal timing of the activity,
30 the suitability and/or quality of the habitat to begin with, and the quantity of habitat disturbed. As
31 indicated above, for other in-water construction factors, effects are not expected to be adverse due
32 to the implementation of project-specific AMMs, BMPs, environmental commitments and/or
33 mitigation measures, which could include seasonal timing restrictions on in-water activities, and
34 implementation of species-specific fish rescue and salvage plans.

35 **Predation**

36 Programs and projects contributing to the cumulative effects on the covered fish species, that
37 involve the construction of in- and over-water structures (e.g., docks and associated pilings) could
38 potentially result in increased predation relative to Existing Conditions. These types of structures
39 can provide suitable predator habitat by providing shade and cover for predatory fishes, and
40 perching areas for piscivorous birds.

41 Overall, predation risks to covered fish species is expected to increase due to a number of factors,
42 including the continued spread of nonnative species and alteration of habitat conditions in the Plan

1 Area. This includes non-native predator fish species that directly prey on native species, as well as
2 invasive aquatic plants, such as water hyacinth and *Egeria*. Increases in these non-native aquatic
3 vegetation species is believed to provide excellent habitat for nonnative ambush predators, such as
4 bass and sunfish, which prey on native fish species. *Egeria* is thought to reduce turbidity through a
5 reduction in water velocity, which has been hypothesized to increase predation rates on some native
6 fish (Brown and Michniuk 2007).

7 However, structural and operational improvements implemented at the SWP/CVP facilities and
8 programs implemented elsewhere in the Plan Area, to reduce predator habitat, are expected to
9 reduce site-specific predation levels. In addition, the expected amount of in-water and overwater
10 structures likely to be permitted would be small compared to the overall habitat occurring in the
11 Plan Area. Therefore, the effect would not be adverse.

12 **NEPA Effects:** Overall, the potential cumulative effects on covered fish species from construction and
13 maintenance activities occurring in the Plan Area would include effects from increased turbidity,
14 accidental spills, disturbance of contaminated sediment, underwater noise, fish stranding, in-water
15 work activities, loss of spawning, rearing or migration habitat, and predation. These effects would be
16 similar to those described for Alternative 1A (Impact AQUA-1 and Impact AQUA-2), also as
17 described in those sections, these effects would not be adverse because of the limited extent,
18 intensity, and duration of expected construction projects in the Plan Area. In addition, any such
19 construction projects would be subject to a separate environmental compliance process, with
20 permit stipulations which would include the implementation of project-specific AMMs, BMPs,
21 environmental commitments and/or mitigation measures. This would include project-specific
22 erosion and sediment control plans; hazardous materials management plans; SWPPPs; spill
23 prevention and control plans; and limiting in-water activities to periods of low flow and/or to times
24 when covered fish species are not likely to be present.

25 The construction activity with the most potential to affect covered fish species is the installation of
26 cofferdams (pile driving), particularly under the proposed project. While other projects could also
27 require some pile driving activities, the extent and duration of such activities would be substantially
28 less than those of the proposed project. However, the implementation of Mitigation Measures AQUA-
29 1a and AQUA-1b, and other similar measures for other projects, would effectively avoid and
30 minimize adverse effects from impact pile driving. Therefore, the effects of construction and
31 maintenance projects on covered fish species would not be adverse, and no additional mitigation
32 would be required.

33 **CEQA Conclusion:** The potential impact on covered fish species from construction and maintenance
34 activities is considered less than significant due to implementation of the measures described in
35 Appendix 3B, *Environmental Commitments*. Similar measures are expected to be required for other
36 construction and maintenance project occurring in the Plan Area through the late long-term period.
37 These measures would reduce the amount of turbidity from in-water construction and will guide
38 rapid and effective response in the case of inadvertent spills of hazardous materials. Construction
39 would not be expected to increase predation rates relative to Existing Conditions, but would likely
40 result in both temporary and permanent alteration of rearing and migratory habitats used by some
41 or all of the covered fish species. However, these effects are not expected to be significant because
42 the loss of habitat would not be substantial compared to the amount of habitat currently available in
43 combination with the amount of new habitat that would result from restoration actions. Thus, the
44 cumulative effects of most construction or maintenance activities would be less than significant.

1 While most construction activities would result in less-than-significant effects, the direct effects of
2 underwater construction noise from impact pile driving could be a significant impact because of the
3 high likelihood that it would cause injury or death to fish in the immediate vicinity of the activity.
4 However, implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce the
5 potential for effects from underwater noise and would reduce the severity of impacts to a less-than-
6 significant level. Similar measures are expected to be required for other construction and
7 maintenance project occurring in the Plan Area through the late long-term period.

8 **Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects**
9 **of Pile Driving and Other Construction-Related Underwater Noise**

10 Please refer to Mitigation Measure AQUA-1a under Alternative 1A, Impact AQUA-1.

11 **Mitigation Measure AQUA-1b: Use an Attenuation Device to Reduce Effects of Pile Driving**
12 **and Other Construction-Related Underwater Noise**

13 Please refer to Mitigation Measure AQUA-1b under Alternative 1A, Impact AQUA-1.

14 **Impact AQUA-CUM2: Effects of Maintenance of Facilities on Covered Fish Species**

15 **NEPA Effects:** The discussion of maintenance activity effects are provided above with the
16 construction effects (Impact AQUA-CUM1), and the conclusions would also be the same.

