water quality and habitat conditions, impacts on splittail would be less than significant. Consequently, no mitigation is required.

Impact AQUA-121: Effects of Localized Reduction of Predatory Fish on Sacramento Splittail (Environmental Commitment 15)

NEPA Effects: Potential impacts on Sacramento splittail from predator removal at the north Delta intakes and at the south Delta export facilities is expected to slightly reduce the predation rates on Sacramento splittail. However and as concluded for Alternative 1A (Impact AQUA-121), because the affected proportion of the population would be very small this effect would not be detectable. There would not be an adverse effect on splittail.

CEQA Conclusion: Because the proportion of the population affected by Environmental Commitment 15 would be very small and not measurable, there would be a less than significant impact to splittail. Consequently, no mitigation would be required.

Impact AQUA-122: Effects of Nonphysical Fish Barriers on Sacramento Splittail (Environmental Commitment 16)

As described for Alternative 1A, although the NPB at the divergence of Georgiana Slough from the Sacramento River under Alternative 4A would be constructed and operated to benefit salmonids, Sacramento splittail are likely to also be deterred by the NPB based on their hearing ability and strong swimming ability as young juveniles. This would reduce the risk of predation for juvenile splittail by reducing their entry into the low-survival interior Delta.

NEPA Effects: The NPB also has the potential to attract predatory fish, which often hold around underwater human-made structure. Therefore, there is a slightly increased risk of predation for juvenile Sacramento splittail in the area immediately around the NPB. However, the structure is intended to promote successful survival of salmonids and designs are being tested to minimize any risk of predation associated with the structure. Additionally, the 2011 pilot study of the NPB at Georgiana Slough did not find that predation near the NPB was more frequent than predation farther from the NPB (DWR 2012). As such, the overall effects of NPB would not be adverse.

CEQA Conclusion: As described for Alternative 1A, the first months of the juvenile Sacramento splittail migration to the Delta overlap with the latter portion of the main juvenile salmonid outmigration period during which the NPB would be implemented. Deterrence away from the interior Delta would reduce the risk of predation for juvenile splittail, although the NPB also has the potential to attract predatory fish, which often hold around underwater human-made structures. Therefore, there is a slightly increased risk of predation for juvenile Sacramento splittail in the area immediately around the NPB. However the overall impacts of the NPB are expected to be less than significant on Sacramento splittail because they would reduce entry into the low-survival interior Delta, where entrainment and predation potential increases. Consequently, no mitigation would be required.

Green Sturgeon

Construction and Maintenance of Water Conveyance Facilities

The discussion of potential effects to delta smelt from construction and maintenance of the water conveyance facilities under Alternative 4A is also relevant to green sturgeon. Adult and juvenile green sturgeon would have the potential to encounter construction and maintenance because of their presence in the Delta for considerable periods of time (Table 11-8).

Impact AQUA-127: Effects of Construction of Water Conveyance Facilities on Green Sturgeon

The potential effects of construction of the water conveyance facilities on green sturgeon or their designated critical habitat would be the same as described for Alternative 4 (Impact AQUA-127). This section provides additional detail on underwater noise impacts which are also applicable to Impact AQUA-127 in Alternative 4.

Table 11-8 presents the life stages of green sturgeon and months of their potential presence in the north, east, and south Delta during the proposed in-water construction window (June 1–October 31). Based on the proposed timing of pile driving activities and the occurrence of sensitive life stages of the covered species in the affected reaches, green sturgeon are considered most vulnerable to pile driving impacts because of their potential year-round presence in the plan area.

Under Alternative 4A, impact pile driving could result in exposure of juvenile and adult green sturgeon to underwater noise levels exceeding the injury thresholds at a number of construction sites where in-water pile driving is proposed. The potential for exposure of adults and juveniles to pile driving noise is highest in the north Delta (Sacramento River in the vicinity of the three proposed intakes) which serves as the primary migration route utilized by adults to access upstream spawning areas, and the primary migration route for juveniles entering the Delta from natal rearing areas in the upper Sacramento River. Restricting impact pile driving to June 1 to October 31 avoids the peak periods of upstream migration of adults (late February to early May) although some adults may migrate through the Delta as late as June or July. Some adults may also be exposed to pile driving noise during their outmigration; outmigration of tagged adults has been observed during summer (June–August) and late fall or winter (November-December) coincident with increases in flow from the first significant rain events (Heublein et al. 2009). Juvenile and sub-adult green sturgeon may be present in the Delta year-round and therefore subject to pile driving noise during pile driving activities at the proposed intakes, barge landings, and other in-water structures. Following the larval rearing period, young-of-the-year juveniles enter the Delta where they continue to rear for up to three years before entering the ocean. Fish salvage data collected at the state and federal water export facilities in the southern Delta indicate that juvenile green sturgeon in the Delta range in length from 100 to 600 mm, with most being greater than 200 mm (Adams et al. 2002, Beamesderfer et al. 2007).

Several factors likely reduce the potential for injury or mortality of adult and juvenile sturgeon during pile driving activities at the proposed intake structures. As described earlier, the estimated impact distances above are worst-case estimates based on impact driving in open water with no attenuation measures and an unimpeded underwater propagation path. To mitigate potential adverse effects, DWR proposes to use vibratory driving to the extent feasible to minimize both the area and duration of potentially harmful underwater noise levels associated with impact driving in open water outside the work window (Mitigation Measure AQUA-1a). In addition, construction of the intake facilities would be spread out over a period of five years, limiting the number of sites where pile driving will take place and the duration of impact driving in any given year (Table 4.3.7-1 under Delta Smelt). Although pile driving activities could occur 42 to 55 days per season at each intake location, in-water pile driving will not be continuous and limited to daylight hours only, resulting in 12-16 hour periods each day for migrating fish to pass the construction sites undisturbed.

Several aspects of green sturgeon life history and biology also affect the potential for injury or mortality of adult and juvenile green sturgeon to pile driving noise. All in-water pile driving will be performed after June 1 and before October 31, avoiding the primary upstream and downstream migration periods of pre- and post-spawning adults. Adult sturgeon are large (>19 kilograms) and presumably much less vulnerable to pile driving noise than smaller fish (approximately 2 grams or smaller) protected by the SPL and SEL injury criteria. In addition, adult sturgeon are highly mobile and thus able to rapidly avoid or swim away from areas of elevated noise. Their exposure would also be limited by their rapid migration rate; recent telemetry studies indicate that adult green sturgeon migrate rapidly to and from spawning areas in the upper Sacramento River, traversing the estuary and Delta in less than one week (Heublein et al. 2009). The behavioral responses of green sturgeon to pile driving noise are unknown but could include disruptions of normal migratory behavior and potential delays in migration. However, given the intermittent nature of pile driving and the daily cessation of pile driving at night, such delays are expected to be minor and not affect the ability of adults to successfully reach the spawning grounds.

Because of their relatively small body size, widespread distribution, and year-round presence in the Delta and estuary, juvenile and sub-adult green sturgeon are at higher risk of injury and mortality to pile driving noise than adults. Similar to adults, the potential for exposure to pile driving noise is highest in the North Delta (Sacramento River in the vicinity of the three proposed intakes) which serves as the primary migration route for young-of-the-year juveniles entering the Delta from natal rearing areas in the upper Sacramento River. Based on the size distribution of juveniles observed at the export facilities in the southern Delta, most juveniles entering the Delta would be expected to be actively swimming juveniles (>100 mm in length) capable of avoiding or swimming away from areas of elevated noise. Because juveniles spend the majority of their lives in deep brackish portions of the estuary before entering the ocean (Moyle 2002), the Sacramento River adjacent to the proposed intake locations likely serves primarily as a migratory corridor, reducing the duration of potential exposures of juveniles to pile driving sound. Another factor that may contribute to reducing the exposure of juveniles to pile driving noise would be the cessation of pile driving activities at night when juveniles appear to be most active and higher in the water column (Kynard et al. 2005).

A number of data sources suggest that the distribution of juvenile green sturgeon is widespread in the Delta and estuary, indicating that juvenile green sturgeon could be exposed to pile driving sounds at a number of construction sites in the Delta. In the absence of information on the movements and distribution of juveniles, potential impacts to the population can be generally assessed based on the proportion of total habitat subject to pile driving sounds. Under existing conditions, the Delta comprises an estimated 84,280 acres of subtidal aquatic habitat. Using this estimate as a measure of the total amount of potential foraging and rearing habitat available to juveniles, Table 4.3.7-2 shows the percentage of habitat that would be subjected to pile driving noise exceeding the injury thresholds during each year of pile driving activities.

Table 4.3.7-2. Potential underwater noise impact areas in each year of pile driving activities as a percentage of the total amount of subtidal aquatic habitat in the Delta (Alternative 4A).

Construction Year	Facilities/Structures	Potential Impact Area (acres)	Approximate Percentage of Subtidal Habitat
2	Intake 5 cofferdams	69	<0.1%
3	Intake 3 cofferdams Intake 5 foundation piles	153	0.2%
4	Intake 2 cofferdams Intake 3 foundation piles Intake 5 bridge piles	204	0.2%
5	Intake 2 foundation piles Intake 3 bridge piles Barge unloading facilities (5)	3,436	4.1%
6	Intake 2 bridge piles	45	<0.1%
7	HOR barrier cofferdams and foundation	36	<0.1%
8	CCF cofferdams	364	0.4%
9	CCF siphons	175	0.2%

These estimates represent a general order-of-magnitude estimate of the potential exposure of the population to pile driving noise. Thus, potential for exposure of the population to project pile driving noise is very low in most years. The exception is year 5 when an estimated 3,436 acres or 4.1% of the total amount of subtidal habitat would be subject to pile driving noise levels that could harm juvenile green sturgeon. This potential impact is due largely to the construction of six barge unloading facilities at various locations along the pipeline/tunnel alignment. Factors that may further limit exposure of the population to adverse effects include the short duration of pile driving activities at most locations (Table 4.3.7-1 under Delta Smelt). In addition, the total area of habitat available to juvenile green sturgeon expands beyond the Delta into the lower estuary and bays as juveniles grow and develop salinity tolerance. Juvenile typically achieve full tolerance by the end of their first year at sizes larger than 250 mm (Adams et al. 2002). Thus, there is a low likelihood of significant population-level effects on green sturgeon due to pile driving noise.

NEPA Effects: As concluded for Alternative 4, Impact AQUA-127, the effect would not be adverse for green sturgeon. Implementation of the measures described in Appendix 3B, *Environmental Commitments*, such as *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan* would guide rapid and effective response in the case of inadvertent spills of hazardous materials. Construction will result in both temporary and permanent alteration of rearing and migratory habitats used by green sturgeon. However, Alternative 4A includes Environmental Commitment 4 to restore tidal habitat. The direct effects of underwater construction noise on green sturgeon that may be present could be adverse if sturgeon are exposed. However, considering the ability of green sturgeon to move away from the noise and migrate during the night or other times that pile driving is not occurring, the relatively few green sturgeon in the area of pile driving, and the implementation of Mitigation Measures AQUA-1a and AQUA-1b, that would minimize exposure, this effect would not be adverse.

CEQA Conclusion: As described in Alternative 4, Impact AQUA-127, the impact of the construction of the water conveyance facilities on green sturgeon would not be significant except for construction noise associated with pile driving. Construction of Alternative 4A involves several elements with the potential to affect green sturgeon. However, these turbidity and hazardous material spill effects will be effectively avoided and/or minimized through implementation of environmental commitments (see Impact AQUA-1 and Appendix 3B, *Environmental Commitments*: *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*). Implementation of Mitigation Measures AQUA-1a and 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

Mitigation Measure AQUA-1b: Monitor Underwater Noise and if Necessary, Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise

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 4A would be the same as those described for Alternative 4, Impact AQUA-128. As concluded in Alternative 4, Impact AQUA-128, the impact would not be adverse for green sturgeon.

CEQA Conclusion: As described in Alternative 4, Impact AQUA-128, the impact of maintenance of water conveyance facilities on green sturgeon or their designated critical habitat would be less than significant and no mitigation is required.

Operations of Water Conveyance Facilities

Impact AQUA-129: Effects of Water Operations on Entrainment of Green Sturgeon

Water Exports

The potential entrainment effects under Alternative 4A would be the same as those under Alternative 4, which reflects the analysis for Alternative 1A. Operating new north Delta intakes and conveyance for SWP have the potential to avoid or reduce entrainment as described for Alternative 1A; there would be no adverse effect.

Scenario H3_ELT would substantially reduce entrainment of juvenile green sturgeon at the south Delta export facilities. Entrainment loss would be reduced 56% in wetter years and by 37% in drier years under Scenario H3_ELT compared to NAA_ELT (Table 11-4A-98). Entrainment losses of green sturgeon would be somewhat less under HOS_ELT. Under both the H3_ELT and H4_ELT scenarios, however, entrainment at the south Delta facilities would be substantially reduced compared to the NAA_ELT.

