7 Effects Determination

7.1 Introduction

The Biological Assessment's (BA) determination of effects for listed species and their designated critical habitat considers direct and indirect effects of the proposed action (PA) together with the effect of other activities that are interrelated or dependent on the PA. The BA also considers effects associated with actions identified in the environmental baseline and effects anticipated to result from future state or private activities that are reasonably certain to occur (cumulative effects). This Chapter presents a summary of the effects for listed species and their designated critical habitat discussed in detail in Chapters 4 to 6 of the BA. The effects determinations for terrestrial species in Suisun Marsh are provided in Appendix 6.C, *Suisun Marsh Species*.

7.2 Chinook Salmon, Sacramento River Winter-run ESU

7.2.1 Sacramento River Upstream of Delta

Upstream quantitative analyses of temperature and flow effects are based on CalSim II modeling. The uncertainties associated with using CalSim II outputs must be considered in interpreting biological analyses (Appendix 5.A, *CALSIM Methods and Results*). CalSim II is a long-term planning model that allows for quantitative simulation of the CVP and SWP operations on a monthly time-step across a wide range of hydrologic, regulatory and operations instances. CalSim II uses a set of pre-defined generalized rules, which represent the assumed regulations, to specify operations of the CVP/SWP. These rules are often specified as a function of year type or a prior month's simulated storage or flow condition. As described above, the model has no capability of adjusting these rules to respond to specific events that may have occurred historically, e.g., fish presence, levee failures, fluctuations in barometric pressure that may have affected Delta tides and salinities, facility outages, etc. These generalized rules have been developed based on historical operational trends and on limited CVP/SWP operator input and only provide a coarse representation of the project operations over the inputted hydrologic conditions. Thus, results do not exactly match what operators might do in a specific month or year within the simulation period since the latter will be informed by numerous real-time considerations that cannot be input to CalSim II. Rather, results are intended to be a reasonable representation of long-term operational trends of CVP and SWP, providing the ability to compare and contrast the effect of current and assumed future operational conditions.

Analysis of potential effects of the PA on Sacramento River winter-run Chinook salmon in the Sacramento River upstream of the Delta found differences between the NAA and PA that include

- Increased frequency of water temperature threshold exceedances during August through October coinciding with the winter-run Chinook salmon spawning and rearing period;
- Increased risk of redd dewatering for egg cohorts spawned in June and August; and
- Reduced flows in above normal, below normal, and dry water years during September and in wet and above normal water years during November that could affect juvenile migration.

The reduced Shasta releases associated with the PA's operational modeling result in the modeled increased frequency of the water temperature threshold exceedances during September. However, modeling of the cold-water pool volume, which is more indicative of temperature management, suggests PA end-of-September storage similar to that of the NAA (Appendix 5.C, *Upstream Water Temperature Methods and Results*). Based on the proposed decision making approaches and criteria for real-time cold-water pool management efforts described in Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and 3.3.3, *Real-Time Operational Decision-Making Process*, releases from Shasta Lake under the PA will be at similar levels as the NAA during September. Thus, the PA will not result in higher September water temperatures. Considering these results, the frequency and magnitude of differences in effects between NAA and the PA are so small as to be biologically insignificant to the species. The PA will provide flows and water temperatures for spawning, rearing, and migration consistent with those required by NMFS (2009, 2011). As such, there will be no take of winter-run Chinook salmon in areas upstream of the Delta, other than the take previously authorized by NMFS (2009).

The effects described above will be further minimized, in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by day-to-day decision-making on the part of the CVP/SWP operators. These decisions consider the recommendations from many of the decision-making/advisory teams, such as the Sacramento River Temperature Technical Group (SRTTG), Water Operations Management Team (WOMT), b2 interagency team (B2IT) and American River Operations Group. The current decision-making processes and the advisory groups will continue and will be improved under the PA (Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and Section 3.3, *Operations and Maintenance for the New and Existing Facilities*). A separate real time operations coordination team (RTOCT) will meet to assist DWR and Reclamation in fulfilling their responsibility to inform the SWP and CVP participants regarding available information and real-time decisions. This coordination effort may also periodically review how to enhance or strengthen the scientific and technical information used to inform decision-making, and how to communicate with the public and other interested parties. This revised process and RTOCT will allow for alternative criteria to be developed, based on the results of coordinated monitoring and research under real-time operations (RTO) and the Adaptive Management Program, that will continue to address effects to listed species under future operations of the PA consistent with the applicable requirements of the ESA, while maximizing water supplies.

In addition, Reclamation will work with NMFS and other state and Federal agencies to adjust the RPA Action Suite 1.2, as described in Section 3.1.4.5, *Annual/Seasonal Temperature Management Upstream of the Delta*. This process is anticipated to conclude in the fall of 2016, and may include refinements and additions to the existing annual/seasonal temperature management processes, including spring storage targets, revised temperature compliance criteria and a range in summertime Keswick release rates. The adjusted RPA Action Suite I.2 will apply to Reclamation's Shasta operations. This RPA revision process is intended to improve egg-to-fry survival of winter-run Chinook salmon to Red Bluff, but would likely improve survival of other races of Chinook salmon, steelhead, and green sturgeon, depending on the timing of refinements that will be made.

7.2.2 Sacramento-San Joaquin Delta

The PA is expected to result in incidental take of Sacramento River winter-run Chinook salmon associated with construction effects of the PA by mechanisms including underwater noise from pile driving, in-water use of construction equipment, fish rescue efforts, and possibly the accidental discharge of contaminants (Section 5.2, *Effects of Water Facility Construction on Fish*). The effects of construction activities will be minimized through avoidance and minimization measures. Temporary and permanent habitat losses will be offset by 4.3 miles of channel margin enhancement and 154.8 acres of tidal perennial habitat restoration (Table 3.4-1).

The PA has the potential to result in incidental take of Sacramento River winter-run Chinook salmon through operational effects that include entrainment (Sections 5.4.1.3.1.1.1.1 *Entrainment* and 5.4.1.3.1.1.2.1 *Entrainment*), impingement (Section 5.4.1.3.1.1.1.2 *Impingement and Screen Contact*), and predation (Sections 5.4.1.3.1.1.1.3 *Predation* and 5.4.1.3.1.1.2.2 *Predation*) at the NDD (see also Section 5.4.1.4.1.1.1 *Risk to Salmonids from North Delta Exports*) and south Delta facilities (see also Section 5.4.1.4.1.1.2 *Risk to Salmonids from South Delta Exports*), and changes in flows that may affect migratory success (Section 5.4.1.3.1.2.1 *Indirect Mortality Within the Delta;* Section 5.4.1.4.1.2.1 *Risk to Salmonids from Indirect Mortality Within the Delta*) and availability of inundated riparian bench habitat (Section 5.4.1.3.1.2.2.1.1 *Operational Effects;* Section 5.4.1.4.1.2.2 *Risk to Salmonids from Changes in Habitat Suitability*). PA operations in compliance with NMFS (2009) BiOp conditions together with the additional PA proposed operational criteria for south Delta, NDD, and DCC provide protection during the winter and spring, thereby reducing the impact of CVP/SWP Delta operations on Chinook salmon. The RTO and adaptive management and monitoring provisions included in the PA provide additional opportunities to refine the operating criteria and make adjustments to the CVP/SWP Delta operations to minimize the risk of incidental take while maximizing water supply. Adverse operational effects will be offset by restoring channel margin habitat (Section 5.4.1.3.1.2.2.1.2 *Channel Margin Enhancement*) and installing a nonphysical barrier at the Sacramento River-Georgiana Slough divergence (Section 5.4.1.3.1.2.1.2.2 *Nonphysical Fish Barrier at Georgiana Slough*). Projected operation of other Delta facilities (for example, the North Bay Aqueduct, Rock Slough Diversion, and the Suisun Marsh Salinity Control Gates [SMSCG]) is expected to result in a discountable risk of incidental take of Sacramento River winter-run Chinook salmon (Sections 5.4.1.3.1.1.5 through 5.4.1.3.1.1.7, *Suisun Marsh Facilities, North bay Aqueduct*, and *Other Facilities*, respectively; Sections 5.4.1.4.1.1.5 through 5.4.1.4.1.1.7 *Risk to Salmonids from Suisun Marsh Facilities, Risk to Salmonids from North Bay Aqueduct*, and *Risk to Salmonids from Other Facilities*, respectively).

7.2.3 Cumulative Effects and the Changing Baseline

Cumulative effects on Sacramento River winter-run Chinook salmon include effects associated with water diversions, agricultural practices, increased urbanization, and wastewater treatment plants. These effects will accrue over the duration of the PA. Non-federal water diversions are potentially a cause of mortality via entrainment, but ongoing projects such as the CVPIA fish screen program are reducing the number of such diversions and their mortality risk, so this effect is likely to diminish over time. Potentially adverse agricultural practices primarily entail water quality impairments; the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects, so this effect is likely to be maintained in the future. Adverse effects of urbanization include point and nonpoint-source water quality impairments, and increased vessel traffic in waterways. These activities are likely to further degrade Chinook salmon habitat over time. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; thus this stressor is likely to diminish over time. Some of these effects will improve, and others will impair habitat quality for Chinook salmon in the action area; their net effect is to approximately maintain current conditions for the foreseeable future because improvements are generally implemented to compensate for adverse project effects through the ESA consultation and other environmental review processes. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

The environmental baseline for Sacramento River winter-run Chinook salmon is described in Chapter 4. Due to the span of time until the beginning of water operations under the proposed action, and over the course of the proposed operations, the baseline is expected to change. The principal such changes concern climate change, and certain federal actions that are reasonably certain to occur but have not yet been implemented.

Foreseeable climate change effects, described in Section 4.3.2.1 *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for Chinook salmon, and also to increase year-to-year fluctuations in population sizes. There will also be changes in the marine environment where Chinook salmon spend most of their life cycle. Marine changes, and their likely effects upon Chinook salmon, are difficult to forecast, and may include both beneficial and adverse consequences.

Federal actions that are reasonably certain to occur but have not yet been implemented primarily include habitat protection and restoration requirements and passage above dams on the Sacramento River, included in the NMFS (2009) BiOp. These actions are expected to have beneficial consequences for adult and juvenile passage, and for juvenile migration and rearing, within the action area.

7.2.4 Determination of Effects to Sacramento River Winter-run Chinook Salmon ESU

The PA is likely to adversely affect the Sacramento River winter-run Chinook salmon ESU due to incidental take associated with facility construction and operation.

7.2.5 Determination of Effects to Sacramento River Winter-run Chinook Salmon ESU Designated Critical Habitat

Due to the implementation of avoidance and minimization measures and the construction of habitat restoration measures, the PA will minimize effects on the physical and biological features of the Sacramento River winter-run Chinook salmon designated critical habitat. Restoration measures proposed under the PA include 154.8 acres of tidal perennial aquatic habitat and 4.3 miles of channel margin habitat, as described in Section 3.4 *Conservation Measures*.