17 **CEQA Conclusion:** The conclusion provide above for the construction activity effects (Impact AQUA-
18 CUM1), would typically be very similar to those expected to occur during maintenance activities.

19 **Water Operations of CM1**

20 Operational impacts on fish may include changes in spawning, migration, and rearing habitat
21 associated with changes in Sacramento River and tributary flows due to reservoir operations, water
22 diversions, and the consequent changes in water quality and circulation through the Delta. As
23 indicated in Chapter 5 *Water Supply*, the proposed project alternatives would have varying impacts
24 on water supply, including changes in Delta exports and SWP and CVP deliveries. These impacts
25 range from not adverse to adverse, depending on decreases or increases in exports and/or
26 deliveries. Similarly, cumulative impacts on fish as a result of changes in water operations are likely
27 to vary across alternatives. Considering the projects included in Table 11-13, there are three
28 diversion projects that were not assumed to be operational in the analysis of the action alternatives
29 (e.g., not included in the modeling) but would likely have some impact on water operations as they
30 relate to fish and aquatic resources. Table 11-14 provides a summary of these three projects.

1 **Table 11-14. Effects on Fish from the Programs, Projects, and Policies Considered for Cumulative**
 2 **Analysis**

Agency	Program/Project	Status	Description of Program/Project	Effects on Fish
Contra Costa Water District and Bureau of Reclamation	Los Vaqueros Reservoir Expansion Project	Program under development. Draft EIS/EIR in 2009. Final EIS/EIR in 2010. Completed in 2012.	Project increases the storage capacity of Los Vaqueros Reservoir and diverts additional water from the Delta intake near Rock Slough to fill the additional storage volume (Bureau of Reclamation and Contra Costa Water District 2009).	The Los Vaqueros Expansion Project provides water to South Bay water agencies that otherwise would receive all of their Delta supplies through the existing SWP and CVP export pumps. The purpose of the project is to improve water quality to Bay Area water users and to adjust the pattern of diversions from the Delta to reduce impacts to aquatic resources. The project provides water supplies for previously identified water demands and not for additional non-identified growth. There are no new demands or increased water rights or contract amounts. An environmental impact report has been completed and indicates no significant adverse effects on fish and aquatic resources.
Davis, Woodland, and University of California, Davis	Davis-Woodland Water Supply Project	Program under development. Final EIR in 2009. Specific design and operations criteria not identified, but operation is expected to begin in 2016.	Project that will divert water on the Sacramento River upstream of the American River confluence to be conveyed to a new water treatment plant (City of Davis 2007).	Water diversions under the Davis-Woodland Water Supply Project would be made in compliance with Standard Water Right Permit Term 91, which prohibits surface water diversions when water is being released from CVP or SWP storage reservoirs to meet in-basin entitlements, including water quality and environmental standards for protection of the Sacramento- San Joaquin Delta. Water supply needs during periods applicable to Term 91 would be satisfied by entering into water supply transfer agreements with senior water rights holders within the Sacramento River watershed. The total diversion would be up to 45,000 acre-feet/year. An environmental impact report has been completed and indicates no significant adverse effects on fish and aquatic resources.

Agency	Program/Project	Status	Description of Program/Project	Effects on Fish
U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Services, Department of Water Resources, and Department of Fish and Game	San Joaquin River Restoration Program	Final EIS/EIR and Record of Decision completed in 2011.	Program that aims at restoring flows to the San Joaquin River from Friant Dam to the confluence of Merced River (Bureau of Reclamation 2011).	The San Joaquin River Restoration Program would modify the release pattern of water from Friant Dam into the San Joaquin River, implement a combination of channel and structural modifications along the San Joaquin River below Friant Dam, and reintroduce Chinook salmon into portions of the San Joaquin River. Part or all of water released from Friant Dam could be recirculated to upstream water users. A final environmental impact report has been completed and indicates no significant adverse effects on fish and aquatic resources. The project has the potential to result in beneficial impacts for salmonids.

1

2 All of these projects have completed final environmental documents that analyzed their potential
3 impacts on fish and aquatic resources. According to these documents, the impacts on fish and
4 aquatic resources would be less than significant or less than significant after mitigation measures
5 are implemented.

6 Considering the results of the environmental analyses for these three projects, implementation of
7 these projects in combination with the BDCP, are not anticipated to result in a significant change in
8 flows in the locations considered in environmental documentation for these projects related to
9 surface water resources beyond those changes presented above in the analysis of action
10 alternatives. As a result, no significant changes to the entrainment of covered fish species, as well as
11 the spawning, rearing, and migration habitat conditions for these species is expected beyond those
12 changes presented above in the analysis of action alternatives. The following impact discussions
13 present these conclusions.