Table 11-4A-98. Juvenile Green Sturgeon Entrainment Index at the SWP and CVP Salvage Facilities—Differences (Absolute and Percentage) between Model Scenarios for Alternative 4A (Scenario H3_ELT)

	Absolute Difference (Percent Difference)	
Water Year Type[b]	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet and Above Normal	-68 (-58%)	-62 (-56%)
Below Normal, Dry, and Critical	-21 (-43%)	-17 (-37%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
[a] Estimated annual number of fish lost, based on non-normalized data.
[b] Sacramento Valley water year-types.

Predation Associated with Entrainment

Entrainment-related predation loss of juvenile green sturgeon would not be greater under Alternative 4A and may be lower relative to baseline due to a reduction in entrainment loss. Conditions under Scenario H4_ELT would likely reduce predation loss relative to Scenario H3_ELT. 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: In conclusion, the effect of Alternative 4A on entrainment and associated predation of green sturgeon would not be adverse and may provide modest benefit due to reduced losses at the south Delta facilities.

CEQA Conclusion: Similar to differences in south Delta entrainment described above for the NAA_ELT, there would be decreases in south Delta entrainment under H3_ELT relative to Existing Conditions (58% in wetter years; 43% in drier years; Table 11-4A-90). Therefore, the impact of the water operations on green sturgeon related to entrainment and associated predation losses would be less than significant and no mitigation would be required.

Impact AQUA-130: Effects of Water Operations on Spawning and Egg Incubation Habitat for Green Sturgeon

In general, Alternative 4A would not affect spawning and egg incubation habitat for green sturgeon relative to the NAA_ELT.

H3_ELT/ESO_ELT

Sacramento River

Mean flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation. Mean flows under H3_ELT would generally be similar to or up to 12% greater than flows under NAA_ELT for all months and water year types at both locations

Mean water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

The number of days when temperatures exceeded the analysis criterion (i.e., 63°F identified in Table 11-4A-13) by >0.5°F to >5°F in 0.5°F increments was determined for each month (May through September) and year of the 82-year modeling period. The combination of number of days and degrees above the 63°F threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between baselines and H3_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-99. There would be no substantial differences between NAA_ELT and H3_ELT in the number of years with each "level of concern".

Table 11-4A-99. Differences between Baseline and H3_ELT Scenarios in the Number of Years in Which Water Temperature Exceedances above 63°F are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Red	3 (75%)	0 (0%)
Orange	0 (0%)	0 (0%)
Yellow	1 (50%)	-1 (-25%)
None	-4 (-5%)	1 (1%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Total degree-days exceeding 63°F at Bend Bridge were summed by month and water year type during May through September (Table 11-4A-100). Total degree-days (all water years combined) under H3_ELT would be 18% lower than under NAA_ELT during July and similar to the total under NAA_ELT in the remaining 4 months.

Table 11-4A-100. Differences between Baseline and H3_ELT Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Sacramento River at Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
May	Wet	17 (131%)	0 (0%)
	Above Normal	0 (NA)	-2 (-100%)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	2 (NA)	1 (100%)
	All	19 (146%)	-1 (-3%)
June	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)
July	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	129 (1613%)	-30 (-18%)
	All	129 (1613%)	-30 (-18%)
August	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	28 (NA)	-1 (-3%)
	Critical	610 (303%)	-56 (-6%)
	All	638 (317%)	-57 (-6%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	4 (NA)	3 (300%)
	Dry	137 (442%)	7 (4%)
	Critical	497 (186%)	-44 (-5%)
	All	638 (214%)	-34 (-4%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and during the February through June green sturgeon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT at Thermalito would generally be similar to or up to 106% greater (June of below normal years) than flows under NAA_ELT, with minor exceptions. Differences at the confluence with the Sacramento River would generally be similar to but smaller than those at Thermalito. These results indicate that flows in the Feather River would increase overall under H3_ELT independent of climate change.

Mean water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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%) between NAA_ELT and H3_ELT in mean water temperatures for any month or water year type during the period.

Water temperature-related effects of H3_ELT on green sturgeon spawning, egg incubation, and rearing habitat in the Feather River were evaluated by determining the percent of months during May through September in which water temperatures exceed a 64°F temperature threshold at Gridley (Table 11-4A-101). Effects on spawning and egg incubation are evaluated here for May and June; effects on rearing are evaluated under Impact AQUA-131. The percent of months exceeding the threshold during May and June under H3_ELT would generally be similar to or up to 26% lower (absolute difference) than that under NAA_ELT with few exceptions.

Table 11-4A-101. Differences between Baselines and H3_ELT in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 64°F Threshold, May through September

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H3_ELT					
May	25 (77%)	16 (87%)	7 (75%)	9 (233%)	4 (150%)
June	2 (3%)	1 (1%)	-1 (-2%)	1 (2%)	-1 (-3%)
July	0 (0%)	0 (0%)	0 (0%)	9 (10%)	20 (29%)
August	0 (0%)	0 (0%)	7 (8%)	14 (17%)	19 (30%)
September	-9 (-13%)	-9 (-16%)	5 (17%)	14 (183%)	5 (200%)
NAA_ELT vs. H3_ELT					
May	-4 (-6%)	-1 (-3%)	-5 (-22%)	0 (0%)	0 (0%)
June	-1 (-1%)	-6 (-6%)	-14 (-15%)	-21 (-24%)	-26 (-36%)
July	0 (0%)	0 (0%)	0 (0%)	-1 (-1%)	4 (4%)
August	0 (0%)	0 (0%)	-1 (-1%)	-1 (-1%)	-1 (-2%)
September	10 (20%)	6 (16%)	5 (17%)	1 (6%)	-1 (-14%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Water temperature-related effects of H3_ELT on green sturgeon spawning, egg incubation, and rearing habitat in the Feather River were also evaluated by determining the total degree-months exceeding the 64°F temperature threshold at Gridley (Table 11-4A-102). Effects on spawning and egg incubation are evaluated here for May and June; effects on rearing are evaluated under Impact AQUA-131. Combining water years, total degree-months exceeding the threshold during May and June under H3_ELT would be 6% to 23% lower relative to NAA_ELT. Within months, total degree-months under H3_ELT would be similar or up to 45% lower than that under NAA_ELT depending on month and water year type. These results indicate that there would be a small to moderate benefit of H3_ELT to green sturgeon spawning and egg incubation temperature-related conditions in the Feather River.

Table 11-4A-102. Differences between Baselines and H3_ELT in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 64°F in the Feather River at Gridley, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
May	Wet	11 (183%)	0 (0%)
	Above Normal	4 (36%)	-4 (-21%)
	Below Normal	12 (150%)	-1 (-5%)
	Dry	16 (114%)	-1 (-3%)
	Critical	12 (71%)	-1 (-3%)
	All	55 (98%)	-7 (-6%)
June	Wet	12 (16%)	-32 (-27%)
	Above Normal	-6 (-12%)	-23 (-34%)
	Below Normal	-19 (-29%)	-37 (-45%)
	Dry	10 (11%)	-16 (-13%)
	Critical	21 (38%)	1 (1%)
	All	18 (5%)	-107 (-23%)
July	Wet	11 (7%)	6 (3%)
	Above Normal	5 (9%)	0 (0%)
	Below Normal	19 (28%)	4 (5%)
	Dry	46 (53%)	20 (18%)
	Critical	58 (73%)	32 (30%)
	All	139 (31%)	62 (12%)
August	Wet	5 (3%)	8 (5%)
	Above Normal	15 (33%)	7 (13%)
	Below Normal	25 (36%)	7 (8%)
	Dry	69 (101%)	26 (23%)
	Critical	18 (21%)	-8 (-7%)
	All	132 (30%)	40 (7%)
September	Wet	-26 (-67%)	7 (117%)
	Above Normal	-4 (-25%)	11 (1100%)
	Below Normal	6 (21%)	-7 (-17%)
	Dry	13 (46%)	2 (5%)
	Critical	20 (100%)	2 (5%)
	All	9 (7%)	15 (12%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

San Joaquin River

Flows in the San Joaquin River under H3_ELT would be similar to those under NAA_ELT throughout the March through June period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

H4_ELT /HOS_ELT

Sacramento River

Mean flows in the Sacramento River at Keswick and upstream of Red Bluff during the March through July spawning and egg incubation period for green sturgeon under H4_ELT would generally be similar to flows under NAA_ELT for all months and water year types at both locations (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

There would be no differences between NAA_ELT and H4_ELT in the number of years with each level of concern in the Sacramento River at Bend Bridge (Table 11-4A-103).

Table 11-4A-103. Differences between Baseline Scenarios and H1 and H4_ELT Scenarios in the Number of Years in Which Water Temperature Exceedances above 63°F Are within Each Level of Concern, Sacramento River at Bend Bridge, May through September

Level of Concern	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
Red	2 (50%)	-1 (-14%)
Orange	-1 (-100%)	-1 (-100%)
Yellow	-2 (-100%)	-4 (-100%)
None	1 (1%)	6 (9%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Total degree-days (all water year types combined) exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge under H4_ELT during May through September would range from no different than to 54% lower than those under NAA_ELT for all months during the period (Table 11-4A-104). This represents a moderate benefit of H4_ELT to green sturgeon temperature-related spawning conditions in the Sacramento River.

Table 11-4A-104. Differences between Baseline Scenarios and H4_ELT in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 63°F in the Sacramento River at Bend Bridge, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
May	Wet	17 (131%)	0 (0%)
	Above Normal	1 (NA)	-1 (-50%)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	0 (0%)
	All	19 (146%)	-1 (-3%)
June	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)
July	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	69 (862.5%)	-90 (-54%)
	All	69 (863%)	-90 (-54%)
August	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	23 (NA)	-6 (-21%)
	Critical	352 (175%)	-314 (-36%)
	All	375 (187%)	-320 (-36%)
September	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	5 (NA)	4 (400%)
	Dry	112 (361%)	-18 (-11%)
	Critical	223 (84%)	-318 (-39%)
	All	340 (114%)	-332 (-34%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Feather River

Flows under H4_ELT in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June period would generally be similar to or up to 548% greater (April of below normal water years) than flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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%) between NAA_ELT and H4_ELT in any month or water year type during the period.

The percent of months exceeding the 64°F NMFS threshold during May and June under H4_ELT would be similar to or up to 28% lower (absolute difference) than that under NAA_ELT, representing a small to moderate benefit of H4_ELT (Table 11-4A-105).

Table 11-4A-105. Differences between Baselines and H4_ELT Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 64°F Threshold, May through September

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISITING CONDITIONS vs. H4_ELT					
May	0 (0%)	-2 (-13%)	0 (0%)	6 (167%)	2 (100%)
June	4 (4%)	5 (6%)	6 (8%)	14 (21%)	12 (26%)
July	0 (0%)	0 (0%)	0 (0%)	7 (8%)	22 (32%)
August	0 (0%)	0 (0%)	9 (9%)	19 (23%)	33 (54%)
September	-7 (-11%)	-6 (-11%)	2 (9%)	11 (150%)	4 (150%)
NAA_ELT vs. H4_ELT					
May	-28 (-47%)	-20 (-55%)	-12 (-56%)	-2 (-20%)	-1 (-20%)
June	0 (0%)	-2 (-3%)	-6 (-7%)	-9 (-10%)	-12 (-17%)
July	0 (0%)	0 (0%)	0 (0%)	-2 (-2%)	6 (7%)
August	0 (0%)	0 (0%)	0 (0%)	4 (4%)	14 (17%)
September	11 (22%)	9 (22%)	2 (9%)	-1 (-6%)	-2 (-29%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Combining water years, total degree-months exceeding the 64°F NMFS threshold during the May and June spawning period under H4_ELT would be 5% to 29% lower relative to NAA_ELT. Within months, total degree-months under H4_ELT would be similar or up to 74% lower than that under NAA_ELT depending on water year type (Table 11-4A-106). These results indicate that there would be a small to moderate benefit of H4_ELT to green sturgeon spawning and egg incubation temperature-related conditions in the Feather River

Table 11-4A-106. Differences between Baselines and H1 and H4_ELT Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 64°F in the Feather River at Gridley, May through September

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
May	Wet	0 (0%)	-11 (-65%)
	Above Normal	-6 (-55%)	-14 (-74%)
	Below Normal	6 (75%)	-7 (-33%)
	Dry	17 (121%)	0 (0%)
	Critical	12 (71%)	-1 (-3%)
	All	28 (50%)	-34 (-29%)
June	Wet	40 (53%)	-4 (-3%)
	Above Normal	14 (27%)	-3 (-4%)
	Below Normal	4 (6%)	-14 (-17%)
	Dry	22 (23%)	-4 (-3%)
	Critical	20 (36%)	0 (0%)
	All	100 (29%)	-25 (-5%)
July	Wet	37 (22%)	32 (18%)
	Above Normal	29 (55%)	24 (41%)
	Below Normal	33 (49%)	18 (22%)
	Dry	58 (67%)	32 (29%)
	Critical	49 (62%)	23 (22%)
	All	207 (45%)	130 (24%)
August	Wet	43 (24%)	46 (26%)
	Above Normal	30 (67%)	22 (42%)
	Below Normal	36 (51%)	18 (20%)
	Dry	71 (104%)	28 (25%)
	Critical	20 (24%)	-6 (-5%)
	All	199 (45%)	107 (20%)
September	Wet	-14 (-36%)	19 (317%)
	Above Normal	3 (19%)	18 (1800%)
	Below Normal	20 (71%)	7 (17%)
	Dry	9 (32%)	-2 (-5%)
	Critical	20 (100%)	2 (5%)
	All	37 (28%)	43 (34%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

San Joaquin River

Flows under H4_ELT in the San Joaquin River during the March through June period would be very similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperature modeling was in the San Joaquin River.