The physical and biological features (PBFs)[1] of critical habitat for winter-run Chinook salmon include: (1) access to spawning areas in the upper Sacramento River; (2) the availability of clean gravel for spawning substrate; (3) adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles; (4) water temperatures for successful spawning, egg incubation, and fry development; (5) habitat areas and adequate prey that are not contaminated; (6) riparian habitat that provides for successful juvenile development and survival; and (7) access downstream so that juveniles can migrate from spawning grounds to San Francisco Bay and the Pacific Ocean.

As discussed in Chapter 5, *Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, Section 5.4.2.1.5.1, *Winter-Run Chinook Salmon*, upstream of the Delta, these PBFs could only be affected by the PA through changes in instream flows and water temperatures. Because any effects of the project on flow and water temperature upstream of the Delta will be insignificant and consistent with the requirements of NMFS (2009), the PA will have insignificant effects on these PBFs. These insignificant effects will be further minimized, in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by real-time operations as described in Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and Section 3.3.3, *Real-Time Operational Decision-Making Process*, which will be used to avoid and minimize the modeled effects found in this effects analysis.

As described in Section 5.4.1.5, *Effects of the Action on Designated Critical Habitat*, within the Delta, operational criteria (bypass flows) will minimize the potential for adverse effects to PBF 7, downstream access, for juvenile winter-run Chinook salmon (e.g., from reduced Sacramento River flows downstream of the NDD influencing probability of survival because reduced transit speed), and the Georgiana Slough NPB will minimize near-field and far-field effects of the NDD on PBF 7 by keeping a greater proportion of juvenile winter-run Chinook salmon migrating down the Sacramento River out of the low-survival interior Delta. Channel margin enhancement of poor habitat will compensate for potential reduction in PBF 6, riparian habitat, at inundated bench areas caused by reductions in Sacramento River water level by the NDD.

[1] The designations of critical habitat for listed species have generally used the term primary constituent elements (PCEs). NMFS and USFWS' recently issued a final rule amending the regulations for designating critical habitat (81 FR 7414; February 11, 2016), which replaced the term PCEs with physical or biological features (PBFs). In addition, NMFS and USFWS' recently issued a final rule revising the regulatory definition of "destruction or adverse modification" of critical habitat (81 FR 7214; February 11, 2016), which refers to PBFs, not PCEs. The shift in terminology does not change the approach used in conducting an analysis of the effects of the proposed action on critical habitat, which is the same regardless of whether the original designation identified PCEs or PBFs. In this biological assessment, we use the term PBFs to include PCEs, as appropriate for the specific critical habitat, for NMFS species.

In summary, the PA is likely to adversely affect the physical and biological features of designated critical habitat for Sacramento River winter-run Chinook salmon because the temporary impairment of critical habitat functions associated with in-water construction activities, permanent impairment associated with permanent placement of in-water structures, and potential impairment associated with flow diversion at the NDDs. However, these effects will be avoided, minimized, and/or compensated. The impairment associated with in-water construction activities will be minimized through avoidance and minimization measures. The impairment associated with permanent placement of in-water structures will be offset by habitat restoration in the form of tidal perennial aquatic habitat restoration and channel margin enhancement. The impairment associated with flow diversion will be minimized through real-time operations that use transitional flow criteria based on fish presence, installing a nonphysical barrier at the Sacramento River-Georgiana Slough divergence, and restoring channel margin habitat.

7.3 Chinook Salmon, Central Valley Spring–run ESU

7.3.1 Sacramento River Upstream of Delta

Upstream quantitative analyses of temperature and flow effects are based on CalSim II modeling. The uncertainties associated with using CalSim II outputs must be considered in interpreting biological analyses (Appendix 5.A, *CALSIM Methods and Results*). CalSim II is a long-term planning model that allows for quantitative simulation of the CVP and SWP operations on a monthly time-step across a wide range of hydrologic, regulatory and operations instances. CalSim II uses a set of pre-defined generalized rules, which represent the assumed regulations, to specify operations of the CVP/SWP. These rules are often specified as a function of year type or a prior month's simulated storage or flow condition. As described above, the model has no capability of adjusting these rules to respond to specific events that may have occurred historically, e.g., fish presence, levee failures, fluctuations in barometric pressure that may have affected Delta tides and salinities, facility outages, etc. These generalized rules have been developed based on historical operational trends and on limited CVP/SWP operator input and only provide a coarse representation of the project operations over the inputted hydrologic conditions. Thus, results do not exactly match what operators might do in a specific month or year within the simulation period since the latter will be informed by numerous real-time considerations that cannot be input to CalSim II. Rather, results are intended to be a reasonable representation of long-term operational trends of CVP and SWP, providing the ability to compare and contrast the effect of current and assumed future operational conditions.

Analysis of potential effects of the PA on Central Valley spring-run Chinook salmon in the Sacramento River upstream of the Delta found differences between the NAA and PA that include

- Increased frequency of water temperature threshold exceedances during August through October coinciding with the spring-run Chinook salmon spawning and rearing period;
- Increased risk of redd dewatering for egg cohorts spawned in August;

- Decreased rearing WUA during June in some portions of the Sacramento River, if population numbers were high enough that habitat could be limiting[2];
- Reduced flows in above normal, below normal, and dry water years during September that could affect adult migration and in wet and above normal water years during November that could affect juvenile migration.

The reduced Shasta releases associated with the PA's operational modeling result in the modeled increased frequency of water temperature threshold exceedances during September. However, modeling of the cold-water pool volume, which is more indicative of temperature management, suggests PA end-of-September storage similar to that of the NAA (Appendix 5.C, *Upstream Water Temperature Methods and Results*). Based on the proposed decision making approaches and criteria for real-time cold-water pool management efforts described in Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and 3.3.3, *Real-Time Operational Decision-Making Process*, releases from Shasta Lake under the PA will be at similar levels as the NAA during September. Thus, the PA will not result in higher September water temperatures. Considering these results, the frequency and magnitude of differences in effects between NAA and the PA are so small as to be biologically insignificant to the species. The PA will provide flows and water temperatures for spawning, rearing, and migration consistent with those required by NMFS (2009). As such, there will be no take of spring-run Chinook salmon in areas upstream of the Delta, other than the take previously authorized by NMFS (2009).

The effects described above will be further minimized in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by day-to-day decision-making on the part of the CVP/SWP operators. These decisions consider the recommendations from many of the decision-making/advisory teams, such as the Sacramento River Temperature Technical Group (SRTTG), Water Operations Management Team (WOMT), b2 interagency team (B2IT) and American River Operations Group. The current decision-making processes and the advisory groups will continue and will be improved under the PA (Section 3.1.5, *Real-Time Operations Upstream of the Delta,* and Section 3.3, *Operations and Maintenance for the New and Existing Facilities*). A separate real time operations coordination team (RTOCT) will meet to assist DWR and Reclamation in fulfilling their responsibility to inform the SWP and CVP participants regarding available information and real-time decisions. This coordination effort may also periodically review how to enhance or strengthen the scientific and technical information used to inform decision-making, and how to communicate with the public and other interested parties. This revised process and RTOCT will allow for alternative operating criteria to be developed, based on the results of the coordinated monitoring and research under real-time operations (RTO) and the Adaptive Management Program, that will continue to address effects to listed species under future operations of the PA consistent with the applicable requirements of the ESA, while maximizing water supplies.

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[2] Habitat limitation has not been a concern in recent years due to low population size, but it could be in the future if population size was to increase or there was a strong year class. Awareness of the effects to be managed in the best interest of the species is necessary, regardless of variability in population size.

In addition, Reclamation will work with NMFS and other state and Federal agencies to adjust the RPA Action Suite 1.2, as described in Section 3.1.4.5, *Annual/Seasonal Temperature Management Upstream of the Delta*. This process is anticipated to conclude in the fall of 2016, and may include refinements and additions to the existing annual/seasonal temperature management processes, including spring storage targets, revised temperature compliance criteria and a range in summertime Keswick release rates. The adjusted RPA Action Suite I.2 will apply to Reclamation's Shasta operations. This RPA revision process is intended to improve egg-to-fry survival of winter-run Chinook salmon to Red Bluff, but would likely improve survival of spring-run Chinook salmon as well, depending on the timing of refinements that will be made.

7.3.2 Sacramento-San Joaquin Delta

The PA is expected to result in incidental take of Central Valley spring-run Chinook salmon associated with construction effects of the PA by mechanisms including underwater noise from pile driving, in-water use of construction equipment, fish rescue efforts, and possibly the accidental discharge of contaminants (Section 5.2, *Effects of Water Facility Construction on Fish*). The effects of construction activities will be minimized through avoidance and minimization measures. Temporary and permanent habitat losses will be offset by 4.3 miles of channel margin enhancement and 154.8 acres of tidal perennial habitat restoration (Table 3.4-1).

The PA has the potential to result in incidental take to Central Valley spring-run Chinook salmon through operational effects that include entrainment (Sections 5.4.1.3.1.1.1.1, *Entrainment* and 5.4.1.3.1.1.2.1, *Entrainment*), impingement (Section 5.4.1.3.1.1.1.2, *Impingement and Screen Contact*), and predation (Sections 5.4.1.3.1.1.1.3, *Predation*, and 5.4.1.3.1.1.2.2, *Predation*) at the NDD (see also Section 5.4.1.4.1.1.1 *Risk to Salmonids from North Delta Exports*) and south Delta facilities (see also Section 5.4.1.4.1.1.2 *Risk to Salmonids from South Delta Exports*), and changes in flows that may affect migratory success (Section 5.4.1.3.1.2.1, *Indirect Mortality Within the Delta;* Section 5.4.1.4.1.2.1 *Risk to Salmonids from Indirect Mortality Within the Delta*) and availability of inundated riparian bench habitat (Section 5.4.1.3.1.2.2.1.1, *Operational Effects;* Section 5.4.1.4.1.2.2 *Risk to Salmonids from Changes in Habitat Suitability*), although San Joaquin River basin spring-run Chinook would not be affected by NDD construction or operations. PA operations in compliance with NMFS (2009) BiOp conditions together with the additional PA proposed operational criteria for south Delta, NDD, and DCC provide protection during the winter and spring, thereby reducing the impact of CVP/SWP Delta operations on Chinook salmon. The RTO and adaptive management and monitoring provisions included in the PA provide additional opportunities to refine the operating criteria and adjust the CVP/SWP Delta operations to minimize the risk of incidental take while maximizing water supply. Adverse operational effects will be offset by restoring channel margin habitat (Section 5.4.1.3.1.2.2.1.2, *Channel Margin Enhancement*) and installing a nonphysical barrier at the Sacramento River-Georgiana Slough divergence (Section 5.4.1.3.1.2.1.2.2, *Nonphysical Fish Barrier to Georgiana Slough*). Projected operation of other Delta facilities (for example, the North Bay Aqueduct, Rock Slough Diversion, and the Suisun Marsh Salinity Control Gates [SMSCG]) is expected to result in a discountable risk of incidental take of Central Valley spring-run Chinook salmon(Sections 5.4.1.3.1.1.5 through 5.4.1.3.1.1.7, *Suisun Marsh Facilities, North Bay Aqueduct, and Other Facilities*, respectively; Sections 5.4.1.4.1.1.5

through 5.4.1.4.1.1.7 *Risk to Salmonids from Suisun Marsh Facilities*, *Risk to Salmonids from North Bay Aqueduct*, and *Risk to Salmonids from Other Facilities*, respectively; Sections 5.4.1.4.1.1.5 through 5.4.1.4.1.1.7 *Risk to Salmonids from Suisun Marsh Facilities*, *Risk to Salmonids from North Bay Aqueduct*, and *Risk to Salmonids from Other Facilities*, respectively). Additionally, the PA would result in benefits to San Joaquin River basin spring-run Chinook due to the reduced use of the south Delta facilities (*Section 5.4.1.4.1.1.2 Risk to Salmonids from South Delta Exports)*.