14 **Impact AQUA-CUM3: Effects of Water Operations on Entrainment of Covered Fish Species**

15 Numerous methods were used to estimate entrainment losses under the NAA, and a complete
16 analysis can be found in the *BDCP Effects Analysis – Appendix B, Entrainment, Section B.5 – Methods of
17 Biological Analysis (hereby incorporated by reference)*. Overall the primary mechanism for
18 entrainment losses in the Plan Area is the operation of the existing south Delta export facilities, and
19 the implementation of the proposed project would be the primary mechanism for altering the level
20 of these entrainment losses. Therefore, the modeling results from Alternative 1A (see Impact AQUA-
21 3) provide an approximation of the maximum cumulative effects on entrainment in the Plan Area.
22 Simulations of entrainment conditions differ depending on the time period modeled, although the
23 average annual proportion of covered fish populations, lost to entrainment at the south Delta
24 facilities under Existing Conditions, increased under model simulations of the NAA. These results
25 were most notably in wet, above-normal and below-normal water years. This proportional

1 entrainment loss solely reflects variability attributable to simulated differences in south Delta
2 export pumping (which influences OMR flows) and X2 flows. Despite these modeled increases in
3 entrainment, the differences are not expected to reach the level of adverse effects on covered fish
4 species populations (less than 5% of the population), primarily due to the implementation of
5 restrictions implemented as part of the USFWS 2008 BiOp, and continued improvements in water
6 export and fish salvage operations, as well as efforts to divert covered fish species from exposure to
7 the south Delta facilities.

8 There is also no evidence of substantial entrainment at other intakes in the Plan Area, and any future
9 intakes, including the three projects in Table 11-14, would be screened appropriately to minimize or
10 eliminate entrainment, although some entrainment will continue to occur. Whatever entrainment is
11 occurring would be reduced by continued efforts to screen the existing intakes in the Plan Area.
12 While the effectiveness of the salvage operations at the south Delta facilities is relatively low, it has
13 improved in recent years, and will continue to improve in the future (U.S. Fish and Wildlife Service
14 2008a). A substantial portion of this improvement would occur through the reduced use of the
15 SWP/CVP south Delta facilities as part of the proposed project.

16 General improvements implemented during the NAA timeframe are expected to reduce entrainment
17 losses of covered fish species through the implementation of the NMFS and USFWS BiOp
18 requirements (National Marine Fisheries Service 2009; U.S. Fish and Wildlife Service 2008a),
19 particularly the reverse OMR flow criteria, court-ordered restrictions on water operations, and
20 actions taken by the water project operators in accordance with biological opinions (National
21 Marine Fisheries Service 2009; U.S. Fish and Wildlife Service 2008). In addition, on-going and future
22 operational improvements at the SWP/CVP south Delta facilities, and reduced use of these facilities
23 under the proposed project, are expected to continue to reduce the rate of entrainment from water
24 exports from the Delta, under the NAA.

25 **NEPA Effects:** The cumulative effects of water operations on entrainment would not be adverse to
26 the covered fish species.

27 **CEQA Conclusion:** Implementation of south Delta export pumping restrictions under the NMFS and
28 USFWS BiOp requirements (National Marine Fisheries Service 2009; U.S. Fish and Wildlife Service
29 2008a) has considerably limited entrainment loss of covered fish species. This would continue into
30 the future, under the cumulative effects assumptions, along with enhancements to reduce overall
31 entrainment at the SWP/CVP facilities and improve operation procedures. The reduced use of the
32 SWP/CVP south Delta facilities is also expected to substantially reduce overall entrainment rates
33 from water exports in the Delta. Therefore, the effect would be less than significant and no
34 mitigation would be required.

35 **Impact AQUA-CUM4: Effects of Water Operations on Spawning and Egg Incubation Habitat for** 36 **Covered Fish Species**

37 **NEPA Effects:** Hydrology would change under implementation of the action alternatives, as
38 previously described in this chapter. These changes are a result of implementing the various
39 operational scenarios associated with each alternative. The three diversion-related projects in Table
40 11-14 also have the potential to change hydrology and/or spawning habitat. Cumulative effects to
41 the extent and quality of spawning habitat would occur if physical habitat was modified or if changes
42 in flow on the Sacramento and San Joaquin rivers and/or their tributaries result in substantially
43 reduced spawning habitat, increased water temperatures, or increased occurrences of redd
44 dewatering. However, the analyses for these projects indicates that there would not be any adverse

1 effects on fish and aquatic resources, including spawning habitat. Therefore, the cumulative effects
2 would be effectively approximated by the analyses conducted for the various action alternatives. As
3 a result, implementation of these projects in combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9
4 would result in cumulative adverse effects on spawning habitat. However, implementation of these
5 projects in combination with the BDCP (Alternative 4) would not result in cumulative adverse
6 effects on spawning habitat.

7 **CEQA Conclusion:** Implementation of the three diversion-related projects in Table 11-14 in
8 combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in significant cumulative impacts
9 on spawning habitat. However, implementation of these projects in combination with the BDCP
10 (Alternative 4) would not result in significant cumulative impacts on spawning habitat.