NEPA Effects: Collectively, these modeling results indicate that there would not be adverse effects on green sturgeon spawning and egg incubation habitat because the amount of suitable habitat would not be substantially reduced. Flow and temperature conditions would generally be similar between Alternative 4A and the NEPA baseline in the Sacramento River and San Joaquin River and would be beneficial under Alternative 4A relative the NEPA baseline in the Feather River. Temperature conditions would be slightly improved under H4 relative to H3.

CEQA Conclusion: Collectively, the results of the Impact AQUA-130 CEQA analysis show that the difference between the CEQA baseline and Alternative 4A could be significant because, when compared to the CEQA baseline, the alternative would substantially reduce the quantity and quality of spawning and egg incubation habitat for green sturgeon relative to Existing Conditions. However, as further described below in the Summary of CEQA Conclusion, the comparison to the NAA is a better approach because it isolates the effects of the alternative from those of sea level rise, climate change, and future water demand. Based on this identification of the actual increment of change attributable to the alternative, Alternative 4A would not affect the quantity and quality of spawning and egg incubation habitat for green sturgeon relative to the CEQA baseline.

H3_ELT /ESO_ELT

Sacramento River

Mean flows were examined in the Sacramento River between Keswick and upstream of Red Bluff during the March to July spawning and egg incubation period for green sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3_ELT would generally be similar to those under Existing Conditions at both locations, with minor exceptions. These results indicate that there would be no effect on flows in the Sacramento River under H3_ELT relative to Existing Conditions.

Mean water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 water temperature between Existing Conditions and H3_ELT in any month or water year type throughout the period.

There would be 3 more years with a “red” NMFS level of concern in the Sacramento River at Bend Bridge under H3_ELT than under Existing Conditions (Table 11-4A-99).

Total degree-days exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge under H3_ELT (for all water years combined) would be up to 1,613% higher than under Existing Conditions during the May through September period (Table 11-4A-100). The very high increase between Existing Conditions and H3_ELT on the relative scale (1,613%) is a mathematical artifact resulting from the small value of the divisor (i.e., degree-days for Existing Conditions). On an absolute scale, the increase of 129 degree days constitutes an increase of only 0.3 degrees on each day over the 82-year period, which is a small change.

Feather River

Flows were examined in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February through June green sturgeon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Thermalito, mean flows under H3_ELT would generally be similar to or up to 48% lower than those under Existing Conditions during February and March, and would generally be similar to or up to 140% greater than those under Existing Conditions during April through June. At the confluence with the Sacramento River, flows under H3_ELT would generally be similar to those under Existing Conditions in all months and water year types of the period, except June, in which flows under H3_ELT would be up to 28% higher. These results indicate that there would generally be lower flows in the Feather River under H3_ELT relative to Existing Conditions early in the spawning and egg incubation period and greater flows later in the period.

Mean water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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 water temperatures between H3_ELT and Existing Conditions for any other month or water year type during the period.

Water temperature-related effects of H3_ELT on green sturgeon spawning, egg incubation, and rearing habitat in the Feather River were evaluated by determining the percent of months during May through September in which water temperatures exceed a 64°F temperature threshold at Gridley (Table 11-4A-101). Effects on spawning and egg incubation are evaluated here for May and June; effects on rearing are evaluated under Impact AQUA-131. The percent of months exceeding the threshold during May and June under H3_ELT would be similar to or up to 25% greater (absolute difference) than that under Existing Conditions, representing a small to moderate negative effect of H3_ELT, although this comparison includes the effect of climate change.

Water temperature-related effects of H3_ELT on green sturgeon spawning, egg incubation, and rearing habitat in the Feather River were also evaluated by determining the total degree-months exceeding the 64°F temperature threshold at Gridley (Table 11-4A-102). Effects on spawning and egg incubation are evaluated here for May and June; effects on rearing are evaluated under Impact AQUA-131. Combining water years, total degree-months exceeding the threshold during May and June under H3_ELT would be 5% to 98% greater relative to Existing Conditions. Within months, total degree-months under H3_ELT would be similar or up to 183% higher than that under Existing Conditions depending on water year type. These results indicate that there would be a moderate negative effect of H3_ELT on green sturgeon spawning and egg incubation temperature-related conditions in the Feather River, although this comparison includes the effect of climate change.

San Joaquin River

Mean flows in the San Joaquin River under H3_ELT would generally be up to 16% lower than those under Existing Conditions throughout the March through June spawning and egg incubation period for green sturgeon except during May, in which there would be no differences in flows between H3_ELT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperatures modeling was conducted in the San Joaquin River.

H4_ELT /HOS_ELT

Sacramento River

Mean flows under H4_ELT in the Sacramento River at Keswick and upstream of Red Bluff during the March through July spawning and egg incubation period for green sturgeon would generally be similar to flows under Existing Conditions for all months and water year types in the period. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Bend Bridge were examined during the March through July green sturgeon 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 Existing Conditions and H4_ELT in any month or water year type throughout the period.

There would be 2 more years with a "red" NMFS level of concern in the Sacramento River at Bend Bridge under H4_ELT than under Existing Conditions (Table 11-4A-103).

Total degree-days exceeding the 63°F NMFS threshold in the Sacramento River at Bend Bridge under H4_ELT would be up to 863% higher than under Existing Conditions during the May through September period (Table 11-4A-104). On an absolute scale this increase is 69 degree days, which constitutes a small change relative to the 82-year period of record used for the analysis.

Feather River

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay during the February through June period would generally be similar to or up to 19% lower than flows under Existing Conditions in February. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). However, flows under H4_ELT during April through June would be up to 509% greater than flows under Existing Conditions. Flows would be variable during March, but generally similar between Existing Conditions and H4_ELT. Mean flows under H4_ELT at the confluence with the Sacramento River would generally be similar to or up to 112% greater than those under Existing Conditions.

Mean water temperatures in the Feather River at Gridley were examined during the February through June green sturgeon 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 any month or water year type during the period.

The percent of months exceeding the 64°F NMFS threshold during May and June under H4_ELT would be similar to or up to 14% greater than (absolute difference) that under Existing Conditions, representing a small negative effect of H4_ELT (Table 11-4A-105). This analysis includes climate change.

Combining water years, total degree-months exceeding the threshold during May and June under H4_ELT would be 29% to 50% greater relative to Existing Conditions. Within months, total degree-months under H4_ELT would be 55% lower to 121% higher than that under Existing Conditions depending on water year type (Table 11-4A-106). These results indicate that there would be a moderate to large negative effect of H4_ELT on green sturgeon spawning and egg incubation temperature-related conditions in the Feather River. This analysis includes the effect of climate change.

San Joaquin River

Flows in the San Joaquin River under H4_ELT would be similar to or up to 16% lower than those under Existing Conditions throughout the March through June spawning and egg incubation period for green sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

No water temperature modeling was in the San Joaquin River.

Summary of CEQA Conclusion

Under Alternative 4A, flows would generally not differ in the Sacramento River. However, flows would be lower under Alternative 4A in the Feather and San Joaquin rivers and water temperature conditions would be degraded in all rivers examined relative to Existing Conditions. Results would generally be consistent between H3 and H4. Contrary to the NEPA conclusion set forth above, these modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of green sturgeon as a result of elevated exceedances above temperature thresholds.

However, this interpretation of the biological modeling results is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA_ELT) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. The comparison to the NAA_ELT is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

When compared to NAA_ELT and informed by the NEPA analysis above, flow and water temperature conditions under Alternative 4A would be similar to or better than those under NAA_ELT. These modeling results represent the increment of change attributable to the alternative, demonstrating the similarities in flows, reservoir storage, and water temperature under Alternative 4A and the NAA_ELT, and addressing the limitations of the CEQA baseline (Existing Conditions). Therefore, this impact is found to be less than significant and no mitigation is required.

Impact AQUA-131: Effects of Water Operations on Rearing Habitat for Green Sturgeon

In general, Alternative 4A would not affect the quantity and quality of green sturgeon larval and juvenile rearing habitat relative to the NAA_ELT.

Water temperature was used to determine the potential effects of alternatives on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

H3_ELT/ESO_ELT

Sacramento River

Mean water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon 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_ELT and H3_ELT in any month or water year type throughout the period.

Feather River

Mean water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon 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 water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Water temperature-related effects of H3_ELT on green sturgeon rearing habitat in the Feather River were evaluated by determining the percent of months during May through September in which water temperatures exceed a 64°F temperature threshold at Gridley (Table 11-4A-101). The percent of months exceeding the threshold under H3_ELT would be similar to or up to 26% lower (absolute difference) than that under NAA_ELT during May and June, similar to that under NAA_ELT during July and August, and similar to or up to 10% greater than that under NAA_ELT during September.

Water temperature-related effects of H3_ELT on green sturgeon rearing habitat in the Feather River were also evaluated by determining the total degree-months exceeding the 64°F temperature threshold at Gridley (Table 11-4A-102). Combining water years, total degree-months exceeding the threshold under H3_ELT would be 6% to 23% lower relative to NAA_ELT during May and June and 7% to 112% higher during July through September. These results indicate that there would be both beneficial and negative temperature-related effects to green sturgeon rearing in the Feather River. However, the largest change in degree-months (62 degree-months during July) would equate to an increase of less than 0.8 degrees per month. Given the highly variable nature of the Feather River outside of the low-flow channel, this change is not expected to be biologically meaningful. In fact, it is not unexpected that this amount of change would occur daily on a diel cycle.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River, however flows in all months and water year types, based on CALSIM II, were the same or very similar between NAA_ELT and H3_ELT and H4_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), and therefore no temperature effects would occur as a result of Alternative 4A.

H4_ELT/HOS_ELT

Sacramento River

Mean water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon 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_ELT and H4_ELT in any month or water year type throughout the period.

Feather River

Mean water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon 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 water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

The percent of months exceeding the 64°F NMFS threshold under H4_ELT would be similar to or up to 28% lower (absolute difference) than that under NAA_ELT during May and June, and similar or up to 14% greater than that under NAA_ELT during July through September. (Table 11-4A-105).

Combining water years, total degree-months exceeding the 64°F NMFS threshold under H4_ELT would be 5% to 29% lower relative to NAA_ELT during May and June and 20% to 34% higher (relative scale) during July through September (Table 11-4A-106). These results indicate that there would be both beneficial and negative temperature-related effects of H4_ELT on green sturgeon rearing in the Feather River. However, the largest change in degree-months (130 degree-months during July) would equate to an increase of less than 1.6 degrees per month. Given the highly variable nature of the Feather River outside of the low-flow channel, this change is not expected to be biologically meaningful. In fact, it is not unexpected that this amount of change would occur daily on a diel cycle.

San Joaquin River

Water temperature modeling was not conducted in the San Joaquin River, however flows in all months and water year types, based on CALSIM II, were the same or very similar between NAA_ELT and H3_ELT and H4_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*), and therefore no temperature effects would occur as a result of Alternative 4A.

NEPA Effects: Collectively, these modeling results indicate that the effect would not be adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Water temperatures in the Sacramento and Feather rivers and exceedances of NMFS temperature thresholds in the Feather River under Alternative 4A would be similar to those under NAA_ELT. Although degree-months would be higher on a relative scale under Alternative 4A during some months, these changes would not be biologically meaningful when considering the high variation in water temperatures relative to these increases. These modeling results would generally be consistent among scenarios.

CEQA Conclusion: In general, Alternative 4A would reduce the quantity and quality of rearing habitat for larval and juvenile green sturgeon relative to Existing Conditions. However, as further described below in the Summary of CEQA Conclusion, reviewing the alternative's impacts in relation to the NAA is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demand. Informed by the NAA comparison, Alternative 4A would not affect the quantity and quality of rearing habitat for larval and juvenile green sturgeon relative to Existing Conditions.

Water temperature was used to determine the potential effects of Alternative 4A on green sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

H3_ELT /ESO_ELT

Sacramento River

Mean water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon 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 water temperature between Existing Conditions and H3_ELT for any month or water year type of the period, except a 6% higher mean temperature for August of critical water years.