7.3.3 Cumulative Effects and the Changing Baseline

Cumulative effects on Central Valley spring-run Chinook salmon are the same as those effects on the Sacramento River winter-run Chinook salmon and include effects associated with water diversions, agricultural practices, increased urbanization, and wastewater treatment plants. These effects will accrue over the duration of the PA. Non-federal water diversions are potentially a cause of mortality via entrainment, but ongoing projects such as the CVPIA fish screen program are reducing the number of such diversions and their mortality risk, so this effect is likely to diminish over time. Potentially adverse agricultural practices primarily entail water quality impairments; the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects, so this effect is likely to be maintained in the future. Adverse effects of urbanization include point and nonpoint-source water quality impairments, and increased vessel traffic in waterways. These activities are likely to further degrade Chinook salmon habitat over time. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; thus this stressor is likely to diminish over time. Some of these effects will improve, and others will impair habitat quality for Chinook salmon in the action area; their net effect is to approximately maintain current conditions for the foreseeable future because improvements are generally implemented to compensate for adverse project effects through the ESA consultation and other environmental review processes. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

The environmental baseline for Central Valley spring-run Chinook salmon is described in Chapter 4. Due to the span of time until the beginning of water operations under the proposed action, and over the course of the proposed operations, the baseline is expected to change. The principal such change concern climate change, and certain federal actions that are reasonably certain to occur but have not yet been implemented.

Foreseeable climate change effects, described in Section 4.3.2.1 *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for Chinook salmon, and also to increase year-to-year fluctuations in population sizes. There will also be changes in the marine environment where Chinook salmon spend most of their life cycle. Marine changes, and their likely effects upon Chinook salmon, are difficult to forecast, and may include both beneficial and adverse consequences.

Federal actions that are reasonably certain to occur but have not yet been implemented primarily include habitat protection and restoration requirements and passage above dams on the Sacramento and American Rivers, included in the NMFS (2009) BiOp. These actions are expected to have beneficial consequences for adult and juvenile passage, and for juvenile migration and rearing, within the action area.

7.3.4 Determination of Effects to Central Valley Spring-run Chinook Salmon ESU

The PA is likely to adversely affect the Central Valley spring-run Chinook salmon ESU due to incidental take associated with facility construction and operation.

7.3.5 Determination of Effects to Central Valley Spring-run Chinook Salmon ESU Designated Critical Habitat

Due to the implementation of avoidance and minimization measures and the construction of habitat restoration measures, the PA will minimize effects on the physical and biological features of the Central Valley spring-run Chinook salmon designated critical habitat. Restoration measures proposed under the PA include 154.8 acres of tidal perennial aquatic habitat and 4.3 miles of channel margin habitat, as described in Section 3.4 *Conservation Measures*.

The physical and biological features (PBFs)[3] of critical habitat for Central Valley spring-run Chinook salmon include: (1) spawning habitat with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; (2) freshwater rearing habitat with water quantity and quality, floodplain connectivity, forage, and natural cover supporting juvenile development, growth, mobility, and survival; (3) freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival; and (4) estuarine areas free of obstruction and excessive predation supporting mobility and survival, with water quantity, water quality, and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater, and natural cover and forage supporting growth, maturation and survival.

As discussed in Chapter 5, *Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, Section 5.4.2.1.5.2, *Spring-Run Chinook Salmon*, upstream of the Delta, these PBFss could only be affected by the PA through changes in instream flows and water temperatures. Because any effects of the project on flow and water temperature upstream of the Delta will be insignificant and consistent with the requirements of NMFS (2009), the PA will have insignificant effects on these PBFs. These insignificant effects will be

[3] The designations of critical habitat for listed species have generally used the term primary constituent elements (PCEs). NMFS and USFWS' recently issued a final rule amending the regulations for designating critical habitat (81 FR 7414; February 11, 2016), which replaced the term PCEs with physical or biological features (PBFs). In addition, NMFS and USFWS' recently issued a final rule revising the regulatory definition of "destruction or adverse modification" of critical habitat (81 FR 7214; February 11, 2016), which refers to PBFs, not PCEs. The shift in terminology does not change the approach used in conducting an analysis of the effects of the proposed action on critical habitat, which is the same regardless of whether the original designation identified PCEs or PBFs. In this biological assessment, we use the term PBFs to include PCEs, as appropriate for the specific critical habitat, for NMFS species.

further minimized, in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by real-time operations as described in Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and Section 3.3.3, *Real-Time Operational Decision-Making Process,* which will be used to avoid and minimize the modeled effects found in this effects analysis.

As described in Section 5.4.1.5, *Effects of the Action on Designated Critical Habitat*, and above for winter-run Chinook salmon, within the Delta, operational criteria (bypass flows) will minimize the potential for adverse effects to PBF 7, downstream access, for juvenile spring-run Chinook salmon (e.g., from reduced Sacramento River flows downstream of the NDD influencing probability of survival because of reduced transit speed), and the Georgiana Slough NPB will minimize near-field and far-field effects of the NDD on PBF 7 by keeping a greater proportion of juvenile spring-run Chinook salmon migrating down the Sacramento River out of the low-survival interior Delta.. Channel margin enhancement of poor habitat will compensate for potential reduction in PBF 6, riparian habitat at inundated bench areas caused by reductions in Sacramento River water level by the NDD..

In summary, the PA is likely to adversely affect the physical and biological features of designated critical habitat for Central Valley spring-run Chinook salmon because the temporary impairment of critical habitat functions associated with in-water construction activities, permanent impairment associated with permanent placement of in-water structures, and potential impairment associated with flow diversion at the NDDs. However, these effects will be avoided, minimized, and/or compensated. The impairment associated with in-water construction activities will be minimized through avoidance and minimization measures. The impairment associated with permanent placement of in-water structures will be offset by habitat restoration in the form of tidal perennial aquatic habitat restoration and channel margin enhancement. The impairment associated with flow diversion will be minimized through real-time operations that use transitional flow criteria based on fish presence.

7.4 Steelhead, California Central Valley DPS

7.4.1 Upstream (Sacramento and American Rivers)

Upstream quantitative analyses of temperature and flow effects are based on CalSim II modeling. The uncertainties associated with using CalSim II outputs must be considered in interpreting biological analyses (Appendix 5.A, *CALSIM Methods and Results*). CalSim II is a long-term planning model that allows for quantitative simulation of the CVP and SWP operations on a monthly time-step across a wide range of hydrologic, regulatory and operations instances. CalSim II uses a set of pre-defined generalized rules, which represent the assumed regulations, to specify operations of the CVP/SWP. These rules are often specified as a function of year type or a prior month's simulated storage or flow condition. As described above, the model has no capability of adjusting these rules to respond to specific events that may have occurred historically, e.g., fish presence, levee failures, fluctuations in barometric pressure that may have affected Delta tides and salinities, facility outages, etc. These generalized rules have been developed based on historical operational trends and on limited CVP/SWP operator input and only provide a coarse representation of the project operations over the inputted hydrologic conditions. Thus, results do not exactly match what operators might do in a specific month or year within the simulation period since the latter will be informed by numerous real-time considerations that cannot be input to CalSim II. Rather, results are intended to be a reasonable representation of long-term operational trends of CVP and SWP, providing the ability to compare and contrast the effect of current and assumed future operational conditions.

Analysis of potential effects of the PA on California Central Valley steelhead in the Sacramento River upstream of the Delta and the American River found differences between the NAA and PA that include:

- Decreased rearing WUA during June in some portions of the Sacramento River, if population numbers were high enough that habitat could be limiting[4];

- Reduced flows in above normal, below normal, and dry water years during September that could affect adult migration in the Sacramento River and in wet and above normal water years during November that could affect juvenile and adult migration in the Sacramento River and adult migration in the American River.

The reduced Shasta releases associated with the PA's operational modeling result in the modeled reduced migratory flows during September. Based on the proposed decision making approaches and criteria for real-time reservoir operations described in Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and 3.3.3, *Real-Time Operational Decision-Making Process*, releases from Shasta Lake under the PA will be at similar levels as the NAA during September. Thus, the PA will not result in adult California Central Valley steelhead experiencing reduced flows during September. Considering these results, the frequency and magnitude of differences in effects between NAA and the PA are so small as to be biologically insignificant to the species. The PA will provide flows and water temperatures for spawning, rearing, and migration consistent with those required by NMFS (2009). As such, there will be no take of steelhead in areas upstream of the Delta, other than the take previously authorized by NMFS (2009).

The effects described above will be further minimized, in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by day-to-day decision-making on the part of the CVP/SWP operators. These decisions consider the recommendations from many of the decision-making/advisory teams, such as the Sacramento River Temperature Technical Group (SRTTG), Water Operations Management Team (WOMT), b2 interagency team (B2IT) and American River Operations Group. The current decision-making processes and the advisory groups will continue and will be improved under the PA (Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and Section 3.3, *Operations and Maintenance for the New and Existing Facilities*). A separate real time operations coordination team (RTOCT) will meet to assist DWR and Reclamation in fulfilling their responsibility to inform the SWP and CVP participants regarding available information and real-time decisions. This coordination effort may also periodically review how to enhance or strengthen the scientific and technical information used to inform decision-making, and how to communicate with the public and other interested parties.

[4] Habitat limitation has not been a concern in recent years due to low population size, but it could be in the future if population size was to increase or there was a strong year class. Awareness of the effects to be managed in the best interest of the species is necessary, regardless of variability in population size.