11 **Impact AQUA-CUM5: Effects of Water Operations on Rearing Habitat for Covered Fish Species**

12 **NEPA Effects:** Hydrology would change under implementation of the action alternatives, as
13 previously described in this chapter. These changes are a result of implementing the various
14 operational scenarios associated with each alternative. The three diversion-related projects in Table
15 11-14 also have the potential to change hydrology and/or rearing habitat. Cumulative effects to the
16 extent and quality of rearing habitat would occur if physical habitat was modified or if changes in
17 flow on the Sacramento and San Joaquin rivers and/or their tributaries result in substantially
18 reduced rearing habitat because of substantially reduced Delta outflow or increased water
19 temperatures. However, the analyses for these projects indicates that there would not be any
20 adverse effects on fish and aquatic resources, including rearing habitat. Therefore, the cumulative
21 effects would be effectively approximated by the analyses conducted for the various action
22 alternatives. As a result, implementation of these projects in combination with Alternatives 1, 2, 3, 5,
23 6, 7, 8, and 9 would result in cumulative adverse effects on rearing habitat. However,
24 implementation of these projects in combination with Alternative 4 would not result in cumulative
25 adverse effects on rearing habitat.

26 **CEQA Conclusion:** Implementation of the three diversion-related projects in Table 11-14 in
27 combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in significant cumulative impacts
28 on rearing habitat. However, implementation of these projects in combination with BDCP
29 (Alternative 4) would not result in significant cumulative impacts on rearing habitat.

30 **Impact AQUA-CUM6: Effects of Water Operations on Migration Habitat for Covered Fish** 31 **Species**

32 **NEPA Effects:** Hydrology would change under implementation of the action alternatives, as
33 previously described in this chapter. These changes are a result of implementing the various
34 operational scenarios associated with each alternative. The three diversion-related projects in Table
35 11-14 also have the potential to change hydrology and/or migration habitat. Cumulative impacts to
36 migration habitat would occur if changes in flow on the Sacramento and San Joaquin Rivers and/or
37 their tributaries result in substantially reduced migration habitat because of reduced flows or
38 increased water temperatures, which provide environmental cues for some species to trigger the
39 timing of migration. However, the analyses for these projects indicates that there would not be any
40 adverse effects on fish and aquatic resources, including migration habitat. Therefore, the cumulative
41 effects would be effectively approximated by the analyses conducted for the various action
42 alternatives. As a result, implementation of these projects in combination with Alternatives 1, 2, 3, 5,
43 6, 7, 8, and 9 would result in cumulative adverse effects on migration habitat. However,

1 implementation of these projects in combination with Alternative 4 would not result in cumulative
2 adverse effects on migration habitat.

3 **CEQA Conclusion:** Implementation of the three diversion-related projects in Table 11-14 in
4 combination with Alternatives 1, 2, 3, 5, 6, 7, 8, and 9 would result in significant cumulative impacts
5 on migration habitat. However, implementation of these projects in combination with the BDCP
6 (Alternative 4) would not result in significant cumulative impacts on migration habitat.

7 **Restoration Measures (CM2, CM4–CM7, and CM10)**

8 The BDCP conservation measures include implementation of a suite of restoration activities
9 intended to offset and mitigate for the short- and long-term effects on habitat conditions for the
10 covered fish species. These effects are also expected to be similar to those resulting from the other
11 programs and projects listed in Table 11-13. Therefore, the cumulative effects would incrementally
12 alter the relative level of the effects, but not significantly change the nature of the effects.

13 **NEPA Effects:** Overall, the implementation of the conservation measures would result in short-term
14 negative effects on habitat conditions, but the long-term effects would generally be beneficial to the
15 covered fish species. These short-term effects could include the potential for increased turbidity and
16 methylmercury exposure, accident spills, disturbance of contaminated sediments, disturbance from
17 in-water activities, and increased predation.

18 Even with the large areas of proposed restoration provided by the BDCP, and the other projects and
19 programs throughout the Plan Area, these activities would occur over a number of years. As a result,
20 simultaneous restoration projects would likely be limited and dispersed, and would have minimal
21 potential for cumulative adverse effects. Therefore, the cumulative effects from short-term
22 restoration activities are not adverse to the covered species, and any effects would likely be
23 localized, sporadic, and of low magnitude, and would be more than offset by the collective benefits
24 of broad-scale habitat restoration programs throughout the Plan Area. Therefore the cumulative
25 effect would be beneficial, and no additional mitigation would be required.

26 **CEQA Conclusion:** Habitat restoration activities could result in short-term effects on covered fish
27 species, primarily as a result of the potential for increased turbidity and potential for contaminated
28 sediments to enter the water column. Given the minimal extent of anticipated adverse impacts and
29 the substantial net-benefits of habitat restoration, these impacts would be less than significant and
30 no additional mitigation would be necessary.