Feather River

Mean water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon 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 water temperature between Existing Conditions and H3_ELT in any month or water year type throughout the period, except during July of critical water years (7% higher under H3_ELT) and August of dry years (6% higher under H3_ELT).

Water temperature-related effects of H3_ELT on green sturgeon rearing habitat in the Feather River were evaluated by determining the percent of months during May through September in which water temperatures would exceed a 64°F temperature threshold at Gridley (Table 11-4A-101). The percent of months exceeding the threshold under H3_ELT would generally be greater by up to 25% (absolute difference) than the percent under Existing Conditions during all months, except in September for the >1.0°F and >2.0°F exceedance categories, in both of which exceedances would be 9 percent lower under H3_ELT. These modeling results include the effects of climate change.

Water temperature-related effects of H3_ELT on green sturgeon rearing habitat in the Feather River were also evaluated by determining the total degree-months exceeding the 64°F temperature threshold at Gridley (Table 11-4A-102). Combining water years, total degree-months exceeding the threshold under H3_ELT would be 5% to 98% higher in all months. These results indicate that there would be negative temperature-related effects of H3_ELT on green sturgeon rearing in the Feather River. These modeling results include the effects of climate change.

San Joaquin River

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

H4_ELT /HOS_ELT

Sacramento River

Mean monthly water temperatures in the Sacramento River at Bend Bridge were examined during the May through October green sturgeon 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 Existing Conditions and H4_ELT during May through July and 5% lower during August and October.

Feather River

Mean water temperatures in the Feather River at Gridley were examined during the April through August green sturgeon 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 water temperature between Existing Conditions and H4_ELT in any month or water year type throughout the period, except for 6% lower means under H4_ELT during July of critical water years and August of dry years.

The percent of months exceeding the 64°F NMFS threshold under H4_ELT would generally be greater by up to 33% than the percent under Existing Conditions during all months and water year types, except in September for the >1.0°F and >2.0°F exceedance categories, in which exceedances would be 7 and 6 percent lower, respectively, under H3_ELT (Table 11-4A-105). These modeling results include the effects of climate change.

Combining water years, total degree-months exceeding the 64°F NMFS threshold under H4_ELT would be 28% to 50% higher in all months (Table 11-4A-106). These results indicate that there would be negative temperature-related effects of H4 on green sturgeon rearing in the Feather River. These modeling results include the effects of climate change.

San Joaquin River

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

Summary of CEQA Conclusion

Under Alternative 4A, water temperatures would be similar in the Sacramento River, although the exceedance above NMFS temperature thresholds in the Feather River would be higher under Alternative 4A than those under the CEQA baseline, which could increase stress, mortality, and susceptibility to disease for larval and juvenile green sturgeon. These modeling results are consistent among scenarios. Contrary to the NEPA conclusion set forth above, these modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce rearing habitat and substantially reduce the number of green sturgeon as a result of fry and juvenile mortality.

However, this interpretation of the biological modeling results is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA_ELT) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. This suggests that the comparison of the results between the alternative and NAA_ELT is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

When compared to NAA_ELT and informed by the NEPA analysis above, effects of Alternative 4A on water temperatures would be negligible and exceedances above thresholds would be similar between NAA_ELT and Alternative 4A. These modeling results represent the increment of change attributable to the alternative, demonstrating the similarities in flows and water temperatures under Alternative 4A and the NAA_ELT, and addressing the limitations of the CEQA baseline (Existing Conditions). Therefore, this impact would be less than significant and no mitigation is required.

Impact AQUA-132: Effects of Water Operations on Migration Conditions for Green Sturgeon

In general, effects of Alternative 4A on green sturgeon migration conditions relative to the NAA are not adverse.

Upstream of the Delta

H3_ELT/ESO_ELT

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through June adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River mean flows at Keswick under H3_ELT would generally be up to 23% lower than flows under NAA_ELT during November, and similar to flows under NAA_ELT in the remaining months, with minor exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Sacramento River flows at Wilkins Slough under H3_ELT would generally be up to 20% lower than flows under NAA_ELT during September and November, up to 12% greater during May and June, and similar to flows under NAA_ELT in the remaining eight months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Differences between H3_ELT and NAA_ELT in Feather River mean flows at Thermalito would vary a great deal with month and water year type. In general, mean flows under H3_ELT would be up to 48% lower than flows under NAA_ELT during July through September, although flows in critical water years during August and September would be 23% and 25% higher (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The mean flows would generally be up to 106% greater during May and June, and similar to flows under NAA_ELT in the remaining seven months, with a number of exceptions.

Feather River flows at the confluence with the Sacramento River under H3_ELT would generally be up to 50% lower (critical water years) than flows under NAA_ELT during July through September, although flows in critical water years during August and September would be 21% and 14% higher (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The mean flows would generally be greater under H3_ELT during June (up to 77% greater) and similar to flows under NAA_ELT in the remaining eight months, with minor exceptions.

Given the benthic nature of green sturgeon and that flows in the Feather River would be consistent with the flow schedule provided by NMFS during the project planning process that is meant to better mimic the natural flow regime while providing adequate storage to meet downstream temperature and water quality requirements, the reductions in summer flows at both locations in the Feather River are not expected to have a substantial effect on green sturgeon.

Larval transport flows were also examined by utilizing the positive correlation between white sturgeon 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 green sturgeon larval transport that results in improved year class strength. However, there is high uncertainty about what the mechanism responsible for this relationship is because many flow variables correlate throughout the Central Valley. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. In addition, this correlation was developed using data collected in the absence of north Delta intakes. Also, there are temporal and spatial differences between green and white sturgeon larval presence that make using white sturgeon as a surrogate in this analysis highly uncertain and potentially not applicable (Murphy et al. 2011). In particular, unlike white sturgeon, during April and May, green sturgeon adults would be spawning and larvae would be rearing in the upper Sacramento River and Feather River. This mismatch in timing and location limits the confidence in using this as a surrogate for green sturgeon and suggests that year-class strength correlated with flow at another location upstream or during a different period, if at all.

Regardless, for lack of a known relationship for green sturgeon year-class strength, the results using white sturgeon as a surrogate for green sturgeon were examined here. Results for white sturgeon presented in Impact AQUA-150 below suggest that, using the positive correlation between Delta outflow and year class strength, green sturgeon year class strength would be lower under H3_ELT than those under NAA_ELT (up to 50% lower). Given the increased spring outflow in April and May under H4, it is expected that year-class strength would be similar or greater to NAA_ELT under H4_ELT.

H4_ELT /HOS_ELT

Year-round flows in the Sacramento River at Keswick under H4_ELT would be up to 20% lower than flows under NAA_ELT during November, and generally similar to flows under NAA_ELT in the remaining months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows at Wilkins Slough under H4_ELT would generally be similar to those under NAA_ELT except during August, September, and November, when flows would be up to 20% lower under H4_ELT.

Differences between H4_ELT and NAA_ELT in Feather River mean flows at Thermalito would vary a great deal with month and water year type. In general, mean flows under H4_ELT would be up to 60% lower than flows under NAA_ELT during July through September, although flows in critical water years during August and September would be 48% and 52% higher (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The mean flows under H4_ELT would generally be up to 548% greater flows under NAA_ELT during April through June, and similar in the remaining six months, with a number of exceptions.

Feather River flows at the confluence with the Sacramento River under H3_ELT would generally be up to 42% lower than flows under NAA_ELT during July through September, although flows in critical water years during August and September would be 42% and 34% higher (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The mean flows would generally be greater under H4_ELT during April through June (up to 119% greater) and similar to flows under NAA_ELT in the remaining six months, with minor exceptions.

Given the benthic nature of green sturgeon and that flows in the Feather River would be consistent with the flow schedule provided by NMFS during the Alternative 4a planning process that is meant to better mimic the natural flow regime while providing adequate storage to meet downstream temperature and water quality requirements, the reductions in summer flows at both locations in the Feather River are not expected to have a substantial effect on green sturgeon.

Through-Delta

As described for other species (e.g., Sacramento splittail in Impact AQUA-114), migration conditions in the southern Delta generally would be considerably improved relative to NAA_ELT, because of reduced frequency of reverse OMR flows. The range of Alternative 4A operations (i.e., H3_ELT and H4_ELT) includes a range of Delta outflows, as discussed below. The effect on green sturgeon would not be adverse.

NEPA Effects: Upstream flows (above north Delta intakes) are generally similar between Alternative 4A and NAA_ELT. However, due to the removal of water at the North Delta intakes, there are substantial differences in through-Delta flows between Alternative 4A and NAA_ELT. An examination of monthly average Delta outflow exceedances above 15,000 cfs, 20,000 cfs, and 25,000 cfs during April and May of wet and above-normal years was used to provide context for differences in through-Delta migration conditions, per recommendations by the Anadromous Fish Restoration Program (USFWS 1995) (see Table 11-4A-114 in the discussion of white sturgeon below). This showed that the percentage of months exceeding the above Delta outflow thresholds in April and May of wet and above normal years was appreciably lower than NAA_ELT for Alternative 4A's H3_ELT scenario, but was similar or considerably greater than NAA_ELT for Alternative 4A's H4_ELT scenario. As noted for Alternative 4, analysis of white sturgeon year-class strength (USFWS 1995), used here as a surrogate for green sturgeon, found a positive correlation between year class strength and Delta outflow during April and May. However, this conclusion was reached in the absence of north Delta intakes and the exact mechanism that causes this correlation is not known at this time. One hypothesis suggests that the correlation is caused by high flows in the upper river resulting in improved migration, spawning, and rearing conditions in the upper river. Another hypothesis suggests that the positive correlation is a result of higher flows through the Delta triggering more adult sturgeon to move up into the river to spawn. It is also possible that some combination of these factors are working together to produce the positive correlation between high flows and sturgeon year-class strength.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations as described in the adaptive management and monitoring section in Section 4.1. These investigations will inform decisions regarding Delta outflow within the range of H3_ELT/H4_ELT operations such that the effect on green sturgeon Delta flow conditions would not be adverse. This, combined with similarities in upstream flow conditions between Alternative 4A and NAA_ELT, indicate that Alternative 4A would not be adverse to migration conditions for green sturgeon.

CEQA Conclusion: In general, Alternative 4A would reduce the quantity and quality of migration habitat for green sturgeon in upstream locations relative to Existing Conditions. However, as further described below in the Summary of CEQA Conclusion, reviewing the alternative's impacts in relation to the NAA is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demand. Informed by the NAA comparison, Alternative 4A would not affect the quantity and quality of migration habitat for green sturgeon.

Upstream of the Delta

H3_ELT/ESO_ELT

Analyses for green sturgeon migration conditions focused on flows in the Sacramento River between Keswick and Wilkins Slough and in the Feather River between Thermalito and the confluence with the Sacramento River during the April through October larval migration period, the August through March juvenile migration period, and the November through July adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Because these periods encompass the entire year, flows during all months were compared. Reduced flows could slow or inhibit downstream migration of larvae and juveniles and reduce the ability to sense upstream migration cues and pass impediments by adults.

Sacramento River flows at Keswick under H3_ELT would generally be up to 24% lower than flows under Existing Conditions during August, September, and November of dry and critical water years and up to 34% higher during September of wet and above normal water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In the other months and water year types, the mean flows would generally be similar between H3_ELT and Existing Conditions, with several exceptions. Mean flows at Wilkins Slough under H3_ELT would generally be up to 24% lower than flows under Existing Conditions during August, September, and November of dry and critical water years and up to 33% higher during September of wet and above normal water years. Mean flow in June would be up to 18% higher under H3_ELT, and flows would be similar in other months and water year types.

For Delta outflow, the percent of months exceeding outflow thresholds under H3_ELT would consistently be lower than those under Existing Conditions for each flow threshold, water year type, and month (4% to 50% lower on a relative scale) (see Table 11-4A-114 below).

Feather River flows at Thermalito Afterbay under H3_ELT would generally be up to 52% lower than flows under Existing Conditions during January, February, and July, higher than flows under Existing Conditions during April through June and September, and similar to flows under Existing Conditions during the remaining months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flow under H3_ELT at the confluence with the Sacramento River would generally be up to 140% greater than flows under Existing Conditions during February, June, and September, up to 55% lower than flows under Existing Conditions during July, and similar to flows under Existing Conditions during the remaining months.

H4_ELT /HOS_ELT

Year-round flows were examined in the Sacramento River at Keswick and Wilkins Slough. Flows at Keswick under H4_ELT would generally be similar to flows under Existing Conditions, except during September and November, in which mean flows would be up to 20% lower, and during February, in which flows would be up to 12% higher. Flows at Wilkins Slough would generally be similar to flows under Existing Conditions except during September and October, in which flows would be up to 21% lower, and during July, in which flows would be up to 8% greater. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Year-round flows in the Feather River below Thermalito Afterbay (high-flow channel) and at the confluence under H4_ELT would generally be similar to or up to 36% lower than flows under Existing Conditions during January through March, and up to 55% lower during July through

September, although flow would be up to 55% higher during critical water years in August and September, (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During April through June, mean flow under H4_ELT would be up to 509% greater than flow under Existing Conditions. During September, mean flow under H4_ELT would be up to 49% lower in below normal and dry water years and up to 166% higher in wet, above normal, and critical water years. Reductions in flows in the Feather River would be persistent and large enough to have biologically meaningful effects to green sturgeon migration.