This revised process and RTOCT will allow for alternative operating criteria to be developed, based on the results of coordinated monitoring and research under the RTO and Adaptive Management Program, that will continue to address effects to listed species under future operations of the PA consistent with the applicable requirements of the ESA, while maximizing water supplies.

In addition, Reclamation will work with NMFS and other state and Federal agencies to adjust the RPA Action Suite 1.2, as described in Section 3.1.4.5, *Annual/Seasonal Temperature Management Upstream of the Delta*. This process is anticipated to conclude in the fall of 2016, and may include refinements and additions to the existing annual/seasonal temperature management processes, including spring storage targets, revised temperature compliance criteria and a range in summertime Keswick release rates. The adjusted RPA Action Suite I.2 will apply to Reclamation's Shasta operations. This RPA revision process is intended to improve egg-to-fry survival of winter-run Chinook salmon to Red Bluff, but would likely improve survival of steelhead as well, depending on the timing of refinements that will be made.

7.4.2 Sacramento-San Joaquin Delta

The PA is expected to result in incidental take of California Central Valley steelhead associated with construction effects of the PA by mechanisms including underwater noise from pile driving, in-water use of construction equipment, fish rescue efforts, and possibly the accidental discharge of contaminants (Section 5.2, *Effects of Water Facility Construction on Fish*). The effects of construction activities will be minimized through avoidance and minimization measures. Temporary and permanent habitat losses will be offset by 4.3 miles of channel margin enhancement and 154.8 acres of tidal perennial habitat restoration (Table 3.4-1).

The PA has the potential to result in incidental take to California Central Valley steelhead through entrainment (Sections 5.4.1.3.1.1.1.1 *Entrainment* and 5.4.1.3.1.1.2.1 *Entrainment*), impingement (Section 5.4.1.3.2.1.1.2 *Impingement and Screen Contact*), and predation (Sections 5.4.1.3.1.1.1.3 *Predation* and 5.4.1.3.1.1.2.2 *Predation*) at the NDD (see also Section 5.4.1.4.1.1.1 *Risk to Salmonids from North Delta Exports*) and south Delta facilities (see also Section 5.4.1.4.1.1.2 *Risk to Salmonids from South Delta Exports*), and changes in flows that may affect migratory success (Section 5.4.1.3.1.2.1 *Indirect Mortality Within the Delta*; Section 5.4.1.4.1.2.1 *Risk to Salmonids from Indirect Mortality Within the Delta*) and availability of inundated riparian bench habitat (Section 5.4.1.3.1.2.2.1.1, *Operational Effects;* Section 5.4.1.4.1.2.2 *Risk to Salmonids from Changes in Habitat Suitability*). PA operations in compliance with NMFS (2009) BiOp conditions together with the additional PA proposed operational criteria for south Delta, NDD, and DCC provide protection during the winter and spring, thereby reducing the impact of CVP/SWP Delta operations on steelhead. The RTO and adaptive management and monitoring provisions included in the PA provide additional opportunities to refine the operating criteria and make adjustments to CVP/SWP Delta operations to minimize the risks of incidental take while maximizing water supply. Adverse operational effects will be offset by restoring channel margin habitat (Section 5.4.1.3.1.2.2.1.2 *Channel Margin Enhancement*) and installing a nonphysical barrier at the Sacramento River-Georgiana Slough divergence (Section 5.4.1.3.1.2.1.2.2, *Nonphysical Fish Barrier at Georgiana Slough*). Projected operation of other Delta facilities (for example, the North Bay

Aqueduct, Rock Slough Diversion, and the Suisun Marsh Salinity Control Gates [SMSCG]) is expected to result in a discountable risk of take of California Central Valley steelhead (Sections 5.4.1.3.1.1.5 through 5.4.1.3.1.1.7, *Suisun Marsh Facilities, North Bay Aqueduct, and Other Facilities,* respectively; Sections 5.4.1.4.1.1.5 through 5.4.1.4.1.1.7 *Risk to Salmonids from Suisun Marsh Facilities, Risk to Salmonids from North Bay Aqueduct,* and *Risk to Salmonids from Other Facilities*, respectively).

7.4.3 Cumulative Effects and the Changing Baseline

Cumulative effects on California Central Valley steelhead are similar to those for both Sacramento River winter-run and Central Valley spring-run Chinook Salmon, and include effects associated with water diversions, agricultural practices, increased urbanization, and wastewater treatment plants. These effects will accrue over the duration of the PA. Non-federal water diversions are potentially a cause of mortality via entrainment, but ongoing projects such as the CVPIA fish screen program are reducing the number of such diversions and their mortality risk, so this effect is likely to diminish over time. Potentially adverse agricultural practices primarily entail water quality impairments; the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects, so this effect is likely to be maintained in the future. Adverse effects of urbanization include point and nonpoint-source water quality impairments, and increased vessel traffic in waterways. These activities are likely to further degrade steelhead habitat over time. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; thus this stressor is likely to diminish over time. Some of these effects will improve, and others will impair habitat quality for steelhead in the action area; their net effect is to approximately maintain current conditions for the foreseeable future because improvements are generally implemented to compensate for adverse project effects through the ESA consultation and other environmental review processes. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

The environmental baseline for California Central Valley steelhead is described in Chapter 4. Due to the span of time until the beginning of water operations under the proposed action, and over the course of the proposed operations, the baseline is expected to change.. The principal such changes concern climate change, and certain federal actions that are reasonably certain to occur but have not yet been implemented.

Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for steelhead, and also to increase year-to-year fluctuations in population sizes. There will also be changes in the marine environment where steelhead spend most of their life cycle. Marine changes, and their likely effects upon steelhead, are difficult to forecast, and may include both beneficial and adverse consequences.

Federal actions that are reasonably certain to occur but have not yet been implemented primarily include habitat protection and restoration requirements and passage above dams on the Sacramento and American Rivers, included in the NMFS (2009) BiOp. These actions are expected to have beneficial consequences for adult and juvenile passage, and for juvenile migration and rearing, within the action area.

7.4.4 Determination of Effects to California Central Valley Steelhead DPS

The PA is likely to adversely affect the California Central Valley steelhead DPS due to incidental take associated with facility construction and operation.

7.4.5 Determination of Effects to California Central Valley Steelhead DPS Designated Critical Habitat

Due to the implementation of avoidance and minimization measures and the construction of habitat restoration measures, the PA will minimize effects on the physical and biological features of the California Central Valley steelhead designated critical habitat. Restoration measures proposed under the PA include 154.8 acres of tidal perennial aquatic habitat and 4.3 miles of channel margin habitat, as described in Section 3.4 *Conservation Measures*..

The physical and biological features PBFs of critical habitat for California Central Valley steelhead include: (1) spawning habitat with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; (2) freshwater rearing habitat with water quantity and quality, floodplain connectivity, forage, and natural cover supporting juvenile development, growth, mobility, and survival; (3) freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival; and (4) estuarine areas free of obstruction and excessive predation supporting mobility and survival, with water quantity, water quality, and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater, and natural cover and forage supporting growth, maturation and survival.

As discussed in Chapter 5, *Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, Section 5.4.2.1.5.3, *California Central Valley Steelhead*, upstream of the Delta these PBFs could only be affected by the PA through changes in instream flows and water temperatures. Because any effects of the project on flow and water temperature upstream of the Delta will be insignificant and consistent with the requirements of NMFS (2009), the PA will have insignificant effects on these PBFs. These insignificant effects will be further minimized, in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by real-time operations as described in Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and Section 3.3.3, *Real-Time Operational Decision-Making Process*, which will be used to avoid and minimize the modeled effects found in this effects analysis.

As described in Section 5.4.1.5, *Effects of the Action on Designated Critical Habitat*, and above for winter-run and spring-run Chinook salmon, within the Delta, operational criteria (bypass flows) will minimize the potential for adverse effects to PBF 7, downstream access, for juvenile steelhead (e.g., from reduced Sacramento River flows downstream of the NDD influencing probability of survival because of reduced transit speed), and the Georgiana Slough NPB will minimize near-field and far-field effects of the NDD on PBF 7 by keeping a greater proportion of juvenile steelhead migrating down the Sacramento River out of the low-survival interior Delta. Channel margin enhancement of poor habitat will compensate for potential reduction in PBF 6, riparian habitat, at inundated bench areas caused by reductions in Sacramento River water level by the NDD.

In summary, the PA is likely to adversely affect the physical and biological features of designated critical habitat for California Central Valley steelhead because the temporary impairment of critical habitat functions associated with in-water construction activities, permanent impairment associated with permanent placement of in-water structures, and potential impairment associated with flow diversion at the NDDs. However, these effects will be avoided, minimized, and/or compensated. The impairment associated with in-water construction activities will be minimized through avoidance and minimization measures. The impairment associated with permanent placement of in-water structures will be offset by habitat restoration in the form of tidal perennial aquatic habitat restoration and channel margin enhancement. The impairment associated with flow diversion will be minimized through real-time operations that use transitional flow criteria based on fish presence.

7.5 Green Sturgeon, Southern DPS

7.5.1 Sacramento River Upstream of Delta

Upstream quantitative analyses of temperature and flow effects are based on CalSim II modeling. The uncertainties associated with using CalSim II outputs must be considered in interpreting biological analyses (Appendix 5.A, *CALSIM Methods and Results*). CalSim II is a long-term planning model that allows for quantitative simulation of the CVP and SWP operations on a monthly time-step across a wide range of hydrologic, regulatory and operations instances. CalSim II uses a set of pre-defined generalized rules, which represent the assumed regulations, to specify operations of the CVP/SWP. These rules are often specified as a function of year type or a prior month's simulated storage or flow condition. As described above, the model has no capability of adjusting these rules to respond to specific events that may have occurred historically, e.g., fish presence, levee failures, fluctuations in barometric pressure that may have affected Delta tides and salinities, facility outages, etc. These generalized rules have been developed based on historical operational trends and on limited CVP/SWP operator input and only provide a coarse representation of the project operations over the inputted hydrologic conditions. Thus, results do not exactly match what operators might do in a specific month or year within the simulation period since the latter will be informed by numerous real-time considerations that cannot be input to CalSim II. Rather, results are intended to be a reasonable representation of long-term operational trends of CVP and SWP, providing the ability to compare and contrast the effect of current and assumed future operational conditions.

Analysis of potential effects of the PA on Southern DPS green sturgeon in the Sacramento River upstream of the Delta found insignificant differences between the NAA and PA in flows and water temperatures for spawning, rearing, and migration. The PA will provide flows and water temperatures consistent with those required by NMFS (2009). As such, there will be no take of green sturgeon in areas upstream of the Delta, other than the take previously authorized by NMFS (2009).