31 **Other Conservation Measures (CM12–CM19 and CM21)**

32 In addition to the conservation measures related to habitat restoration actions, the BDCP includes
33 conservation measures that improve existing habitat conditions or enhance fish populations. As
34 with the restoration conservation measures, the cumulative effects of these other conservation
35 measures would include similar corresponding activities occurring through other projects or
36 programs in the Plan Area (see Table 11-13). Overall, the effects of most of these measures would be
37 individually and cumulatively beneficial. The following assessment is based on the more detailed
38 analysis included in BDCP *Effects Analysis – Appendix F, Biological Stressors (hereby incorporated by*
39 *reference)*.

40 As indicated above, the BDCP would provide a long-term comprehensive program to address a wide
41 range of stressors on the covered fish species, and some existing and future conservation measures

1 would complement and cumulatively add to the overall effectiveness of these programs. For
2 example, CM12 *Methylmercury Management* will be developed and implemented in coordination
3 with efforts of the Central Valley Regional Water Quality Control Board to comply with
4 Methylmercury TMDL standards. This conservation measure will minimize conditions that promote
5 production of methylmercury in restored areas and its subsequent introduction to the foodweb and
6 the covered species. Modeling of water operations effects of the BDCP show little changes in
7 methylmercury concentrations in water or fish tissue, although methylmercury concentrations in
8 both media would be expected to continue to exceed criteria under all the action alternatives.

9 Under CM13 *Invasive Aquatic Vegetation Control*, the BDCP would contribute to the control of
10 invasive species in the Plan Area, through chemical and mechanical treatment in BDCP restoration
11 sites, to ensure that the benefits of these restoration projects are not eroded by invasive vegetation
12 expansion. The BDCP will provide additional funding for project such as the current California
13 Department of Boating and Waterways (DBW) water hyacinth and *Egeria densa* control programs,
14 and the DWR Watercraft Inspection Program to reduce the spread of invasive aquatic vegetation.
15 Under CM13 *Invasive Aquatic Vegetation Control*, BDCP is expected to treat an average of 1,679–
16 3,358 acres per year of tidal habitat throughout the Delta (5–10% of the acreage of tidal habitat
17 areas within and outside restoration sites).

18 The BDCP (CM14 *Stockton Deep Water Ship Channel Dissolved Oxygen Levels*) would provide funding
19 for the continued operation of an aeration facility in the ship channel, as well as the implementation
20 of measures to improve the facility's effectiveness in meeting BDCP biological goals and objectives.
21 This conservation measure would also coordinate with the Central Valley Regional Water Quality
22 Control Board to meet EPA water quality standards with regard to the established dissolve oxygen
23 TMDL requirements.

24 While existing predator control measures would also continue to be implemented, the BDCP (CM15
25 *Predator Control*) would provide additional funding to expand the programs, and more effectively
26 target specific predation hot spot areas. This conservation measure would be implemented in
27 conjunction with other measures, such as CM13, *Invasive Aquatic Vegetation Control*, to reduce
28 predator habitat as well the direct reduction of predator populations.

29 Similarly, the BDCP (CM16 *Nonphysical Fish Barriers*) would enhance and expand the current DWR
30 program for installing non-physical fish barriers to increase survival of covered fish in the Delta.
31 Non-physical barriers control the distribution of covered fish species to minimize movements into
32 areas of high predation or entrainment risks. This conservation measure is expected to benefit some
33 of the covered fish species (particularly juvenile salmonids), although these structures have not
34 been proven to be effective to deter such species as delta smelt and longfin smelt.

35 The expansion of the existing DFG's Delta-Bay Enhanced Enforcement Program, through the
36 BDCP (CM17 *Illegal Harvest Reduction*), would further reduce the illegal harvest of covered fish
37 species. Implementation of this conservation measure will provide funds to DFG to hire and equip
38 about 17 additional game wardens assigned to the Delta-Bay Enhanced Enforcement Program.
39 Enhanced enforcement on poaching will contribute toward reducing mortality and potentially
40 increasing population sizes of covered species, such as sturgeon, Chinook salmon (all races),
41 steelhead and Sacramento splittail.

42 While the existing University of California, Davis conservation hatchery would continue to operate,
43 the BDCP (CM18 *Conservation Hatcheries*) would provide additional funding and support to improve
44 the performance and/or biological effectiveness of the program through the adaptive management

1 and monitoring process. The goals of this conservation measure is to expand the refugial
2 populations of delta smelt and longfin smelt, and maintain them over the long term.

3 The implementation of CM19 *Urban Stormwater Treatment*, under the BDCP, would provide an
4 additional source of funding for grants to entities such as the Sacramento Stormwater Quality
5 Partnership, and area cities and counties, whose stormwater contributes to Delta waterways under
6 NPDES MS4 stormwater permits. These grants would help to implement actions from, and in
7 addition to, their respective stormwater management plans. Reducing the amount of pollution in
8 stormwater runoff entering Delta waterways will benefit delta smelt, white sturgeon, steelhead, and
9 Chinook salmon (Essex Partnership DRERIP 2009).