Through-Delta

Given the improved OMR flows and the range of Delta outflows under Alternative 4A's H3_ELT and H4_ELT that would be refined through the Adaptive Management Program to avoid negative impacts to green sturgeon (see NEPA Effects discussion above), the potential impact of Alternative 4A on in-Delta conditions for green sturgeon is considered less than significant, and no mitigation would be required.

Summary of CEQA Conclusion

Under Alternative 4A, there would be frequent small to large reductions in flows in the Sacramento and Feather Rivers upstream of the Delta that would reduce the ability of all three life stages of green sturgeon to migrate successfully. Exceedance of Delta outflow thresholds would be lower under Alternative 4A's H3_ELT scenario than under Existing Conditions, but would be similar or greater than under Existing Conditions for the H4_ELT scenario. Note that there is high uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta outflows co-vary with another unknown factor. Contrary to the NEPA conclusion set forth above, these modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce upstream migration conditions for green sturgeon.

However, this interpretation of the biological modeling is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA_ELT) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. This suggests that the comparison in results between the alternative and NAA_ELT, is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

When compared to NAA_ELT and informed by the NEPA analysis above, there would be negligible effects on green sturgeon migration conditions in upstream areas. Within the Plan Area, the Adaptive Management Program will evaluate water operations through the adaptive management and monitoring program as described in Section 4.1 and ensure the impacts of water operations on migration conditions for green sturgeon are less than significant. Therefore, this impact is found to be less than significant and no mitigation is required.

Restoration Measures (Environmental Commitment 4, Environmental Commitment 6, Environmental Commitment 7, and Environmental Commitment 10)

As described for other covered fishes, Alternative 4A includes a greatly reduced extent of restoration measures relative to Alternative 4 and Alternative 1A. The mechanisms of impacts of habitat restoration discussed for winter-run Chinook salmon generally would be similar for green sturgeon. Because green sturgeon may inhabit the Delta year-round, they would be more likely to encounter any effects from restoration measures. However, because the extent of restoration is limited to offsetting losses from construction of the water conveyance facilities, any such effects would be greatly limited compared to Alternative 1A and 4, for example.

Impact AQUA-133: Effects of Construction of Restoration Measures on Green Sturgeon

As noted for Alternative 1A's discussion of Impact AQUA-133, in-water and shoreline construction activities (e.g., riprap removal and levee breaching; shoreline excavation and recontouring) could increase turbidity, but green sturgeon are tolerant to such increases and implementation of the environmental commitments described under Impact AQUA-1 for delta smelt and in Appendix 3B, Environmental Commitments (Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material), would minimize or eliminate effects on green sturgeon.

NEPA Effects: The effects of short-term construction activities would not be adverse to green sturgeon because environmental commitments would limit the potential for construction-related effects.

CEQA Conclusion: As discussed for Alternative 1A, habitat restoration activities could result in short-term effects on green sturgeon but would be localized, sporadic, and of low magnitude; such effects would be avoided by limiting the frequency, duration, and spatial extent of in-water work and with implementation of environmental commitments (see Appendix 3B, *Environmental Commitments*). The potential impact of habitat restoration activities is considered less than significant because it would not substantially reduce green sturgeon habitat, restrict its range, or interfere with its movement. No additional mitigation would be required.

Impact AQUA-134: Effects of Contaminants Associated with Restoration Measures on Green Sturgeon

The factors influencing the potential effects of contaminants from restored areas on green sturgeon are discussed in the analysis of Impact AQUA-134 under Alternative 1A. Because the extent of habitat restoration under Alternative 4A is considerably reduced relative to Alternative 1A, any effects from contaminants also would be considerably reduced.

NEPA Effects: While Alternative 4A habitat restoration actions may result in a very small increase production, mobilization, and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system, any such releases would be short-term and localized, and would be unlikely to result in measurable increases in the bioaccumulation of these contaminants in green sturgeon. Alternative 4A would restore 59 acres of tidal wetlands that, depending on the specific site conditions of the restoration, may result in the colonization of benthic grazers that bioaccumulate selenium. As sturgeon are benthic feeders, the increased habitat for grazers may result in increased exposure to selenium. However, the small amount of area to be restored would not result in a substantial change in exposure potential. Overall, the effects of contaminants associated with restoration measures would not be adverse for green sturgeon.

CEQA Conclusion: Habitat restoration under Alternative 4A may result in increased production, mobilization, and bioavailability of contaminants in the aquatic system, but these would be short-term and localized, and would be unlikely to result in measurable increases in the bioaccumulation in green sturgeon. For methylmercury, implementation of *Environmental Commitment 12 Methylmercury Management* would help to minimize the increased mobilization of methylmercury in the limited restoration areas. Therefore, the impact of contaminants is considered less than significant because it would not substantially affect green sturgeon either directly or through habitat modifications. Consequently, no mitigation would be required.

Impact AQUA-135: Effects of Restored Habitat Conditions on Green Sturgeon

Restored habitat under *Environmental Commitment 4 Tidal Natural Communities Restoration* and *Environmental Commitment 6 Channel Margin Enhancement* is intended to offset habitat loss/modification caused by construction and operation of the water facilities proposed under Alternative 4A.

NEPA Effects: The effects of restored habitat conditions on green sturgeon would not be adverse because restoration is intended to provide habitat benefits for green sturgeon.

CEQA Conclusion: As described above, habitat restoration would be undertaken to offset loss/modification of habitat from water facility construction and operation. The effects of restored habitat conditions on green sturgeon would be less than significant. Consequently, no mitigation would be required.

Other Environmental Commitments (Environmental Commitment 12, Environmental Commitment 15, and Environmental Commitment 16)

As noted for other covered species, Alternative 4A includes three other Environmental Commitments, which are reduced in their extent relative to the Conservation Measures included in other Alternatives (e.g., Alternative 1A and Alternative 4A). While the extent of these measures is reduced compared to these alternatives, the nature of the mechanisms for green sturgeon remains the same.

Impact AQUA-136: Effects of Methylmercury Management on Green Sturgeon (Environmental Commitment 12)

The impact discussion for winter-run Chinook salmon (Impact AQUA-46) is also applicable to green sturgeon.

NEPA Effects: The effects of methylmercury management on green sturgeon would not be adverse because it is expected to reduce overall methylmercury levels resulting from habitat restoration.

CEQA Conclusion: As noted for winter-run Chinook salmon, effects of *Environmental Commitment 12 Methylmercury Management* within the areas restored under Alternative 4A are expected to reduce overall methylmercury levels resulting from habitat restoration. Because it is designed to improve water quality and habitat conditions, impacts on green sturgeon would be less than significant. Consequently, no mitigation is required.

Impact AQUA-139: Effects of Localized Reduction of Predatory Fish on Green Sturgeon (Environmental Commitment 15)

Alternative 4A includes a predator removal program similar to Conservation Measure 15 included in Alternative 1A, although the environmental commitment under Alternative 4A is reduced in scope to focus solely on the north and south Delta export locations, whereas Alternative 1A would include predator removal at these and other potential hotspots. As described under Alternative 1A, it is possible, but not assured, that there would be some reduction in predation losses of green sturgeon under *Environmental Commitment 15 Localized Reduction of Predatory Fish*. As described for Alternative 1A, there is uncertainty in the potential efficacy of Environmental Commitment 15 and also uncertainty in the importance of predation to juvenile green sturgeon, given the likely limited period of vulnerability to predation in the Delta. Due to these uncertainties, there would be no demonstrable effect of this conservation measure on green sturgeon. As noted for Alternative 1A, there is a very small risk of sturgeon by-catch during implementation of Environmental Commitment 15, but the number of green sturgeon affected is expected to be very low.

NEPA Effects: Consistent with the analysis for Alternative 1A and reflecting the above discussion, the overall effect would not be adverse because few, if any, sturgeon would be affected.

CEQA Conclusion: Consistent with the analysis for Alternative 1A and reflecting the above discussion, the impact is considered less than significant. Consequently, no mitigation would be required.

Impact AQUA-140: Effects of Nonphysical Fish Barriers on Green Sturgeon (Environmental Commitment 16)

As described for winter-run Chinook salmon, under Alternative 4A, an NPB at the divergence of Georgiana Slough from the Sacramento River would be implemented to guide juvenile salmonids away from Georgiana Slough and the interior Delta, wherein survival is relatively low compared to the Sacramento River (Perry et al. 2010). As described in the *BDCP Effects Analysis*, the effects of an NPB at this location would be expected to have little to no effect on green sturgeon because of their position in the water column (near the river bottom, whereas an NPB at this location would be likely to function in the upper half of the water column; DWR 2012) and their physiology (limited hearing ability in the range employed by the NPB's acoustic deterrence stimuli; see section 5C.5.3.9 in *BDCP Effects Analysis Appendix 5.C* and section 5.B.6.1.11.1 *BDCP Effects Analysis Appendix 5.B, both hereby incorporated by reference*).

NEPA Effects: Consistent with the analysis for Alternative 1A and reflecting the above discussion, the overall effect would not be adverse because green sturgeon are unlikely to encounter the NPB, which would not be located near the channel bottom and because green sturgeon have limited hearing within the range of acoustic sound generated by the NPB.

CEQA Conclusion: Consistent with the analysis for Alternative 1A and reflecting the above discussion, the impact is considered less than significant. Consequently, no mitigation would be required.

White Sturgeon

Construction and Maintenance of Water Conveyance Facilities

Impact AQUA-145: Effects of Construction of Water Conveyance Facilities on White Sturgeon

The potential effects of construction of the water conveyance facilities on white sturgeon would be the same as those described for Alternative 4, Impact AQUA-145. This section provides additional detail on underwater noise impacts which are also applicable to Impact AQUA-145 in Alternative 4.

Table 11-8 presents the life stages of white sturgeon and months of their potential presence in the north, east, and south Delta during the proposed in-water construction window (June 1–October 31). Under Alternative 4A, white sturgeon adults and juveniles occur year-round in the Delta and therefore could be exposed to pile driving noise during construction of the proposed intakes, barge unloading facilities, CCF cofferdams, CCF siphons, and Head of Old River operable barrier. Larvae may also be exposed to pile driving noise but are generally at lower risk than juveniles and adults because of only minor spatial and temporal overlap with in-water pile driving activities. Because the majority of the population spawns in the Sacramento River, adults, larvae, and juveniles are most likely to encounter pile driving noise at the proposed intake locations in the north Delta as they migrate or disperse to and from upstream spawning areas. Similar to green sturgeon, adult white sturgeon are large (>15 kilograms) and less susceptible to noise from impact driving, and are able to avoid injurious exposure to underwater noise from pile driving. They may experience short delays in migration upon encountering pile driving noise; however, pile driving would occur only intermittently through a portion of the day, and minor migration delays are not expected to affect their ability to successfully reach the spawning grounds.

Because of their relatively small body size, larvae and juvenile white sturgeon are at higher risk of injury or mortality from pile driving noise. Juveniles are most likely to encounter pile driving noise because of their widespread distribution and year-round presence in the Delta. Although juvenile white sturgeon are capable of actively avoiding pile driving noise and other in-water disturbances, some may be injured or killed if they remain in the areas subject to cumulative SELs exceeding the injury thresholds (Table 4.3.7-1 under Delta smelt). In the absence of information on the movements and distribution of juveniles, potential impacts to the population can be generally assessed based on the proportion of total habitat subject to pile driving sounds. Under existing conditions, the Delta comprises an estimated 84,280 acres of subtidal aquatic habitat. Using this estimate as a measure of the total amount of potential foraging and rearing habitat available to juveniles, Table 4.3.7-2 shows the percentage of habitat that would be subjected to pile driving noise exceeding the injury thresholds during each year of pile driving activities.

These estimates represent a general order-of-magnitude estimate of the potential exposure of the population to pile driving noise. Thus, potential for exposure of the population to project pile driving noise is very low in most years. The exception is year 5 when an estimated 3,436 acres or 4.1% of the total amount of subtidal habitat would be subject to pile driving noise levels that could harm juvenile sturgeon. This potential impact is due largely to the construction of six barge unloading facilities at various locations along the pipeline/tunnel alignment. Factors that may further limit exposure of the population to adverse effects include the short duration of pile driving activities at most locations (Table 4.3.7-1 under Delta Smelt). In addition, the total area of habitat available to juvenile white sturgeon expands beyond the Delta into Suisun and San Pablo Bays as juveniles grow and develop salinity tolerance, further reducing the probability of encountering pile driving noise.