These insignificant effects will be further minimized, in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by day-to-day decision-making on the part of the CVP/SWP operators. These decisions consider the recommendations from many of the decision-making/advisory teams, such as the Sacramento River Temperature Technical Group (SRTTG), Water Operations Management Team (WOMT), b2 interagency team (B2IT) and American River Operations Group. The current decision-making processes and the advisory groups will continue and will be improved under the PA (Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and Section 3.3, *Operations and Maintenance for the New and Existing Facilities*). A separate real time operations coordination team (RTOCT) will meet to assist DWR and Reclamation in fulfilling their responsibility to inform the SWP and CVP participants regarding available information and real-time decisions. This coordination effort may also periodically review how to enhance or strengthen the scientific and technical information used to inform decision-making, and how to communicate with the public and other interested parties. This revised process and RTOCT will allow for alternative criteria to be developed, based on the results of coordinated monitoring and research under the RTO and Adaptive Management Program, that will continue to address effects to listed species under future operations of the PA consistent with the applicable requirements of the ESA, while maximizing water supplies.

In addition, Reclamation will work with NMFS and other state and Federal agencies to adjust the RPA Action Suite 1.2, as described in Section 3.1.4.5, *Annual/Seasonal Temperature Management Upstream of the Delta*. This process is anticipated to conclude in the fall of 2016, and may include refinements and additions to the existing annual/seasonal temperature management processes, including spring storage targets, revised temperature compliance criteria and a range in summertime Keswick release rates. The adjusted RPA Action Suite I.2 will apply to Reclamation's Shasta operations. This RPA revision process is intended to improve egg-to-fry survival of winter-run Chinook salmon to Red Bluff, but would likely improve survival of green sturgeon as well, depending on the timing of refinements that will be made.

7.5.2 Sacramento-San Joaquin Delta

The PA is expected to result in incidental take of Southern DPS green sturgeon associated with construction effects of the PA by mechanisms including underwater noise from pile driving, in-water use of construction equipment, fish rescue efforts, and possibly the accidental discharge of contaminants (Section 5.2, *Effects of Water Facility Construction on Fish*). The effects of construction activities will be minimized through avoidance and minimization measures. Temporary and permanent habitat losses will be offset by 154.8 acres of tidal perennial habitat restoration (Table 3.4-1).

The PA has the potential to result in incidental take to Southern DPS green sturgeon through entrainment, impingement, and predation at the NDD (Section 5.4.1.3.2.1.1 *North Delta Exports;* Section 5.4.1.4.2.1.1 *Risk to Green Sturgeon from North Delta Exports)* and south Delta facilities (Section 5.4.1.3.2.1.2 *South Delta Exports;* 5.4.1.4.2.1.2 *Risk to Green Sturgeon from South Delta Exports*), and changes in flows that may affect migratory success (Section 5.4.1.3.2.2.1 *Indirect Mortality Within the Delta;* 5.4.1.4.2.2.1 *Risk to Green*

Sturgeon from Indirect Mortality Within the Delta). PA operations in compliance with NMFS (2009) BiOp conditions together with the additional PA proposed operational criteria for south Delta, NDD, and DCC provide protection during the winter and spring, thereby reducing the impact of CVP/SWP Delta operations on green sturgeon. The RTO and adaptive management and monitoring provisions included in the PA provide additional opportunities to better define the operating criteria and make adjustments to CVP/SWP Delta operations to minimize the risks of incidental take while maximizing water supply. Projected operation of other Delta facilities (for example, the North Bay Aqueduct, Rock Slough Diversion, and the Suisun Marsh Salinity Control Gates [SMSCG]) is expected to result in a discountable risk of take of green sturgeon (Sections 5.4.1.3.1.1.5 through 5.4.1.3.1.1.7 *Suisun Marsh Facilities, North Bay Aqueduct, and Other Facilities*, respectively; Sections 5.4.1.4.2.1.5 through 5.4.1.4.2.1.7 *Risk to Green Sturgeon from Suisun Marsh Facilities, Risk to Green Sturgeon from North Bay Aqueduct*, and *Risk to Green Sturgeon from Other Facilities*, respectively).

7.5.3 Cumulative Effects and the Changing Baseline

As with the salmonids, cumulative effects on Southern DPS green sturgeon include effects associated with water diversions, agricultural practices, increased urbanization, and wastewater treatment plants. These effects will accrue over the duration of the PA. Non-federal water diversions are potentially a cause of mortality via entrainment, but ongoing projects such as the CVPIA fish screen program are reducing the number of such diversions and their mortality risk, so this effect is likely to diminish over time. Potentially adverse agricultural practices primarily entail water quality impairments; the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects, so this effect is likely to be maintained in the future. Adverse effects of urbanization include point and nonpoint-source water quality impairments, and increased vessel traffic in waterways. These activities are likely to further degrade green sturgeon habitat over time. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; thus this stressor is likely to diminish over time. Some of these effects will improve, and others will impair habitat quality for green sturgeon in the action area; their net effect is to approximately maintain current conditions for the foreseeable future because improvements are generally implemented to compensate for adverse project effects through the ESA consultation and other environmental review processes. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

The environmental baseline for Southern DPS green sturgeon is described in Chapter 4. Due to the span of time until the beginning of water operations under the proposed action, and over the course of the proposed operations, the baseline is expected to change. The principal such changes concern climate change, and certain federal actions that are reasonably certain to occur but have not yet been implemented.

Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for green sturgeon, and also to increase year-to-year fluctuations in population sizes. There will also be changes in the marine environment where green sturgeon spend much of their life cycle. Marine changes, and their likely effects upon green sturgeon, are difficult to forecast, and may include both beneficial and adverse consequences.

Federal actions that are reasonably certain to occur but have not yet been implemented primarily include habitat protection and restoration requirements of the NMFS (2009) BiOp. These actions are expected to have beneficial consequences for adult and juvenile passage, and for juvenile migration and rearing, within the action area.

7.5.4 Determination of Effects to Southern DPS Green Sturgeon

The PA is likely to adversely affect Southern DPS green sturgeon because of incidental take associated with facility construction and operation.

7.5.5 Determination of Effects to Southern DPS Green Sturgeon Designated Critical Habitat

Due to the implementation of avoidance and minimization measures and the construction of habitat restoration measures, the PA will minimize effects on the physical and biological features of the Southern DPS green sturgeon designated critical habitat. Restoration measures proposed under the PA include 154.8 acres of tidal perennial aquatic habitat, as described in Section 3.4 *Conservation Measures*.

The PBFs for Southern DPS green sturgeon include: (1) food resources for larval, juvenile, subadult, and adult life stages; (2) water flow regime with flow magnitude, duration, seasonality, and rate-of-change supporting growth, survival, and migration of all life stages; (3) water quality including temperature, salinity, oxygen content, and other chemical characteristics supporting growth and viability of all life stages; (4) migratory corridor free of obstruction and excessive predation with water quantity and quality conditions supporting safe and timely passage of juveniles and adults within and between riverine, estuarine and marine habitats; (5) water depth sufficient (>5 m) for holding pools supporting adults and subadults; (6) substrate type or size (for freshwater riverine systems but not estuarine habitat) supporting egg deposition, egg and larval development, subadult and adult holding, and adult spawning; and (7) sediment quality (*i.e*, chemical characteristics) supporting growth and viability of all life stages. .

As discussed in Chapter 5, *Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, Section 5.4.2.1.5.4, *Green Sturgeon*, upstream of the Delta, these PBFs could only be affected by the PA through changes in instream flows and water temperatures. Because any effects of the project on flow and water temperature upstream of the Delta will be insignificant and consistent with the requirements of NMFS (2009), the PA will have insignificant effects on these PBFs. These insignificant effects will be further minimized, in a manner that cannot be demonstrated within the limitations of the CalSim II modeling environment, by real-time operations as described in Section 3.1.5, *Real-Time*

Operations Upstream of the Delta, and Section 3.3.3, *Real-Time Operational Decision-Making Process,* which will be used to avoid and minimize any of the modeled effects found in this effects analysis.

As described in Section 5.4.1.5.1, *Effects of the Action on Designated Critical Habitat*, the potential adverse effects to the PBFs of critical habitat in the Delta will be limited.

In summary, the PA is not likely to adversely affect the physical and biological features of designated critical habitat for Southern DPS green sturgeon because the temporary impairment of critical habitat functions associated with in-water construction activities, permanent impairment associated with permanent placement of in-water structures, and potential impairment associated with flow diversion at the NDDs. However, these effects will be avoided, minimized, and/or compensated. The impairment associated with in-water construction activities will be minimized through avoidance and minimization measures. The impairment associated with permanent placement of in-water structures will be offset by habitat restoration in the form of tidal perennial aquatic habitat restoration. The impairment associated with flow diversion will be minimized through real-time operations that use transitional flow criteria based on fish presence.

7.6 Killer Whale, Southern Resident DPS

The PA has insignificant potential to alter the Southern Resident killer whale prey base. Project operations have the potential to affect Southern Resident killer whales by altering salmonid populations, thereby altering prey availability for Southern Resident killer whales. Reductions in prey availability could force the whales to spend more time foraging, and could lead to reduced reproductive rates and higher mortality. However, the effects analysis for salmonids, including the EFH assessment including fall-run Chinook salmon, does not find evidence that the PA will lead to any measurable reduction in abundance of Central Valley salmonid populations that will affect the Southern Resident killer whale prey base.

Based on the effects analysis, the PA may affect, but is not likely to adversely affect the Southern Resident DPS of killer whales, due to an insignificant potential for the PA to affect the Southern Resident killer whale prey base.

Based on the effects analysis, the PA is not likely to adversely affect designated critical habitat for the Southern Resident killer whale due to the PA's insignificant potential to affect the Southern Resident killer whale prey base, compounded by the small percentage of Central Valley salmon potentially present in the Washington waters designated as critical habitat.

7.7 Delta Smelt

7.7.1 Determination of Effects to Delta Smelt

The central component of the PA is to move the point of diversion of water for CVP and SWP export to the north Delta, outside the main range of Delta Smelt, and to minimize and avoid entrainment effects through further reduced reliance on the south Delta export facilities. As a result, the overall effects of the PA on Delta Smelt will be minor and the PA will not affect flows and water temperatures for spawning and rearing. The PA has the potential to result in incidental take of Delta Smelt associated with construction effects of the PA including underwater noise from pile driving, in-water use of construction equipment, fish rescue efforts, and accidental discharge of contaminants (Section 6.1.1, *Effects of Water Facility Construction on Delta Smelt*). The effects of construction activities will be minimized through avoidance and minimization measures and all habitat losses will be offset by tidal perennial habitat and shallow water habitat restoration. Additionally, the in-water construction activities will occur in areas and/or during periods when Delta Smelt are likely not present but could be present in very low densities.