10 Upgrades to existing nonproject diversions to reduce entrainment of covered fish species, and their
11 prey, would also continue to occur over time under the BDCP (CM21 *Nonproject Diversions*). There
12 are currently over 2,500 nonproject diversions in the Plan Area, used primarily for diverting water
13 for agriculture, and about 95% of these diversions are unscreened (Herren and Kawasaki 2001).
14 Currently, Reclamation's Anadromous Fish Screen Program and DFG's Fish Screen and Passage
15 Program are available to update nonproject diversions, and have implemented over 30 projects in
16 recent years throughout the Central Valley, but these programs primarily focus on providing
17 benefits to anadromous salmonids. CM21, *Nonproject Diversions* would provide additional protection
18 for salmonids, as well as for the other covered fish species. Addressing these other species is
19 expected to reduce entrainment of all fish species occurring in the Plan Area.

20 **Summary**

21 As indicated above, the BDCP would provide a long-term comprehensive program to address
22 stressors on the covered fish, and would also complement other existing and future conservation
23 measures in the Plan Area. For example, CM12 *Methylmercury Management* will be developed and
24 implemented in coordination with efforts of the Central Valley Regional Water Quality Control
25 Board to comply with Methylmercury TMDL standards. Ongoing efforts to control invasive aquatic
26 vegetation by DWR will be supplemented by the BDCP (CM13 *Invasive Aquatic Vegetation Control*)
27 through additional programs and as a direct funding source. Implementation of CM14 *Stockton Deep*
28 *Water Ship Channel Dissolved Oxygen Levels* would also provide funding for the continued operation
29 of an aeration facility in the ship channel, as well as the implementation of measures to improve the
30 facility's effectiveness in meeting BDCP biological goals and objectives. This conservation measure
31 would also be coordinated with the Central Valley Regional Water Quality Control Board efforts, to
32 meet EPA water quality standards with regard to the established dissolve oxygen TMDL
33 requirements.

34 While existing predator control measures would also continue to be implemented, the BDCP (CM15
35 *Predator Control*) would expand these efforts and provide direct funding for some of these existing
36 efforts. Similarly, implementation of CM16 *Nonphysical Fish Barriers* will supplement existing efforts
37 by DWR to install non-physical fish barriers to increase survival of juvenile salmonids in the Delta,
38 and expand similar protection to the other covered fish species. The expansion of the existing DFG's
39 Delta-Bay Enhanced Enforcement Program, through the implementation of the BDCP (CM17
40 *Illegal Harvest Reduction*), would further reduce the illegal harvest of covered fish species,
41 particularly sturgeon, salmon and steelhead. While the existing University of California, Davis
42 conservation hatchery would also continue to operate, the BDCP (CM18 *Conservation Hatcheries*)
43 would provide additional funding and monitoring efforts to improve the efficiency and effectiveness
44 of the program into the future.

1 All major urban centers in the Delta, including Sacramento, Stockton, and Tracy, and multiple
2 smaller cities will continue to comply with National Pollutant Discharge Elimination System
3 (NPDES) MS4 permits to develop and implement a stormwater management plan or program with
4 the goal of reducing the discharge of pollutants under the Clean Water Act (CWA). The
5 implementation of CM19 *Urban Stormwater Treatment* under the BDCP, would provide an additional
6 source of funding for these and other entities in the Plan Area to implement these programs.

7 **NEPA Effects:** These BDCP conservation measures are intended to reduce stressors to covered
8 species and have overall neutral or beneficial effects. They would also be compatible with existing
9 and expected future measures implemented in the Plan Area, thereby enhancing the prospects of
10 benefitting the covered species. Therefore, the overall effects would be beneficial.

11 **CEQA Conclusion:** As indicated above, the conservation measures included in the BDCP are designed
12 specifically to benefit the covered fish species. When these are implemented in coordination with, or
13 in addition to, existing or future conservation measures occurring throughout the Plan Area, the
14 cumulative effect would be an overall benefit to the covered species. Therefore, the effect would be
15 less than significant.

16 **11.3.5.3 Non-Covered Fish Species of Primary Concern**

17 **Construction and Maintenance of CM1**

18 The cumulative effects of construction and maintenance activities occurring in the Plan Area, with
19 the implementation of the BDCP, would be similar for both the covered and non-covered fish
20 species. These effects would also be similar for all the non-covered species; therefore, the analysis
21 below is combined for all non-covered species instead of analyzed by individual species.

22 **Impact AQUA-CUM7: Effects of Construction of Facilities on Non-Covered Fish Species**

23 Refer to Impact AQUA-199 under Alternative 1A for a detailed discussion of the types of effects that
24 in-water and near water construction and restoration activities would have on the non-covered fish
25 species of primary concern, as these types of effects would be similar for all such construction
26 activities expected to occur in the Plan Area. As indicated above, for the covered fish species (Impact
27 AQUA-CUM1), potential mechanisms of cumulative effects on non-covered fish species would
28 include turbidity, accidental spills, disturbance of contaminated sediment, underwater noise, fish
29 stranding, in-water work activities, loss of spawning, rearing or migration habitat, and increased
30 predation. However, as described above for the covered fish species, the cumulative effects would
31 not be adverse because of the limited extent, intensity, and duration of expected construction
32 projects occurring outside of the BDCP activities.