Based on these considerations and the implementation of Mitigation Measures AQUA-1a and AQUA-1b, there is a low likelihood of significant population-level effects on white sturgeon due to pile driving noise.

NEPA Effects: As concluded for Alternative 4, Impact AQUA-145, the effect would not be adverse for white sturgeon. Implementation of the measures described in Appendix 3B, *Environmental Commitments*, such as *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan* would guide rapid and effective response in the case of inadvertent spills of hazardous materials. Construction will result in both temporary and permanent alteration of rearing and migratory habitats used by white sturgeon. However, Alternative 4A includes Environmental Commitment 4 to restore tidal habitat. The direct effects of underwater construction noise on white sturgeon that may be present could be adverse if sturgeon are exposed. However, considering the ability of white sturgeon to move away from the noise and migrate during the night or other times that pile driving is not occurring, the relatively few white sturgeon in the area of pile driving, and the implementation of Mitigation Measures AQUA-1a and AQUA-1b,that would minimize exposure, this effect would not be adverse.

CEQA Conclusion: As described in Alternative 4, Impact AQUA-145, the impact of the construction of the water conveyance facilities on white sturgeon would not be significant except for construction noise associated with pile driving. Construction of Alternative 4A involves several elements with the potential to affect white sturgeon. However, these turbidity and hazardous material spill effects will be effectively avoided and/or minimized through implementation of environmental commitments (see Impact AQUA-1 and Appendix 3B, *Environmental Commitments*: *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*). Implementation of Mitigation Measures AQUA-1a and 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

Mitigation Measure AQUA-1b: Monitor Underwater Noise and if Necessary, Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise

Impact AQUA-146: Effects of Maintenance of Water Conveyance Facilities on White Sturgeon

NEPA Effects: The potential effects of the maintenance of water conveyance facilities under Alternative 4A would be the same as those described for Alternative 4, Impact AQUA-146. As concluded in Alternative 4, Impact AQUA-146, the impact would not be adverse for white sturgeon.

CEQA Conclusion: As described in Alternative 4, Impact AQUA-146, the impact of the maintenance of water conveyance facilities on white sturgeon would be less than significant and no mitigation is required.

Operations of Water Conveyance Facilities

Impact AQUA-147: Effects of Water Operations on Entrainment of White Sturgeon

Water Exports

The potential effects of the water operations under Alternative 4A would be the same as those described for green sturgeon (see Impact AQUA-129), which is a reduction in entrainment at the south Delta facilities, and avoidance or reduction of entrainment at the proposed north Delta diversion facilities. As concluded in Impact AQUA-129, the impact of Alternative 4A on white sturgeon would not be adverse.

Predation Associated with Entrainment

The potential effects would be the same as described for green sturgeon in Alternative 4A (see Impact AQUA-129).

NEPA Effects: In conclusion, the effect of Alternative 4A operations on entrainment and associated predation of white sturgeon would not be adverse and may provide modest benefit due to reduced losses at the south Delta facilities.

CEQA Conclusion: As described above for green sturgeon (Impact AQUA-129) the impact of water operations on white sturgeon would be less than significant and no mitigation would be required.

Impact AQUA-148: Effects of Water Operations on Spawning and Egg Incubation Habitat for White Sturgeon

In general, Alternative 4A would not affect spawning and egg incubation habitat for white sturgeon relative to the NAA_ELT. Alternative 4A would provide flow-related benefits to white sturgeon spawning in the Feather River.

H3_ELT/ESO_ELT

Sacramento River

Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to May spawning and egg incubation period for white sturgeon. Mean flows under H3_ELT would generally be similar to those under NAA_ELT throughout the spawning and egg incubation period at both locations (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the February through May white sturgeon spawning 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_ELT and H3_ELT in any month or water year type throughout the period.

The number of days at Hamilton City on which temperature exceeded a 61°F optimal and 68°F lethal threshold by >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above each threshold were further assigned a “level of concern”, as defined in Table 11-4A-14. Differences between baselines and H3_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-107. For the 61°F threshold, there would be 5 fewer (14% fewer) "red" years under H3_ELT than under NAA_ELT. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between NAA_ELT and H3_ELT.

Table 11-4A-107. Differences between Baselines and H3_ELT in the Number of Years in Which Water Temperature Exceedances above the 61°F and 68°F Thresholds Are Within Each Level of Concern, Sacramento River at Hamilton City, March through June

Level of Concern	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
61°F threshold		
Red	23 (288%)	-5 (-14%)
Orange	4 (27%)	-2 (-10%)
Yellow	-12 (-39%)	2 (12%)
None	-15 (-54%)	5 (63%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	1 (NA)	-1 (-100%)
None	-1 (-1%)	1 (1%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
NA = could not be calculated because the denominator was 0.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-4A-108, Table 11-4A-109). Total degree-days exceeding the 61°F threshold under H3_ELT would be 2 degree-day (67%) greater than those under NAA_ELT during March, which would not be biologically meaningful. During April through June, total degree days above 61°F would be 2 to 373 (1% to 11%) lower under H3_ELT than under NAA_ELT. These totals would not be biologically meaningful to white sturgeon considering that the daily reduction in temperature would be <0.2 degrees (2542 and 2460 total days during May and June, respectively over the 82-year modeling period. Total degree-days exceeding the 68°F threshold would be similar between NAA_ELT and H3_ELT, except during May, in which exceedances would be 10 degree-days (33%) fewer under H3_ELT.

Table 11-4A-108. Differences between Baseline and H3_ELT Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	2 (NA)
	Dry	3 (NA)	0 (0%)
	Critical	0 (NA)	0 (NA)
	All	5 (NA)	2 (67%)
April	Wet	18 (150%)	0 (0%)
	Above Normal	15 (150%)	0 (0%)
	Below Normal	16 (267%)	-4 (-15%)
	Dry	47 (92%)	4 (4%)
	Critical	2 (200%)	-2 (-40%)
	All	98 (123%)	-2 (-1%)
May	Wet	478 (144%)	-1 (0%)
	Above Normal	123 (56%)	-113 (-25%)
	Below Normal	227 (123%)	-42 (-9%)
	Dry	209 (103%)	-105 (-20%)
	Critical	219 (108%)	-7 (-2%)
	All	1,256 (110%)	-268 (-10%)
June	Wet	425 (74%)	-65 (-6%)
	Above Normal	151 (50%)	-56 (-11%)
	Below Normal	177 (84%)	-70 (-15%)
	Dry	203 (61%)	-127 (-19%)
	Critical	181 (48%)	-55 (-9%)
	All	1,137 (63%)	-373 (-11%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
NA = could not be calculated because the denominator was 0.

Table 11-4A-109. Differences between Baseline and H3_ELT Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Mar	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)
Apr	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	9 (129%)	0 (0%)
	Above Normal	3 (NA)	-10 (-77%)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	0 (0%)
	All	13 (186%)	-10 (-33%)
Jun	Wet	2 (NA)	0 (0%)
	Above Normal	-1 (-100%)	-2 (-100%)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	0 (0%)
	All	2 (200%)	-2 (-40%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
NA = could not be calculated because the denominator was 0.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows at Thermalito Afterbay under H3_ELT would generally be similar to or greater by up to 30% greater than those under NAA_ELT, with some exceptions. Mean flows at the confluence with the Sacramento River under H3_ELT would be similar to flows under NAA_ELT, with minor exceptions.

Mean water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period. Mean water temperatures would not differ (<5%) between NAA_ELT and H3_ELT at either location throughout the period.

San Joaquin River

Flows in the San Joaquin River at Vernalis under H3_ELT during February through May would be little different from flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted for the San Joaquin River.

H4_ELT /HOS_ELT

Sacramento River

Flows under H4_ELT in the Sacramento River at Wilkins Slough and Verona during February to May would generally be similar to flows under NAA_ELT except during April and May at Verona, in which flows would be up to 36% and 25% higher, respectively (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Hamilton City were examined during the February through May white sturgeon spawning 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_ELT and H4_ELT in any month or water year type throughout the period.

The number of days when temperatures exceeded the analysis criterion (i.e., 61°F optimal and 68°F lethal threshold identified in Table 11-4A-13) by >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year of the 82-year modeling period. The combination of number of days and degrees above each threshold were further assigned a “level of concern”, as defined in Table 11-4A-14. Differences between baselines and H4_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-110. For the 61°F threshold, there would be 1 more (3% increase) “red” year and 3 fewer (14% reduction) “orange” years under H4_ELT than under NAA_ELT, which would not be biologically meaningful. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between NAA_ELT and H4_ELT.

Table 11-4A-110. Differences between Baselines and H4_ELT Scenario in the Number of Years in Which Water Temperature Exceedances above the 61°F and 68°F Thresholds are within Each Level of Concern, Sacramento River at Hamilton City, March through June

Level of Concern	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
61°F threshold		
Red	29 (363%)	1 (3%)
Orange	3 (20%)	-3 (-14%)
Yellow	-14 (-45%)	0 (0%)
None	-18 (-64%)	2 (25%)
68°F threshold		
Red	0 (NA)	0 (NA)
Orange	0 (NA)	0 (NA)
Yellow	1 (NA)	-1 (-50%)
None	-1 (-1%)	1 (1%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

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

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-4A-111, Table 11-4A-112). Total degree-days exceeding the 61°F threshold under H4_ELT would be 2 degree-days (67%) greater than those under NAA_ELT during March and 3 degree-days (2%) greater during April, which would not be biologically meaningful. During the May and June, there would be reductions of 152 degree-days (6%) and 29 degree-days (1%) between NAA_ELT and H4_ELT in total degree-days exceeding the 61°F threshold. Total degree-days exceeding the 68°F threshold would be similar between NAA_ELT and H4_ELT for all four months.

Table 11-4A-111. Differences between Baselines and H4_ELT in Total Degree-Days (°F-days) by Month and Water Year Type for Water Temperature Exceedances above 61°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
March	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	2 (NA)	2 (NA)
	Dry	3 (NA)	0 (0%)
	Critical	0 (NA)	0 (NA)
	All	5 (NA)	2 (67%)
April	Wet	18 (150%)	0 (0%)
	Above Normal	14 (140%)	-1 (-4%)
	Below Normal	20 (333%)	0 (0%)
	Dry	49 (96%)	6 (6%)
	Critical	2 (200%)	-2 (-40%)
	All	103 (129%)	3 (2%)
May	Wet	488 (147%)	9 (1%)
	Above Normal	158 (72%)	-78 (-17%)
	Below Normal	273 (148%)	4 (1%)
	Dry	267 (132%)	-47 (-9%)
	Critical	186 (92.1%)	-40 (-9%)
	All	1,372 (120%)	-152 (-6%)
June	Wet	487 (84%)	-3 (0%)
	Above Normal	265 (87%)	58 (11%)
	Below Normal	237 (112%)	-10 (-2%)
	Dry	325 (97%)	-5 (-1%)
	Critical	167 (45%)	-69 (-11%)
	All	1,481 (82%)	-29 (-1%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
NA = could not be calculated because the denominator was 0.

Table 11-4A-112. Differences between Baselines and H4_ELT in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 68°F in the Sacramento River at Hamilton City, March through June

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
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	9 (129%)	0 (0%)
	Above Normal	12 (NA)	-1 (-8%)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	0 (0%)
	All	22 (314%)	-1 (-3%)
June	Wet	2 (NA)	0 (0%)
	Above Normal	4 (400%)	3 (150%)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	1 (NA)	0 (0%)
	All	7 (700%)	3 (60%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
NA = could not be calculated because the denominator was 0.

Feather River

Mean flows under H4_ELT in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River during the February to May would be similar to or up to 518% greater than flows under NAA_ELT at Thermalito and up to 12% greater at the confluence.

Mean water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period. Mean monthly water temperatures would not differ between NAA_ELT and H4_ELT at either location throughout the period.

San Joaquin River

Mean monthly flows in the San Joaquin River at Vernalis under H4_ELT during February through May would be similar to those under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted for the San Joaquin River.

NEPA Effects: Collectively, these modeling results indicate that the effect is not adverse because it does not have the potential to substantially reduce the amount of suitable habitat. Flows under Alternative 4A would generally be higher in the Feather River relative to the NAA_ELT and generally similar to flows under the NAA_ELT in the Sacramento and San Joaquin Rivers. Alternative 4A would not affect temperatures in any river during the white sturgeon spawning and egg incubation period. Results would generally be similar between H3_ELT and H4_ELT.

CEQA Conclusion: Collectively, the results of the Impact AQUA-148 CEQA analysis show that the difference between the CEQA baseline and Alternative 4A could be significant because, when compared to the CEQA baseline, the alternative would substantially reduce the quantity and quality of spawning and egg incubation habitat for white sturgeon relative to Existing Conditions. However, as further described below in the Summary of CEQA Conclusion, the comparison to the NAA_ELT is a better approach because it isolates the effects of the alternative from those of sea level rise, climate change, and future water demand. Based on this identification of the actual increment of change attributable to the alternative, Alternative 4A would not affect the quantity and quality of spawning and egg incubation habitat for white sturgeon relative to the Existing Conditions.