The PA has the potential to result in incidental take of Delta Smelt through entrainment (Sections 6.1.3.2.1, *Entrainment*, and 6.1.3.3.1, *Entrainment*), impingement (Section 6.1.3.2.2, *Impingement and Screen Contact*), and predation (6.1.3.3.2, *Predation at the South Delta Export Facilities*, and 6.1.3.3.2, *Predation at the South Delta Export Facilities*), at the north Delta intakes and south Delta export facilities. The shifting of exports to the NDD, which is outside the main range of Delta Smelt, allows water exports to occur where the potential to affect most Delta Smelt is substantially reduced or avoided, and the screen design and operations (0.2-ft/s approach velocity) will minimize the potential for entrainment and impingement of Delta Smelt that do occur near the NDD. Actions taken in compliance with USFWS (2008) and the proposed operational criteria for south Delta provide additional protection during the winter and spring, and shifting of pumping to the screened NDD provides further protection, thereby substantially reducing the potential impact of CVP/SWP Delta operations on Delta Smelt. Delta operations and outflows have been designed to minimize effects on Delta Smelt habitat based on assessment of current science. The RTOs and Adaptive Management Program included in the PA provide additional opportunities to better define the operating criteria and make adjustments to CVP/SWP Delta operations to minimize the risks of incidental take while maximizing water supply. Projected operations of other Delta facilities (for example, the North Bay Aqueduct, Rock Slough Diversion, and the Suisun Marsh Salinity Control Gates [SMSCG]) are expected to result in minimal take of Delta Smelt (Sections 6.1.3.7 through 6.1.3.9, *Suisun Marsh Facilities, North Bay Aqueduct,* and *Other Facilities,* respectively).

Accordingly, the PA is likely to adversely affect Delta Smelt in the action area.

7.7.2 Cumulative Effects and the Changing Baseline

Cumulative effects on Delta Smelt include effects associated with water diversions, agricultural practices, increased urbanization, and wastewater treatment plants. These effects will accrue over the duration of the PA. Non-federal water diversions are likely a minor cause of mortality via entrainment (Nobriga et al. 2004), and this effect is likely to be maintained for the foreseeable future. Potentially adverse agricultural practices primarily entail water quality impairments; the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects, so this effect is also likely to be maintained in the future. Adverse effects of urbanization include point and nonpoint-source water quality impairments, and increased vessel traffic in waterways. These activities are likely to further degrade Delta Smelt habitat over time. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; thus this stressor is likely to diminish over time. Overall, these effects will variously improve, maintain, or impair habitat quality for Delta Smelt in the action area; their net effect is to approximately maintain current conditions for the foreseeable future. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

The environmental baseline for Delta Smelt is described in Chapter 4. Due to the span of time until the beginning of water operations under the proposed action, and over the course of the proposed operations, the baseline is expected to change. The principal such effects concern climate change, and certain federal actions that are reasonably certain to occur but have not yet been implemented.

Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for Delta Smelt, and also to increase year-to-year fluctuations in population sizes.

Federal actions that are reasonably certain to occur but have not yet been implemented primarily include habitat protection and restoration requirements of the USFWS (2008) BiOp. These actions are expected to have beneficial consequences for the abundance and quality of Delta Smelt habitat within the action area.

7.7.3 Determination of Effects to Delta Smelt Designated Critical Habitat

Due to the implementation of avoidance and minimization measures and the construction of habitat restoration measures, the PA will minimize effects on the primary constituent elements of Delta Smelt designated critical habitat. Restoration measures proposed under the PA include 74.7 acres of tidal perennial aquatic habitat and 273 acres of shallow water habitat, of which 108 acres of the shallow water habitat will be sandy beach spawning habitat, as described in Section 3.4 *Conservation Measures*.

The PA is likely to adversely affect the primary constituent elements of designated critical habitat for Delta Smelt because of temporary impairment of critical habitat functions associated with in-water construction activities and permanent impairment associated with permanent placement of in-water structures. Additionally, there is a potential for impairment associated with flow diversion at the NDDs. However, these effects will be minimized, avoided, and/or compensated. Water diversion at the NDDs occur through screens meeting agency criteria, including approach velocity of 0.2 ft/s to minimize potential effects on Delta Smelt. The impairment associated with in-water construction activities will be minimized through avoidance and minimization measures. The impairment associated with permanent placement of in-water structures at the NDD will be offset with shallow water habitat at a 5:1 ratio for the intakes and their wing walls, plus the acreage associated with the in-water construction disturbance and a 1,000-foot-downstream suspended sediment effect (28 acres in total). In addition, the potential for reduced access to critical habitat upstream of the NDD because of conversion of low-velocity habitat to high-velocity screen face will be mitigated with restoration of 245 acres of shallow water habitat, of which 108 acres will be sandy beach habitat (representing a 3:1 mitigation ratio for the potential loss of access to 36 acres of existing shallow water sandy beach habitat). In-water effects from construction and facility footprints at the HOR gate and barge landings will be offset by habitat restoration in the form of tidal perennial habitat restoration (74.7 acres in total, representing a 3:1 mitigation ratio).

Continued operation of the south Delta export facilities will be at a lower rate than exists under the NAA, generally resulting in less potential for effects to PCE 3 (river flow); management of Old and Middle River flows in similar ways to those currently in place under the USFWS (2008) BiOp would minimize the potential for adverse effects on PCE 3. Inclusion of the fall X2 criteria from the USFWS (2008) BiOp in the PA would minimize the potential for adverse effects to PCE 4 (low salinity zone) during the important juvenile rearing period, and the general similarity of low salinity zone conditions throughout the year between NAA and PA would minimize effects on PCE 4 for the other life stages.

7.8 Riparian Brush Rabbit

There is minimal potential for the PA to affect riparian brush rabbit. There is no potentially suitable habitat for riparian brush rabbit within the PA construction footprint, and there is not likely to be suitable habitat within 1,260 feet of the HOR gate construction site.

Avoidance and minimization measures require that construction activity be confined to existing disturbed areas. These avoidance and minimization measures will avoid harm or harassment of riparian brush rabbit. Suitable riparian brush rabbit habitat is not expected to be present within 1,260 feet from the HOR gate construction site. At this distance, noise and light associated with construction activity may be perceived by the brush rabbit, but will only slightly exceed background levels and thus is not expected to alter essential behaviors that affect foraging, reproduction, predation risk, etc. Avoidance and minimization measures require that the area within 1,260 feet of riparian brush rabbit habitat be surveyed to confirm there is no suitable habitat in the vicinity of HOR gate related activities – if habitat exists in this area, measures will be implemented to reduce noise and light to the extent that it will not be expected to alter essential behaviors that affect foraging, reproduction, predation risk. Thus the PA may affect, is not likely to adversely affect riparian brush rabbit.

Critical habitat has not been designated for riparian brush rabbit.

7.9 San Joaquin Kit Fox

7.9.1 Determination of Effects to San Joaquin Kit Fox

Overall effects of the PA on San Joaquin kit fox breeding, foraging, and dispersal habitat are less than 50 acres, and will be offset with protection and restoration of habitat. The PA may affect San Joaquin kit fox based on the following.

- Project related activities will occur within and adjacent to San Joaquin kit fox modeled habitat.

- San Joaquin kit fox presence has been detected in the vicinity of the PA, within grassland landscape south of Brentwood, with the most recent sighting in the late 1990s. The species has not been detected, nor is it expected to occur, elsewhere within the action area.

- Protection of San Joaquin kit fox habitat will beneficially affect the species.

The PA is likely to adversely affect the San Joaquin kit fox as follows.

- Harm could result from the permanent loss of 47 acres of San Joaquin kit fox modeled habitat potentially occupied by the species.

- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, storage of equipment onsite, and other construction, operations, and maintenance related activities.

- Harassment could result from noise, lighting, or other human disturbances, which could affect San Joaquin kit fox during construction, operations, and maintenance.

These adverse effects will be minimized through implementation of minimization and avoidance measures to reduce the risk of injury, mortality, and harassment of individuals, and offset by the protection or restoration of up to 141 acres of habitat based on current project impact estimates.

Thus the PA may affect, is likely to adversely affect the San Joaquin kit fox.

7.9.2 Cumulative Effects and Changing Baseline

Potential cumulative effects on San Joaquin kit fox in the action area include habitat loss and impairment, primarily through conversion of rangeland to more developed land uses. This is not likely to be extensive, due to existing constraints upon land use changes, e.g. via existing or developing habitat conservation plans that cover much of the range of San Joaquin kit fox in the action area. In particular the habitat in the action area with the highest likelihood of supporting San Joaquin kit fox is within the plan area of the East Contra Costa County HCP/NCCP, where large scale conservation efforts are being implemented that will benefit the species.

Changing baseline effects are also likely to alter habitat conditions for San Joaquin kit fox between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for San Joaquin kit fox, with potential adverse effects upon species status in the action area.

7.9.3 Determination of Effects to San Joaquin Kit Fox Designated Critical Habitat

Critical habitat has not been designated for the San Joaquin kit fox.

7.10 California Least Tern

There is minimal potential for the PA to affect California least tern. The PA will result in permanent loss of 269 acres of open water that constitutes modeled California least tern foraging habitat, but a Clifton Court Forebay modifications will result in a gain of 677 acres of foraging habitat, for a net gain of 408 acres of habitat. Dredging will temporarily disturb another 1,930 acres. The proposed construction activities are located at least 20 miles from the nearest known or recently active California least tern nesting locations. Typically, foraging habitat for California least tern is located within 2 miles of their colonies (Atwood and Minsky 1983), so the foraging habitat that will be lost to construction is rarely or never used. Furthermore, foraging habitat in the region (San Francisco Bay and the action area) is abundant and is not considered limiting for California least tern (e.g., there are 61,751 acres of modeled foraging habitat in the action area). Therefore, in consideration of the amount of available foraging habitat in the action area and its distance from known nesting sites, the total permanent and temporary foraging habitat loss due to the PA is insignificant. For these reasons, the PA is may affect, is not likely to adversely affect California least tern.

Critical habitat has not been designated for California least tern.

7.11 Western Yellow-Billed Cuckoo

7.11.1 Determination of Effects to Western Yellow-Billed Cuckoo

Overall effects of the PA on western yellow-billed cuckoo include loss of 32 acres of habitat, and will be offset with restoration of its habitat. The PA may affect western yellow-billed cuckoo based on the following.

- Project related activities will occur within and adjacent to western yellow-billed cuckoo modeled habitat.
- Migratory western yellow-billed cuckoos have been detected in the action area in recent years.
- Restoration of western yellow-billed cuckoo habitat will beneficially affect the species.

The PA is likely to adversely affect the western yellow-billed cuckoo as follows.