33 In addition, any such construction projects would be subject to separate environmental compliance
34 processes, with permit stipulations which would include the implementation of project-specific
35 AMMs, BMPs, environmental commitments, and mitigation measures. This would include project-
36 specific erosion and sediment control plans; hazardous materials management plans; SWPPPs; spill
37 prevention and control plans; and limiting in-water activities to periods of low flow and/or to times
38 when non-covered fish species are not likely to be present.

39 **NEPA Effects:** The cumulative effects of construction projects on the non-covered fish species of
40 primary concern would not be adverse.

1 **CEQA Conclusion:** For any projects implemented within the NAA, that include in-water construction
2 and maintenance activities, there would be the potential to stress, injure, or kill non-covered fish
3 species through direct or indirect effects, and the potential to alter spawning, rearing and/or
4 migration habitat of non-covered fish species through direct loss or modification. However, such
5 projects would be subject to specific environmental permitting processes, which would minimize
6 potential effects through the implementation of project-specific AMMs, BMPs, environmental
7 commitments and/or mitigation measures. Thus, the construction-related cumulative effects would
8 be less than significant, and no additional mitigation would be required.

9 **Impact AQUA-CUM8: Effects of Maintenance of Facilities on Non-Covered Fish Species**

10 **NEPA Effects:** The discussion of potential maintenance activity effects would be similar to the
11 discussion provided above with the construction effects (Impact AQUA-CUM1) on the covered fish
12 species, and as concluded, the effect would not be adverse.

13 **CEQA Conclusion:** The conclusion provided above for the construction activity effects (Impact
14 AQUA-CUM1), would typically be very similar to those expected to occur during maintenance
15 activities. Thus, the effect would be less than significant, and no additional mitigation would be
16 required.

17 **Water Operations of CM1**

18 **Impact AQUA-CUM9: Effects of Water Operations on Entrainment of Non-Covered Fish Species**

19 Under Existing Conditions, non-covered fish species are expected to occur in salvage operations at
20 the south Delta facilities throughout the year. This would include eggs, larvae, juvenile, and adult life
21 stages of the various fish species entrained at varying times of the year. The implementation of the
22 BDCP would reduce the use of the south Delta facilities, while proportionally increasing the use of
23 the proposed north Delta facilities, which would be designed to minimize entrainment of all fish
24 species. The increased flexibility in operations provided by the addition of the north Delta export
25 facilities, improvements at the south Delta facilities over time in the water export operations and the
26 salvage processes, and the continued implementation of retrofitting programs for other diversions
27 throughout the Plan Area, are expected to reduce the overall rate of entrainment and loss for all fish
28 species over time.

29 **NEPA Effects:** The cumulative effect on entrainment of the non-covered fish species would not be
30 adverse.

31 **CEQA Conclusion:** The impact of water operations on entrainment of non-covered fish species
32 would be the same as described immediately above. The cumulative effects would likely be a
33 substantial reduction in the entrainment of all fish species occurring in the Plan Area, including the
34 non-covered fish populations. Thus, the impact would be less than significant and no mitigation
35 would be required.

36 **Impact AQUA-CUM10: Effects of Water Operations on Spawning and Egg Incubation Habitat 37 for Non-Covered Fish Species**

38 **NEPA Effects:** Refer to Impact AQUA-202 under Alternative 1A for a detailed discussion of the types
39 of effects expected to occur from water export operations on the non-covered fish species occurring
40 in the Plan Area. These types of effects would continue into the future, although the distribution or

1 magnitude of effects would vary depending on the differential use of the south and north Delta
2 facilities. The overall results indicate that the operational effects would not be adverse, because they
3 would not result in a substantial reduction in spawning habitat for any of the non-covered fish
4 species of primary concern. In addition, the cumulative effects would also not be adverse for these
5 same reasons.

6 **CEQA Conclusion:** As discussed above, and in Impact AQUA-202 under Alternative 1A for non-
7 covered fish species, the increased operational flexibility provided by the north Delta facilities is
8 expected to reduce potential effects of water operations on the non-covered fish species, compared
9 to existing water operations. The results indicate that the operational effects would not result in a
10 substantial reduction in spawning habitat for any of the non-covered fish species of primary
11 concern. Therefore, the cumulative effects would be less than significant, and no mitigation is
12 necessary.

13 **Impact AQUA-CUM11: Effects of Water Operations on Rearing Habitat for Non-Covered Fish** 14 **Species**

15 **NEPA Effects:** Refer to Impact AQUA-203 under Alternative 1A for a detailed discussion of the types
16 of effects expected to occur from water export operations on the non-covered fish species, as these
17 types of effects would continue into the future. These results indicate that the operational effects
18 would not be adverse, because they would not result in a substantial reduction in the rearing habitat
19 for any of the non-covered fish species of primary concern. In addition, the cumulative effects would
20 also not be adverse for these same reasons.