H3_ELT /ESO_ELT

Sacramento River

Flows in the Sacramento River at Wilkins Slough and Verona were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). At Wilkins Slough, mean flows under H3_ELT would generally be similar to those under Existing Conditions. At Verona, mean flow under H3_ELT for most of the months and water year types would be slightly lower (less than 10% lower) than flows under Existing Conditions during February and April, and similar during March and May.

Mean water temperatures in the Sacramento River at Hamilton City were examined during the February through May white sturgeon spawning 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 Existing Conditions and H3_ELT in any month or water year type throughout the period

The number of days when temperatures exceeded the analysis criterion (i.e., 61°F optimal and 68°F lethal threshold identified in Table 11-4A-13) by >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year of the 82-year modeling period. The combination of number of days and degrees above each threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between baselines and H3_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-107. For the 61°F threshold, there would be 23 more (288% increase) "red" years under H3_ELT than under Existing Conditions. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between Existing Conditions and H3_ELT.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-4A-108, Table 11-4A-109). Total degree-days exceeding the 61°F threshold under H3_ELT would be 5 degree-days (percent change unable to be calculated due to division by 0) to 1,256 degree-days (110%) higher depending on month. Total degree-days exceeding the 68°F threshold would not differ between Existing Conditions and H3_ELT during March and April. During May and June, total degree-days would be 13 (186%) and 2 (200%) degree-days higher under H3_ELT, although these small absolute differences would not have a biologically meaningful effect on white sturgeon.

Feather River

Flows in the Feather River between Thermalito Afterbay and the confluence with the Sacramento River were examined during the February to May spawning and egg incubation period for white sturgeon (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Differences in mean flows between H3_ELT and Existing Conditions at Thermalito Afterbay would vary greatly during the period. Mean flows during February and March would be up to 48% lower under H3_ELT in below normal and dry water years and would be similar or moderately higher in other water year types, while in April and May they would be up to 33% higher depending on water year type. Mean flows at the confluence with the Sacramento River under H3_ELT would generally be similar to or greater than flows under Existing Conditions, except in below normal years during February and March (14% and 15% lower, respectively). These results indicate that there would be some reductions in flows in the Feather River under H3_ELT relative to Existing Conditions.

Mean water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures would not differ (<5%) between Existing Conditions and H3_ELT at either location throughout the period.

San Joaquin River

Mean flows under H3_ELT were examined in the San Joaquin River at Vernalis during February through May. Flows under H3_ELT during March and April would be up to 12% lower than those under Existing Conditions, whereas flows under H3_ELT during February and May would be similar to those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted for the San Joaquin River.

H4_ELT/HOS_ELT

Sacramento River

Mean flows under H4_ELT in the Sacramento River at Wilkins Slough and Verona during February to May would generally be similar to or lower than flows under Existing Conditions, except during April and May at Verona, in which flows under H4_ELT would be up to 30% greater (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Hamilton City were examined during the February through May white sturgeon spawning 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 Existing Conditions and H4_ELT in any month or water year type throughout the period.

The number of days when temperatures exceeded the analysis criterion (i.e., 61°F optimal and 68°F lethal threshold identifies in Table 11-4A-13) by >0.5°F to >5°F in 0.5°F increments were determined for each month (March through June) and year of the 82-year modeling period. The combination of number of days and degrees above each threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between baselines and H4_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-110. For the 61°F threshold, there would be 29 more (363% increase) "red" years under H4_ELT than under Existing Conditions. For the 68°F threshold, there would be negligible differences in the number of years under each level of concern between Existing Conditions and H4_ELT.

Total degree-days exceeding 61°F and 68°F were summed by month and water year type at Hamilton City during March through June (Table 11-4A-108, Table 11-4A-109). Total degree-days exceeding the 61°F threshold under H4_ELT would be 5 degree-days (percent change unable to be calculated due to division by 0) to 1,481 degree-days (82%) higher depending on month. Total degree-days exceeding the 68°F threshold would not differ between Existing Conditions and H4_ELT during March and April. During May and June, total degree-days under H4_ELT would be 22 (314%) and 7 (700%) degree-days higher, although these small absolute differences would not have a biologically meaningful effect on white sturgeon.

Feather River

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay and the confluence with the Sacramento River during the February to May would generally be similar to or up to 22% lower than flows under Existing Conditions during February and March and would be up to 509% greater than flows under Existing Conditions during April and May, except for critical water years in which flows would be similar for the two scenarios. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Feather River below Thermalito Afterbay and at the confluence with the Sacramento River were examined during the February through May white sturgeon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would not differ between Existing Conditions and H4_ELT at either location throughout the period.

San Joaquin River

Mean flows under H4_ELT in the San Joaquin River would generally be similar or up to 12% lower than flows under Existing Conditions.

Summary of CEQA Conclusion

Under Alternative 4A, there would be small to moderate, persistent reductions in flows in the Sacramento, Feather, and San Joaquin Rivers that would cause biologically meaningful effects to white sturgeon spawning and egg incubation habitat. Further, there would be increases in exceedances of NMFS temperature thresholds in the Sacramento River that would cause a biologically meaningful effect to white sturgeon spawning and egg incubation. Results would generally be consistent between H3_ELT and H4_ELT. Contrary to the NEPA conclusion set forth above, these modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce the quantity and quality of suitable spawning and egg incubation habitat.

However, this interpretation of the biological modeling results is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA_ELT) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. The comparison to the NAA_ELT is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

When compared to NAA_ELT and informed by the NEPA analysis above, flows under Alternative 4A would generally be higher in the Feather River and generally similar in the Sacramento and San Joaquin Rivers. Alternative 4A would not affect temperatures in any river during the white sturgeon spawning and egg incubation period. These modeling results represent the increment of change attributable to the alternative, demonstrating the similarities in flows, reservoir storage, and water temperature under Alternative 4A and the NAA_ELT, and addressing the limitations of the CEQA baseline (Existing Conditions). Therefore, this impact is found to be less than significant and no mitigation is required.

Impact AQUA-149: Effects of Water Operations on Rearing Habitat for White Sturgeon

In general, Alternative 4A would not affect quantity and quality of white sturgeon larval and juvenile rearing habitat relative to the NAA_ELT.

Water temperature was used to determine the potential effects of alternatives on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

H3_ELT/ESO_ELT

Mean water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon 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 water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Mean water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon 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 water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period

Water temperatures were not modeled in the San Joaquin River.

H4_ELT /HOS_ELT

Mean monthly water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon 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_ELT and H4_ELT in any month or water year type throughout the period.

Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon 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_ELT and H4_ELT in any month or water year type throughout the period.

Water temperatures were not modeled in the San Joaquin River.

NEPA Effects: These modeling results indicate that the effect is not adverse because it does not have the potential to substantially reduce the amount of suitable habitat. There would be no differences in water temperatures between Alternative 4A and the NAA_ELT. Results would be similar between H3_ELT and H4_ELT.

CEQA Conclusion: In general, Alternative 4A would not affect the quantity and quality of white sturgeon larval and juvenile rearing habitat relative to Existing Conditions.

Water temperature was used to determine the potential effects of alternatives on white sturgeon larval and juvenile rearing habitat because larvae and juveniles are benthic-oriented and, therefore, their habitat is more likely to be limited by changes in water temperature than flow rates.

H3_ELT /ESO_ELT

Mean water in the Sacramento River at Hamilton City were examined during the year-round white sturgeon 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 water temperature between Existing Conditions and H3_ELT in any month or water year type throughout the period.

Mean water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures would be similar between Existing Conditions and H3_ELT during all months and water year types except July of critical water years and August of dry years, in which the means would be 7% and 6% higher, respectively, under H3_ELT.

Water temperatures were not modeled in the San Joaquin River.

H4_ELT/HOS_ELT

Mean water temperatures in the Sacramento River at Hamilton City were examined during the year-round white sturgeon 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 water temperature between Existing Conditions and H4_ELT in any month or water year type throughout the period.

Mean monthly water temperatures in the Feather River at Honcut Creek were examined during the year-round white sturgeon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures would be similar between Existing Conditions and H4_ELT during all months and water year types except July of dry and critical water years, in which temperatures under H4_ELT would be 5% and 6% higher, and August of dry years, in which the temperature would be 6% higher.

Water temperatures were not modeled in the San Joaquin River.

Summary of CEQA Conclusion

These modeling results indicate that the effect is less than significant because it does not have the potential to substantially reduce the amount of suitable habitat and no mitigation is required. There would be few differences in water temperatures between Alternative 4A and the CEQA baseline. Results would be similar between H3_ELT and H4_ELT.

Impact AQUA-150: Effects of Water Operations on Migration Conditions for White Sturgeon

In general, effects of Alternative 4A on white sturgeon migration conditions relative to NAA_ELT are not adverse.

Upstream of the Delta

H3_ELT/ESO_ELT

Analyses for white sturgeon focused on the Sacramento River (North Delta to RM 143—i.e., Wilkins Slough and Verona CALSIM nodes). Larval transport flows were represented by the average number of months per year that exceeded thresholds of 17,700 cfs (Wilkins Slough) and 31,000 cfs (Verona) (Table 11-4A-113). Exceedances of the 17,700 cfs threshold for Wilkins Slough and the 31,000 cfs threshold at Verona under H3_ELT would generally be similar to those under NAA_ELT. Despite some large relative difference (up to 25%), the changes on an absolute scale would be small (up to 0.2 fewer months per year).

Table 11-4A-113. Difference and Percent Difference in Number of Months in Which Flow Rates Exceed 17,700 and 5,300 cfs in the Sacramento River at Wilkins Slough and 31,000 cfs at Verona

	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wilkins Slough, 17,700 cfs[a]		
Wet	-0.1 (-4%)	0 (0%)
Above Normal	0.1 (6%)	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%)	-0.1 (-1%)
Above Normal	-0.3 (-4%)	0 (0%)
Below Normal	-0.2 (-4%)	0.1 (3%)
Dry	-0.1 (-1%)	0 (0%)
Critical	0 (0%)	-0.1 (-2%)
Verona, 31,000 cfs[a]		
Wet	-0.4 (-16%)	-0.2 (-8%)
Above Normal	0 (0%)	0 (0%)
Below Normal	-0.1 (-29%)	-0.1 (-17%)
Dry	-0.1 (-40%)	-0.1 (-25%)
Critical	0 (NA)	0 (NA)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

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

[a] Months analyzed: February through May.

[b] Months analyzed: November through May.

The effects of changes in flow for white sturgeon under Alternative 4A was 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 transport (e.g., for white sturgeon larvae or other early life stages) that results in improved year class strength. An examination of monthly average Delta outflow exceedances above 15,000 cfs, 20,000 cfs, and 25,000 cfs during April and May of wet and above-normal years was used to provide context for differences in through-Delta migration conditions, per recommendations by the Anadromous Fish Restoration Program (USFWS 1995). The percentage of months exceeding flow thresholds under H3_ELT would generally be lower than those under NAA_ELT (up to 50% lower) (Table 11-4A-114). These results indicate that, using the positive correlation between Delta outflow and year class strength, year class strength generally would be lower under H3_ELT.

Table 11-4A-114. 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. H3_ELT	NAA_ELT vs. H3_ELT	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
April					
15,000 cfs	Wet	-4 (-4%)	-4 (-4%)	4 (4%)	4 (4%)
	Above Normal	-17 (-18%)	-17 (-18%)	(0%)	(0%)
20,000 cfs	Wet	-8 (-9%)	-8 (-9%)	15 (18%)	15 (18%)
	Above Normal	-33 (-44%)	-33 (-44%)	8 (11%)	8 (11%)
25,000 cfs	Wet	-19 (-24%)	-19 (-24%)	12 (14%)	12 (14%)
	Above Normal	-17 (-29%)	-17 (-29%)	25 (43%)	25 (43%)
May					
15,000 cfs	Wet	-12 (-13%)	-12 (-13%)	8 (9%)	8 (9%)
	Above Normal	-33 (-40%)	-25 (-33%)	(0%)	8 (11%)
20,000 cfs	Wet	-27 (-32%)	-15 (-21%)	-4 (-5%)	8 (11%)
	Above Normal	-17 (-40%)	-8 (-25%)	25 (60%)	33 (100%)
25,000 cfs	Wet	-19 (-28%)	-12 (-19%)	-8 (-11%)	(0%)
	Above Normal	-17 (-50%)	-17 (-50%)	(0%)	(0%)
April/May Average					
15,000 cfs	Wet	-8 (-8%)	-4 (-4%)	4 (4%)	8 (8%)
	Above Normal	-17 (-17%)	-17 (-17%)	(0%)	(0%)
20,000 cfs	Wet	-15 (-17%)	-15 (-17%)	8 (9%)	8 (9%)
	Above Normal	-17 (-25%)	-8 (-14%)	17 (25%)	25 (43%)
25,000 cfs	Wet	-19 (-24%)	-12 (-16%)	(0%)	8 (11%)
	Above Normal	-17 (-33%)	-17 (-33%)	25 (50%)	25 (50%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

For juveniles, flows in the Sacramento River at Verona were examined during the year-round migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at Verona under H3_ELT would be lower by up to 22% relative to NAA_ELT during July, September and November, greater by up to 35% greater during June, and similar in the remaining eight months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

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 11-4A-113). The average number of months exceeding 5,300 cfs under H3_ELT would be similar to the number of months under NAA_ELT.