- Harm could result from the permanent loss of 32 acres of modeled western yellow-billed cuckoo migratory habitat.

These adverse effects will be minimized through implementation of minimization and avoidance measures to reduce the risk of injury, mortality, and harassment of individuals, and offset by the protection or restoration of up to 64 acres of suitable habitat based on current project impact estimates.

Thus the PA may affect, is likely to adversely affect the western yellow-billed cuckoo.

7.11.2 Cumulative Effects and the Changing Baseline

Potential cumulative effects on western yellow-billed cuckoo in the action area include habitat loss and fragmentation, and predation from introduced and native species. Habitat loss and fragmentation could result from conversion of riparian habitat to alternative cover types, which is not likely to be extensive due to existing constraints emplaced to protect riparian natural communities. Predation by existing introduced and native species is likely to be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable; nor are the consequences of such an introduction. These effects will tend to slightly impair habitat quality for western yellow-billed cuckoo in the action area, but their net effect is to approximately maintain current conditions for the foreseeable future. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

Changing baseline effects are also likely to alter habitat conditions for western yellow-billed cuckoo between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for western yellow-billed cuckoo, e.g. by increasing the frequency of flood disturbance in riparian habitat and thus scouring and clearing areas of habitat temporarily, and potentially increasing the fragmentation of that habitat.

7.11.3 Determination of Effects to Western Yellow-Billed Cuckoo Designated Critical Habitat

There is no designated western yellow-billed cuckoo critical habitat in the action area.

7.12 Giant Garter Snake

7.12.1 Determination of Effects to Giant Garter Snake

Overall effects of the PA on giant garter snake and its habitat are minor and temporary, and will be offset with protection and restoration of its habitat. The PA may affect the giant garter snake based on the following.

- Project related activities will occur within and adjacent to giant garter snake modeled habitat.
- Giant garter snake presence has been recorded in the vicinity of areas proposed for clearing and construction.
- Protection and restoration of giant garter snake habitat will beneficially affect the species.

The PA is likely to adversely affect the giant garter snake as follows.

- Harm could result from the loss of 205 acres of aquatic habitat and 570 acres of upland habitat potentially occupied by the species.
- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance related activities.
- Harassment could result from noise, lighting, and vibrations, or other human disturbance adjacent to occupied giant garter snake habitat during construction, operations, and maintenance.

These adverse effects will be minimized and offset through implementation of minimization and avoidance measures to reduce the risk of harm or harassment of individuals, and by the protection or restoration of aquatic and upland habitat in the amounts and according to the mitigation ratios detailed in Table 3.4-4, *Compensation for Direct Effects on Giant Garter Snake Habitat*.

Thus the PA may affect, is likely to adversely affect the giant garter snake.

7.12.2 Cumulative Effects and the Changing Baseline

Potential cumulative effects on giant garter snake in the action area include habitat loss and fragmentation, changes in agricultural and land management practices, predation from introduced and native species, and water pollution. Both habitat loss and fragmentation, and changes in land management practices, could result from conversion of agricultural land to more developed land uses, which is not likely to be extensive due to existing constraints upon land use changes; or from conversion of agricultural land to different crop types having lower habitat suitability, which is not foreseeable. Predation by existing introduced and native species is likely to be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable; nor are the consequences of such an introduction. Water pollution effects could result from a variety of causes, including agricultural practices, increased urbanization, and wastewater treatment plants. Effects associated with agricultural practices are likely to be maintained, because the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects. Water quality effects of urbanization include point and nonpoint-source water quality impairments, and there is a potential for those effects to further degrade water quality as further urbanization occurs in the action area. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; thus this stressor is likely to diminish over time. Some of these effects will improve, and others will impair habitat quality for giant garter snake in the action area; their net effect is to approximately maintain current conditions for the foreseeable future. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

Changing baseline effects are also likely to alter habitat conditions for giant garter snake between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for giant garter snake, and also to increase the potential for year-to-year fluctuations in population sizes, with potential adverse effects upon species status in the action area.

7.12.3 Determination of Effects to Giant Garter Snake Designated Critical Habitat

Critical habitat has not been designated for the giant garter snake.

7.13 California Red-Legged Frog

7.13.1 Determination of Effects to California Red-Legged Frog

Overall effects of the PA on California red-legged frog and its habitat are minor and temporary, and will be offset with protection and restoration of its habitat. The PA may affect the California red-legged frog based on the following.

- Project related activities will occur within and adjacent to California red-legged frog modeled habitat.
- California red-legged frog presence has been recorded in the vicinity of areas proposed for clearing and construction.
- Protection and restoration of California red-legged frog habitat will beneficially affect the species.

The PA is likely to adversely affect the California red-legged frog as follows.

- Harm could result from the permanent loss of 51 acres of modeled upland cover and dispersal habitat (four of which would be outside the construction footprint but subject to vibrations within 75 feet of project activity) and 1 acre of modeled aquatic habitat potentially occupied by the species.
- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance related activities.
- Harassment could result from noise, lighting, and vibrations, and other human disturbance adjacent to occupied California red-legged frog habitat during construction, operations, and maintenance.

These adverse effects will be minimized and offset through implementation of minimization and avoidance measures to reduce the risk of harm or harassment of individuals, and by the protection or restoration of up to 153 acres of upland habitat and 3 acres of aquatic habitat based on current project impact estimates.

Thus the PA may affect, is likely to adversely affect the California red-legged frog.

7.13.2 Cumulative Effects and the Changing Baseline

Potential cumulative effects on California red-legged frog in the action area include habitat loss and impairment, primarily through conversion of rangeland to more developed land uses. This is not likely to be extensive, due to existing constraints upon land use changes, e.g. via existing or developing habitat conservation plans that cover much of the range of California red-legged frog in the action area. In particular the habitat in the action area with the highest likelihood of supporting California red-legged frog is within the plan area of the East Contra Costa County HCP/NCCP, where large scale conservation efforts are being implemented that will benefit the species.

Changing baseline effects are also likely to alter habitat conditions for California red-legged frog between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for California red-legged frog, with potential adverse effects upon species status in the action area.

7.13.3 Determination of Effects to California Red-Legged Frog Designated Critical Habitat

No California red-legged frog critical habitat occurs in the action area. The closest occurrence of critical habitat is approximately 0.5 miles from the nearest construction activity area. Because there is no California red-legged frog critical habitat in the action area, the PA will have no effect on California red-legged frog critical habitat.

7.14 California Tiger Salamander

7.14.1 Determination of Effects to California Tiger Salamander

Overall effects of the PA on California tiger salamander and its habitat are minor and temporary, and will be offset with protection and restoration of its habitat. The PA may affect the California tiger salamander based on the following.

- Project related activities will occur within and adjacent to California tiger salamander modeled habitat.

- California tiger salamander presence has been recorded in the vicinity of areas proposed for clearing and construction.

- Protection and restoration of California tiger salamander upland cover and aestivation habitat will beneficially affect the species.

The PA is likely to adversely affect the California tiger salamander as follows.

- Harm could result from the permanent loss of 50 acres of terrestrial cover and aestivation habitat (three acres of which would be outside the construction footprint but subject to vibrations resulting from construction activities within 75 feet) potentially occupied by the species.
- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance related activities.
- Harassment could result from noise, lighting, vibrations, and other human disturbance adjacent to occupied California tiger salamander upland cover and aestivation habitat during construction, operations, and maintenance.

These adverse effects will be minimized and offset through implementation of minimization and avoidance measures to reduce the risk of harm or harassment of individuals, and by the protection or restoration of up to 150 acres of upland cover and aestivation habitat based on current project impact estimates.

Thus the PA may affect, is likely to adversely affect the California tiger salamander.

7.14.2 Cumulative Effects and the Changing Baseline

Potential cumulative effects on California tiger salamander in the action area include habitat loss and impairment, primarily through conversion of rangeland to more developed land uses. Unauthorized take as a result of urbanization is unlikely where most of the habitat occurs west of CCF because urbanization within the cities of Brentwood, Pittsburg, Oakley, and Clayton is covered by the East Contra Costa County HCP/NCCP. Urban development outside these incorporated cities (i.e., in the jurisdiction of Contra Costa County) is not covered by the East Contra Costa County HCP/NCCP. Although unlikely to occur due to land use controls, if urban development was proposed in or near the community of Byron it could have an adverse effect on California tiger salamander in the action area.

Changing baseline effects are also likely to alter habitat conditions for California tiger salamander between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for California tiger salamander, with potential adverse effects upon species status in the action area.

7.14.3 Determination of Effects to California Tiger Salamander Designated Critical Habitat

Critical habitat for California tiger salamander occurs in the Jepson Prairie area and overlaps with the action area near the terminus of Lindsey Slough, west of Rio Dixon Road. There are no water conveyence facility construction activities proposed in this region, however, tidal restoration could occur in the Cache Slough and Lindsey Slough area. Avoidance and minimization measures require tidal restoration projects be designed to avoid areas within 250 feet of any of the PCEs of California tiger salamander habitat within the designated critical habitat unit, or some lesser distance if it is determined through project review and concurrence by USFWS that tidal restoration actions will not result in changes in hydrology or soil salinity that could adversely affect these PCEs.

In conclusion, the PA is not likely to adversely affect California tiger salamander critical habitat for the following reasons.

- No water conveyance facilities will be constructed in any designated critical habitat unit.
- Tidal restoration associated with mitigation for impacts to other species or habitats will be designed to avoid areas within 250 feet of California tiger salamander PCEs in the critical habitat unit, or a lesser distance with concurrence from USFWS that the restoration will not adversely affect any PCEs for this species.
- No other restoration, management, or enhancement activities will occur in the critical habitat unit without prior concurrence from USFWS that such activity will not adversely affect any PCEs for this species.

7.15 Valley Elderberry Longhorn Beetle

7.15.1 Determination of Effects to Valley Elderberry Longhorn Beetle

Overall effects of the PA on valley elderberry longhorn beetle and its habitat are minor and temporary, and will be offset with restoration of its habitat. The PA may affect the valley elderberry longhorn beetle based on the following.

- Project related activities will occur within and adjacent to valley elderberry longhorn beetle modeled habitat.
- Protection of riparian habitat suitable and managed for elderberry shrubs and planting of elderberry seedlings and associated natives in conservations areas will beneficially affect the species.

The PA is likely to adversely affect the valley elderberry longhorn beetle as follows.

- Harm could result from the removal of an estimated 107 elderberry shrubs with an estimated 2,121 stems that are greater than 1 inch in diameter. The PA will result in the permanent loss of 276 acres of modeled valley elderberry longhorn beetle habitat including 227 acres of modeled grassland habitat and 49 acres of modeled riparian habitat.
- Harm could also result from the deposition of dust and other airborne construction related particulate matter on elderberry shrubs, which could stress and damage shrubs resulting in effects on valley elderberry longhorn beetle.