21 **CEQA Conclusion:** As discussed above, and in Impact AQUA-203 for Alternative 1A for non-covered
22 fish species, the increased operational flexibility provided by the north Delta facilities, is expected to
23 reduce potential effects on the non-covered fish species of primary concern to some degree. Overall,
24 the operational effects would not result in a substantial reduction in rearing habitat for any of the
25 non-covered fish species of primary concern. Similarly, the cumulative effects would be less than
26 significant, and no mitigation is necessary.

27 **Impact AQUA-CUM12: Effects of water operations on migration habitat for non-covered fish** 28 **species**

29 **NEPA Effects:** Refer to Impact AQUA-204 under Alternative 1A for a detailed discussion of the types
30 of effects from water export operations on the migration habitat for non-covered fish species, as
31 these types of effects would continue to occur into the future. The results indicate that the
32 operational effects would not be adverse, because they would not result in a substantial change in
33 migration habitat conditions for any of the non-covered fish species of primary concern. The
34 cumulative effects would also not be adverse for these same reasons.

35 **CEQA Conclusion:** Refer to Impact AQUA-204 under Alternative 1A for non-covered fish species for
36 a detailed discussion of the potential effects of water operations on the migration habitat for the
37 non-covered fish species of primary concern. The results indicate that the operational effects would
38 not result in a substantial reduction in migration habitat conditions for any of the non-covered fish
39 species of primary concern. Similarly, the cumulative effects would be less than significant, and no
40 mitigation is necessary.

1 **Restoration Measures (CM2, CM4–CM7, and CM10)**

2 As described in detail above for the covered fish species, the BDCP would implement a large-scale,
3 long-term comprehensive habitat restoration program in the Plan Area. In addition, restoration
4 activities from other programs in the region would also continue to be implemented, although the
5 extent of these activities would typically be limited compared to the size and distribution of the
6 BDCP activities. All of these restoration activities would include enhancing existing habitat,
7 breaching levees and converting agricultural and other upland areas to tidal, shallow water, open
8 water, and floodplain habitats, as well as enhancement of channel margin habitat.

9 **NEPA Effects:** The overall scope of these restoration actions are expected to result in a substantial
10 improvement in the aquatic habitat condition in the Plan Area, improving conditions for all fish
11 species, including the non-covered fish species of primary concern. As the intended purpose of these
12 restoration measures is to benefit aquatic species, the cumulative effects would not be adverse.

13 **CEQA Conclusion:** As described above, the BDCP would implement a large-scale, long-term
14 comprehensive habitat restoration program, which would be compatible with other restoration
15 actions expected to occur in the Plan Area. The cumulative effect of these habitat improvements is
16 expected to be beneficial to both the covered and non-covered fish species. Therefore the effect
17 would be less than significant, and no additional mitigation would be required.

18 **Other Conservation Measures (CM12–CM19 and CM21)**

19 As indicated above for the covered fish species, the BDCP would provide a long-term comprehensive
20 program to address various stressors on the non-covered fish species of primary concern. These
21 measures would also complement other conservation measures expected to occur in the Plan Area,
22 and the overall effects are expected to be beneficial on the non-covered fish species of primary
23 concern. However, the conservation measures would not necessarily be beneficial for all the non-
24 covered species of primary management concern. For example, the effects of invasive aquatic
25 vegetation control would result in minor differences for predatory species (striped bass and
26 largemouth bass), and for Sacramento tule perch. Invasive aquatic vegetation provides hiding
27 habitat for predatory fish which improves their hunting success, and Sacramento tule perch use the
28 cover of aquatic plants for rearing. Consequently, reducing the amount of invasive aquatic
29 vegetation would negatively affect these species. However, the effects would not substantially
30 reduce the ability of the predatory species to hunt and there will still be substantial areas of suitable
31 habitat in the Plan Area for these species.

32 **NEPA Effects:** In addition to the effects of aquatic vegetation control on habitat conditions for some
33 non-covered aquatic species, the effects of *CM15, Predator Control* would have a direct effect the
34 predatory species that are included as non-covered species of primary concern. These include
35 largemouth and striped bass. However, the numbers of predatory fish are high and the extent of the
36 habitats in which they hunt is extensive. Therefore the effects of this management would not be
37 adverse.

38 **CEQA Conclusion:** As indicated above, the conservation measures included in the BDCP are designed
39 to benefit both covered and non-covered fish species, and would complement other conservation
40 measures expected to occur throughout the Plan Area in the future. The results of these measures
41 are expected to be beneficial for most species of primary concern, although *CM13, Invasive Aquatic*
42 *Vegetation Control* and *CM15, Predator Control* would negatively affect several of the species of
43 primary concern. However, even when combined with similar programs occurring, or expected to

1 occur, in the Plan Area in the future, the effects would be limited. In addition, the large population
 2 size of these predators, and the substantial amount of habitat available to these species in the Plan
 3 Area, would also minimize the potential for negative effects. Therefore, the cumulative effects of CMs
 4 12–19 and 21 would be less than significant, and no mitigation would be required.

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