H4_ELT/HOS_ELT

Year-round flows under H4_ELT in the Sacramento River at Verona would be similar to those under NAA_ELT, except during June, in which mean flows under H4_ELT would be up to 35% higher, during July through September and November, in which flows would be up to 22% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For H4_ELT, the percentage of months exceeding the USFWS's (1995) recommended Delta outflow thresholds in April and May of wet and above normal years was similar or considerably greater than NAA_ELT (Table 11-4A-114). These results indicate that, using the positive correlation between Delta outflow and year class strength, year class strength generally would be similar or greater under H4_ELT relative to NAA_ELT.

Through-Delta

As described for other species (e.g., Sacramento splittail in Impact AQUA-114), migration conditions in the southern Delta generally would be considerably improved relative to NAA_ELT, because of reduced frequency of reverse OMR flows. The range of Alternative 4A operations (i.e., H3_ELT and H4_ELT) includes a range of Delta outflows, as described above (see Table 11-4A-114), which is discussed further below.

NEPA Effects: Upstream flows (above north Delta intakes) would generally be similar between Alternative 4A and NAA_ELT. As noted for green sturgeon and described above, due to the removal of water at the North Delta intakes, there are substantial differences in through-Delta flows between Alternative 4A and NAA_ELT. The percentage of months exceeding the USFWS (1995) Delta outflow thresholds in April and May of wet and above normal years was appreciably lower than NAA_ELT for Alternative 4A's H3_ELT scenario, but was similar or considerably greater than NAA_ELT for Alternative 4A's H4_ELT scenario (Table 11-4A-114). As noted for Alternative 4 and in the analysis of green sturgeon, the exact mechanism for the correlation between white sturgeon year-class strength and Delta outflow is not known at this time.

The scientific uncertainty regarding which mechanisms are responsible for the positive correlation between year class strength and river/Delta flow will be addressed through targeted research and monitoring to be conducted in the years leading up to the initiation of north Delta facilities operations as described in the adaptive management and monitoring program in Section 4.1 to inform decisions regarding Delta outflow such that the effect on white sturgeon Delta flow conditions would not be adverse. This uncertainty and the associated adaptive management and monitoring program, combined with similarities in upstream flow conditions between Alternative 4A and NAA_ELT, indicate that Alternative 4A would not be adverse to migration conditions for white sturgeon.

CEQA Conclusion: In general, Alternative 4A would reduce the quantity and quality of migration habitat for white sturgeon relative to Existing Conditions. However, as further described below in the Summary of CEQA Conclusion, reviewing the alternative's impacts in relation to the NAA_ELT is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demand. Informed by the NAA_ELT comparison, Alternative 4A would not affect the quantity and quality of migration habitat for white sturgeon.

Upstream of the Delta

H3_ELT/ESO_ELT

The number of months per year with exceedances above the 17,700 cfs threshold for Wilkins Slough under H3_ELT would be similar to those under Existing Conditions on the relative scale (%), except in below normal years (25% lower) (Table 11-4A-113). The number of months per year exceeding

31,000 cfs at Verona under H3_ELT would be up to 40% lower than those under Existing Conditions. All of these changes would be small to moderate on the absolute scale (up to 0.4 fewer months per year).

For Delta outflow, the percent of months exceeding outflow thresholds under H3_ELT would consistently be lower than those under Existing Conditions for each flow threshold, water year type, and month (4% to 50% lower on a relative scale) (Table 11-4A-114).

For juveniles, flows in the Sacramento River at Verona were examined during the year-round migration period. In general, mean flows under H3_ELT would be similar or lower relative to Existing Conditions during January through May and July through December, with the largest reductions in flow (up to 31% lower) during July through September. Flows under H3_ELT would be higher (up to 50%) during June of above normal, below normal, and dry water years and during September of wet and above normal water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

For adult migration, the average number of months per year exceeding 5,300 cfs at Wilkins Slough under H3_ELT would be similar to or slightly lower than the number of months under Existing Conditions (up to 4% lower) (Table 11-4A-113).

H4_ELT/HOS_ELT

Year-round flows under H4_ELT in the Sacramento River at Verona would be similar to or up to 43% greater than flows under Existing Conditions during April through June, September, and December, and up to 28% lower than flows under Existing Conditions in the remaining 7 months (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Through-Delta

Given the improved OMR flows and the range of Delta outflows under Alternative 4A's H3_ELT and H4_ELT that would be refined to avoid negative impacts to green sturgeon (see NEPA Effects discussion above), the potential impact of Alternative 4A on in-Delta conditions for white sturgeon is considered less than significant, and no mitigation would be required.

Summary of CEQA Conclusion

Under Alternative 4A, the exceedance of flow thresholds in the Sacramento River would be lower than under Existing Conditions. Exceedance of Delta outflow thresholds would be lower under Alternative 4A's H3_ELT scenario than under Existing Conditions, but would be similar or greater than under Existing Conditions for the H4_ELT scenario, although there is high uncertainty that year class strength is due to Delta outflow or if both year class strength and Delta outflows are co-varying with another unknown factor. Juvenile migration flows in the Sacramento River at Verona would be up to 31% lower in six (for H3_ELT) or seven (for H4_ELT) of 12 months relative to Existing Conditions. These reduced flows would have a substantial effect on the ability to migrate downstream, delaying or slowing rates of successful migration downstream and increasing the risk of mortality. Contrary to the NEPA conclusion set forth above, these modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce migration conditions for white sturgeon.

However, this interpretation of the biological modeling is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA_ELT) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. This suggests that the comparison in results between the alternative and NAA_ELT, is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

When compared to NAA_ELT and informed by the NEPA analysis above, there would be negligible effects on upstream flows.

In addition and as noted for green sturgeon, Real Time Operations described for the water conveyance facilities allow for optimization of short-term adjustments. This will ensure that the impacts of water operations on migration conditions for white sturgeon are less than significant. The adaptive management and monitoring program will evaluate water operations to ensure the impacts of water operations on migration conditions for white sturgeon are less than significant. Therefore, this impact is found to be less than significant and no mitigation is required.

Restoration Measures (Environmental Commitment 2, Environmental Commitment 4–Environmental Commitment 7, and Environmental Commitment 10)

As described for other covered fishes, Alternative 4A includes a greatly reduced extent of restoration measures relative to Alternative 4 and Alternative 1A. The mechanisms of impacts of habitat restoration discussed for winter-run Chinook salmon generally would be similar for white sturgeon. As noted for green sturgeon, white sturgeon may inhabit the Delta year-round and would be more likely to encounter any effects from restoration measures. However, because the extent of restoration is limited to offsetting losses from construction of the water conveyance facilities, any such effects would be greatly limited compared to Alternative 1A and 4, for example.

Impact AQUA-151: Effects of Construction of Restoration Measures on White Sturgeon

The discussion of Impact AQUA-133 for green sturgeon also is applicable to white sturgeon.

NEPA Effects: The effects of short-term construction activities would not be adverse to white sturgeon because environmental commitments would limit the potential for construction-related effects.

CEQA Conclusion: As discussed for Alternative 1A, habitat restoration activities could result in short-term effects on white sturgeon but would be localized, sporadic, and of low magnitude; such effects would be avoided by limiting the frequency, duration, and spatial extent of in-water work and with implementation of environmental commitments (see Appendix 3B, *Environmental Commitments*). The potential impact of habitat restoration activities is considered less than significant because it would not substantially reduce white sturgeon habitat, restrict its range, or interfere with its movement. No additional mitigation would be required.

Impact AQUA-152: Effects of Contaminants Associated with Restoration Measures on White Sturgeon

The discussion of Impact AQUA-134 for green sturgeon also is applicable to white sturgeon.

NEPA Effects: While Alternative 4A habitat restoration actions may result in a very small increase production, mobilization, and bioavailability of methylmercury, selenium, copper, and pesticides in the aquatic system, any such releases would be short-term and localized, and would be unlikely to result in measurable increases in the bioaccumulation of these contaminants in white sturgeon. Alternative 4A would restore 59 acres of tidal wetlands that, depending on the specific site conditions of the restoration, may result in the colonization of benthic grazers that bioaccumulate selenium. As sturgeon are benthic feeders, the increased habitat for grazers may result in increased exposure to selenium. However, the small amount of area to be restored would not result in a substantial change in exposure potential. Overall, the effects of contaminants associated with restoration measures would not be adverse for white sturgeon.

CEQA Conclusion: Habitat restoration under Alternative 4A may result in increased production, mobilization, and bioavailability of contaminants in the aquatic system, but these would be short-term and localized, and would be unlikely to result in measurable increases in the bioaccumulation in white sturgeon. For methylmercury, implementation of *Environmental Commitment 12 Methylmercury Management* would help to minimize the increased mobilization of methylmercury in the limited restoration areas. Therefore, the impact of contaminants is considered less than significant because it would not substantially affect white sturgeon either directly or through habitat modifications. Accordingly, no mitigation would be required.

Impact AQUA-153: Effects of Restored Habitat Conditions on White Sturgeon

Restored habitat under *Environmental Commitment 4 Tidal Natural Communities Restoration* and *Environmental Commitment 6 Channel Margin Enhancement* is intended to offset habitat loss/modification caused by construction and operation of the water facilities proposed under Alternative 4A.

NEPA Effects: The effects of restored habitat conditions on white sturgeon would not be adverse because restoration is intended to provide habitat benefits for white sturgeon.

CEQA Conclusion: As described above, habitat restoration activities could result in short-term effects on white sturgeon, primarily as a result of increased potential for contaminated sediments to enter the water column. However, these effects are likely to be localized, sporadic, and of low magnitude. Adverse effects during restoration would be avoided by limiting the frequency, duration, and spatial extent of in-water work and implementing the commitments described in detail under Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*. The potential impact of habitat restoration activities is considered less than significant because it would not substantially reduce white sturgeon habitat, restrict its range or interfere with its movement. Additionally, there would be substantial long-term net benefits of habitat restoration. Consequently, no additional mitigation would be required.

Other Environmental Commitments (Environmental Commitment 12, Environmental Commitment 15, and Environmental Commitment 16)

As noted for other covered species such as green sturgeon, Alternative 4A includes three other Environmental Commitments, which are reduced in their extent relative to the Conservation

Measures included in other Alternatives (e.g., Alternative 1A and Alternative 4). While the extent of these measures is reduced compared to these alternatives, the nature of the mechanisms for white sturgeon remains the same.

Impact AQUA-154: Effects of Methylmercury Management on White Sturgeon (Environmental Commitment 12)

The impact discussion for winter-run Chinook salmon (Impact AQUA-46) is also applicable to white sturgeon.

NEPA Effects: The effects of methylmercury management on white sturgeon would not be adverse because it is expected to reduce overall methylmercury levels resulting from habitat restoration.

CEQA Conclusion: As noted for winter-run Chinook salmon, effects of *Environmental Commitment 12 Methylmercury Management* within the areas restored under Alternative 4A are expected to reduce overall methylmercury levels resulting from habitat restoration. Because it is designed to improve water quality and habitat conditions, impacts on white sturgeon would be less than significant. Consequently, no mitigation is required.

Impact AQUA-157: Effects of Localized Reduction of Predatory Fish on White Sturgeon (Environmental Commitment 15)

The discussion of Impact AQUA-139 for green sturgeon also is applicable to white sturgeon.

NEPA Effects: The overall effect would not be adverse because it is unlikely that the targeted predators prey on white sturgeon and because the white sturgeon bycatch is expected to be minimal.

CEQA Conclusion: Consistent with the analysis for Alternative 1A, the impact is considered less than significant because it is unlikely that the targeted predators prey on white sturgeon and because the white sturgeon bycatch is expected to be minimal. Consequently, no mitigation would be required.

Impact AQUA-158: Effects of Nonphysical Fish Barriers on White Sturgeon (Environmental Commitment 16)

The discussion of Impact AQUA-140 for green sturgeon also is applicable to white sturgeon.

NEPA Effects: The overall effect would not be adverse because the NPB would not be located in the same portion of the channel that white sturgeon are expected to occur and because their hearing ability is low within the range of sound that the NPB generates.

CEQA Conclusion: Consistent with the analysis for Alternative 1A, the impact is considered less than significant because the NPB would not be located in the same portion of the channel that white sturgeon are expected to occur and because their hearing ability is low within the range of sound that the NPB generates. Consequently, no mitigation would be required.