- Harm could occur as a result of transplanting shrubs that are occupied and the operation of equipment in the vicinity of occupied shrubs if adults are actively dispersing between shrubs.

- Harassment could result from lighting, dust, and other disturbances adjacent to occupied valley elderberry longhorn beetle habitat during construction, operations, and maintenance.

These adverse effects will be minimized and offset through implementation of minimization and avoidance measures to reduce the risk of injury, mortality, and harassment of individuals, and by the restoration of up to an estimated 79 acres of habitat dedicated to the planting of elderberry seedlings and associated natives, as well as the transplanting of an estimated up to 83 shrubs based on current project impact estimates.

Thus the PA may affect, is likely to adversely affect the valley elderberry longhorn beetle.

7.15.2 Cumulative Effects and the Changing Baseline

Potential cumulative effects on valley elderberry longhorn beetle in the action area include habitat loss and impairment, primarily through conversion of rangeland to more developed land uses. Although unlikely to occur due to land use controls, such development could have an adverse effect on valley elderberry longhorn beetle in the action area.

Changing baseline effects are also likely to alter habitat conditions for valley elderberry longhorn beetle between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for valley elderberry longhorn beetle, with potential adverse effects upon species status in the action area. The environmental baseline for valley elderberry longhorn beetle may also be affected by future habitat protection and restoration efforts in the Delta that may protect existing habitat or create new habitat, e.g. by restoration of riparian corridors along Delta waterways.

7.15.3 Determination of Effects to Valley Elderberry Longhorn Beetle Designated Critical Habitat

Critical habitat has been designated for valley elderberry longhorn beetle, but does not occur within the action area. The proposed action will have no effect on designated critical habitat for valley elderberry longhorn beetle.

7.16 Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

7.16.1 Determination of Effects to Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

Overall effects of the PA on vernal pool fairy shrimp and vernal pool tadpole shrimp, and their habitat, are minor and temporary, and will be offset with protection and restoration of their habitat. The PA may affect the vernal pool fairy shrimp and vernal pool tadpole shrimp based on the following.

- Project related activities will occur within and adjacent to vernal pool fairy shrimp and vernal pool tadpole shrimp modeled habitat.
- Protection and restoration of vernal pool fairy shrimp and vernal pool tadpole shrimp will benefit the species.

The PA is likely to adversely affect the vernal pool fairy shrimp and vernal pool tadpole shrimp as follows.

- Harm could result from the permanent loss of 6 acres of modeled habitat for the species.
- Harm could result from altering the hydrology of vernal pool fairy shrimp and vernal pool tadpole shrimp habitat within 250 feet of construction areas, which could reduce the hydroperiod of affected habitat, making it less suitable for the species.
- Harm could occur as a result of changes to water quality in watersheds that support vernal pool fairy shrimp and vernal pool tadpole shrimp habitat.

These adverse effects will be minimized and offset through implementation of minimization and avoidance measures to reduce the risk of injury, mortality, and the conversion of habitat, and by the protection or restoration of habitat. If an existing mitigation bank were used to offset effects, up to 12 acres of habitat restoration credits would be provided. If DWR were to select a non-bank site, habitat losses would be offset by protection of up to 18 acres of existing habitat, based on current project impact estimates.

Thus the PA may affect, is likely to adversely affect the vernal pool fairy shrimp and vernal pool tadpole shrimp.

7.16.2 Cumulative Effects and the Changing Baseline

Potential cumulative effects on vernal pool fairy shrimp and vernal pool tadpole shrimp in the action area include habitat loss and impairment, primarily through conversion of vernal pool or degraded vernal pool natural communities to more developed land uses. This is unlikely to occur due to regulatory prohibitions on such activity. If it were to occur, for example via unauthorized actions, such development could have an adverse effect on vernal pool fairy shrimp and vernal pool tadpole shrimp in the action area.

Changing baseline effects are also likely to alter habitat conditions for vernal pool fairy shrimp and vernal pool tadpole shrimp between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for vernal pool fairy shrimp and vernal pool tadpole shrimp, with potential adverse effects upon species status in the action area. The environmental baseline for vernal pool fairy shrimp and vernal pool tadpole shrimp may also be affected by future habitat protection and restoration efforts in the Delta that may protect existing habitat or create new habitat.

7.16.3 Determination of Effects to Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp Designated Critical Habitat

A critical habitat unit for vernal pool fairy shrimp occurs to the west of Clifton Court Forebay and overlaps with two RTM storage areas. As discussed in Section 6.10.11, *Effects on Critical Habitat*, the wetland delineation prepared by DWR did not identify any modeled vernal pools or alkali seasonal wetland within these RTM footprints. However, two vernal pools occurring in the critical habitat unit may be indirectly affected by one of the RTM storage areas areas and therefore the PA is likely to adversely affect critical habitat for the vernal pool fairy shrimp. However, the PA will not appreciably diminish the value of the designated critical habitat to conservation due to the implementation of avoidance and minimization measures. In addition, to further address effects associated with facilities construction, operation, and maintenance within designated critical habitat, the PA includes implementation of restoration measures.

There is no designated critical habitat for vernal pool tadpole shrimp in the action area. Because there is no vernal pool tadpole shrimp critical habitat in the action area, the PA will have no effect on vernal pool tadpole shrimp critical habitat.

7.17 Least Bell's Vireo

7.17.1 Determination of Effects to Least Bell's Vireo

Overall effects of the PA on least Bell's vireo will include removal of 32 acres of habitat, and will be offset with restoration of 64 acres of its habitat. The PA may affect least Bell's vireo based on the following.

- Project related activities will occur within and adjacent to least Bell's vireo habitat.
- Least Bell's vireos have been detected near the action area in recent years.
- Restoration of least Bell's vireo habitat will beneficially affect the species.

The PA is likely to adversely affect the least Bell's vireo as follows.

- Harm could result from the permanent loss of 32 acres of least Bell's vireo habitat.

These adverse effects will be minimized through implementation of minimization and avoidance measures to reduce the risk of injury, mortality, and harassment of individuals, and offset by the protection or restoration of 64 acres of suitable habitat based on current project impact estimates.

Thus the PA may affect, is likely to adversely affect the least Bell's vireo.

7.17.2 Cumulative Effects and the Changing Baseline

Potential cumulative effects on least Bell's vireo in the action area include habitat loss and fragmentation, and predation from introduced and native species. Habitat loss and fragmentation could result from conversion of riparian habitat to alternative cover types, which is not likely to be extensive due to existing constraints emplaced to protect riparian natural communities. Predation by existing introduced and native species is likely to be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable; nor are the consequences of such an introduction. These effects will tend to slightly impair habitat quality for least Bell's vireo in the action area, but their net effect is to approximately maintain current conditions for the foreseeable future. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the PA, nor are they expected to alter the efficacy of offsetting measures in the PA such as habitat creation and restoration.

Changing baseline effects are also likely to alter habitat conditions for least Bell's vireo between now and the conclusion of the PA. The principal such effects concern climate change. Foreseeable climate change effects, described in Section 4.3.2.1, *Climate Conditions*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods, etc. These effects will tend to impair habitat quality and quantity for least Bell's vireo, e.g. by increasing the frequency of flood disturbance in riparian habitat, and potentially increasing the fragmentation of that habitat.

7.17.3 Determination of Effects to Least Bell's Vireo Designated Critical Habitat

There is no designated least Bell's vireo critical habitat in the action area.

7.18 Conclusion

Reclamation has analyzed the effects of the Proposed Action using the best available science and has made the following effects determinations (Table 7-1).

Table 7-1. Determination of Effects for Species Addressed in This BA

Common and Scientific Names	Scientific Name	Jurisdiction	Status	Effect Determination
Chinook salmon, Sacramento River winter-run ESU	*Oncorhynchus tshawytscha*	NMFS	Endangered	Species: May affect, likely to adversely affect Critical Habitat: Likely to adversely affect
Chinook salmon, Central Valley spring-run ESU	*Oncorhynchus tshawytscha*	NMFS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Likely to adversely affect
Steelhead, California Central Valley DPS	*Oncorhynchus mykiss*	NMFS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Likely to adversely affect
Green sturgeon, southern DPS	*Acipenser medirostris*	NMFS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Likely to adversely affect
Killer whale, Southern Resident DPS	*Orcinus orca*	NMFS	Endangered	Species: May affect, not likely to adversely affect Critical Habitat: Not likely to adversely affect
Delta Smelt	*Hypomesus transpacificus*	USFWS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Likely to adversely affect
Riparian brush rabbit	*Sylvilagus bachmani riparius*	USFWS	Endangered	Species: May affect, not likely to adversely affect Critical Habitat: Not designated
San Joaquin kit fox	*Vulpes macrotis mutica*	USFWS	Endangered	Species: May affect, likely to adversely affect Critical Habitat: Not designated
California least tern	*Sternula antillarum browni*	USFWS	Endangered	Species: May affect, not likely to adversely affect Critical Habitat: Not designated
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	USFWS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Not in action area
Giant garter snake	*Thamnophis gigas*	USFWS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Not designated
California red-legged frog	*Rana draytonii*	USFWS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Not in action area
California tiger salamander	*Ambystoma californiense*	USFWS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Not likely to adversely affect
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	USFWS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Not in action area
Vernal pool fairy shrimp	*Branchinecta lynchi*	USFWS	Threatened	Species: May affect, likely to adversely affect Critical Habitat: Likely to adversely affect
Vernal pool tadpole shrimp	*Lepidurus packardi*	USFWS	Endangered	Species: May affect, likely to adversely affect Critical Habitat: Not in action area
Least Bell's vireo	*Vireo pusillus*	USFWS	Endangered	Species: May affect, likely to adversely affect Critical Habitat: Not in action area
Salt Marsh harvest mouse[a]	*Reithrodontomys raviventris*	USFWS	Endangered	Species: May affect, not likely to adversely affect Critical Habitat: not designated

Common and Scientific Names	Scientific Name	Jurisdiction	Status	Effect Determination
California clapper rail[a]	*Rallus longirostris obsoletus*	USFWS	Endangered	Species: May affect, not likely to adversely affect Critical Habitat: not designated
Soft bird's beak[a]	*Chloropyron molle* ssp. *molle*	USFWS	Endangered	Species: May affect, not likely to adversely affect Critical Habitat: Not likely to adversely affect
Suisun thistle[a]	*Cirsium hydrophilum* var. *hydrophilum*	USFWS	Endangered	Species: May affect, not likely to adversely affect Critical Habitat: Not likely to adversely affect

DPS = distinct population segment
ESU = evolutionarily significant unit
[a] The effects determinations for these species are described in Appendix 6.C, *Suisun Marsh Species.*

7.18.1 References

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